OBJECT LESSONS IN GEOGRAPHY

STANDARDS 1.2.3

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By T. F. G. Dexter, B.A., B.Sc., and A. H. Garlick, B.A. Crown 8vo, 4s. 6d.

OBJECT-LESSONS IN ELEMENTARY SCIENCE.
For Standards I. II. and III. (Scheme A).

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Object Lessons in Geography for Standards I. II. & III.

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PREFACE

An attempt is made in this little work to teach the Elements of Geography by means of Object Lessons.

The order of the lessons is not invariable. It is impossible in a book of this kind to put the lessons in such an order as will best suit the requirements of every case. It is presumed that the sequence of the lessons will vary according to locality and special circumstances.

As in the kindred work, "Object Lessons in Elementary Science," a choice is given to suit special aptitudes and opportunities.

The length of each lesson need not be limited by the quantity of letterpress in any single case. Lessons may, and probably will be, curtailed or expanded according to capacity and progress of the class.

T. F. G. D.
A. H. G.

We wish to acknowledge our indebtedness to the authors for permission to use the following illustrations from their books, viz.: Figs. 59, 64, from Ganot’s "Natural Philosophy"; Figs. 73, 85, 185, 290, from Ganot’s "Physics"; Figs. 66, 165, 171, from Morgan’s "Elementary Physiography"; Figs. 53, 54, 55, 56, 57, 58, 60, 61, 62, 63, from Poyser’s "Elementary Magnetism"; Figs. 49, 91, 95, 118, 138, 154, 164, 167, 168, 187, 219, 238, from Thornton’s "Elementary Physiography"; Figs. 68, 220, from Thornton’s "Practical Physiography," Section I.; Figs. 94, 126, from Bird’s "Elementary Geology"; and Fig. 259, from Paul’s "Domestic Economy."

T. F. G. D.
A. H. G.
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HINTS ON THE MAKING OF GEOGRAPHICAL MODELS

Geographical models are made in clay, moist sand, or paper-pulp.

Kinds of Clay.

_Potter's white or grey clay_ will yield the best results.
Terra-cotta or brown clay will produce good results, but the latter is apt to be gritty.

The Conversion of Hard Clay into Plastic Clay.—
The teacher will probably receive the clay in a more or less hard condition, and it will be first necessary to make it plastic, but not so soft that it becomes sticky.

*The secret of success is the addition of enough, but not too much water.*

1. Break or cut the clay into small pieces. Place in a pail, or better still, in a shallow wooden box.
2. Saturate a woollen cloth with water. Wring out very lightly.
3. Place the wet cloth over the pieces of clay. Allow it to remain there for several hours.
4. Knead several pieces of clay on a board into lumps about the size of the fist. Some of the lumps are likely to be a bit too soft, others a bit too hard.
5. Work a hard lump and a soft lump up together, or two hard lumps and one soft one, or _vice versa_, until the required consistency is obtained. The clay is of the requisite consistency if, when thus worked up, it yields easily to the pressure of the thumb, and the thumb does not stick to the clay, but can be brought away...
clean. If the clay does not yield easily, it is still too hard. If the thumb sticks to the clay, and if, when the thumb is withdrawn, anything more than a suspicion of clay is found on it, then the clay is too moist. If it is too moist, work up some harder clay with it, or expose it to the air for some time. Generally the clay is likely to be rather too moist than too dry. A frequent cause of the clay being too moist is, that water has been allowed to collect in the bottom of the pail or box.

6. When the clay is of the proper consistency, it may be maintained in a fair workable condition by spreading a moist (but not too wet) woollen cloth over it, and moistening the woollen cloth every night and morning.

To Make a Simple Clay Model.

1. Cut off from the mass of clay the quantity required for the part (island, cape, mountain, &c.) it is proposed to model. Place upon the modelling board or tray.

2. The clay should not be manipulated more than is necessary. The heat of the hands causes it to become dry and cracked, the model is not satisfactory, and clay dust falls upon the table and floor. It is well to keep the fingers moist by occasionally damping them on a sponge which should be just moist but not wet.

3. A piece of wood shaped like the handle of a toothbrush will be found useful for finishing off a model.

Preservation of Clay Models.

1. If it is intended to preserve the model, great care should be taken that there are no air-holes in the clay. During the baking or drying, the imprisoned air will expand, and distort and spoil the model.

2. The model should be placed in a cupboard of equable temperature, and allowed to stop there till quite dry, or,

3. The model may be partially dried, and afterwards baked in a slow oven.

4. When dry, the model may be varnished and coloured.
Moist Sand.

Moist sand has many advantages over clay. It is less expensive, more easily obtained, easier to manipulate, and more cleanly in working. Some teachers prefer to have a ground-work of clay, and to indicate such physical features as hills, mountains, plateaux, &c., with moist sand. The great defect of moist sand is that it cannot be made into a permanent model.

Paper-Pulp.

Perhaps this is the most satisfactory model-making material, especially if it is desired to make the model permanent. Paper can always be obtained, and the manipulation of paper-pulp is clean and easy. It is not so liable to crack in drying as clay is, and it colours much more readily and more effectively than clay does.

**Method of Making Paper-Pulp.**

* a. Cut, or better still, tear some old newspapers into small pieces. Blotting-paper will be even better, but becomes expensive when large quantities are required.

* b. Soak for some time in water. Stir frequently.

* c. Afterwards squeeze and roll in hands till the whole is reduced to pulp.

* d. Pour off the superfluous water.

* e. Take small lumps of the pulp and gently squeeze them, till they seem to be of the proper consistency.

* f. Knead the small lumps together into a compact mass. During this operation keep the hands moist with a damp (but not wet) sponge. The paper-pulp is now ready for use.

**To Make a Paper-Pulp Model of a Country or of any Part of it.**

[Much the same method may be pursued in making a clay model, or a temporary moist sand model.]
Apparatus.

1. Paper-pulp, plastic clay, or moist sand in sufficient quantity for the completion of the model.

2. A board or tray.
   a. A piece of cardboard will do for a small permanent paper-pulp model.
   b. A large board about the thickness of a drawing-board and about 3 feet square will answer well for ordinary class purposes. If the model be merely required for temporary purposes, it should be removed from the board as soon as the lesson is over, and the board itself should be carefully cleaned with a damp sponge.
   c. A tray about 3 feet square with an inside depth of 2 to 3 inches is of great service. When the pulp or clay model is completed, water coloured blue can be poured in to represent seas or lakes.
   d. Some teachers who model in moist sand use a tray with a glass bottom. The parts of the glass uncovered by the sand can be supposed to represent the sea. The course of a river can be traced out in the layer of sand, and the glass which is exposed represents admirably the water of the river.

3. A map of the district to be modelled.—Contour lines upon this map will be of great assistance in enabling the teacher to represent with fair accuracy the comparative elevations of various parts of the country.

4. A relief map of the district to be modelled.—This will give a capital idea of what the model should be. The various relief maps in this book will, it is hoped, be of considerable assistance in building up the models required.

5. Some blue-coloured water.—A little solid aniline blue can be purchased for a few pence and will last a long time.

6. A knife or a wooden modelling tool.
The Building of the Model.

1. Draw the outline of the country or district in black lead on the modelling board.

2. Cover the surface to be represented by land with a layer of pulp of about one inch in thickness. The pulp should be made of uniform thickness.

3. Add pulp to represent the hills and mountains. Work these up into the required shapes.

4. Add a little pulp to those parts of the coast that are high, flatten down slightly those that are low.

5. Trace out the chief river channels by lightly pressing on model with a blunt-pointed slate pencil or a modelling tool.

6. Next direct attention to the coast-line and re-model any parts that may have become somewhat distorted in operations 4 and 5.

7. If the model has been made in a tray, pour in blue-coloured water to the depth of about half an inch to represent the sea. Take care that the blue water does not splash over the model.

8. If it is desired to make the model permanent, it would be advisable not to pour in the water at all, because the water causes the coast to become "pappy," and distortion in drying frequently results.

9. Let the model dry slowly and thoroughly. Place it out of dust in a room or cupboard of fairly equable temperature.

10. Trace out the tributaries of the rivers, the main streams of which have been already traced out in 5.

11. Colour and varnish the whole model. Rivers may be coloured dark blue. The summits of mountains above the snow-line may be coloured white.
STANDARD I
LESSON I

FIRST IDEAS OF A PLAN

Apparatus.—Knitting-needles (or slate-pencils); bits of string or cotton; slates and pencils or squared paper and blackleads for children.

Introduction.

Introduce subject by speaking of the building of a house. House has to be in a certain position, of a certain size and shape. How does the builder know this? He has a drawing or plan showing all these things.

Plans of Lines.

1. STRAIGHT LINES.—Serve out a knitting-needle, or something similar, to each child. Take a needle. Lay it on the table. Class imitates. Bring the eye right over it. Class imitates each step. What is seen? A straight line. Draw straight lines of same length as needle. That is called the plan of the needle. Infer that a plan is a drawing.

2. Repeat the exercise by varying the direction of the needle as in A, B, C, D (Fig. 1). Class imitates as before. Elicit that the plan of the needle is always a straight line, but the direction may vary. Infer from this that a plan shows direction.

3. Serve out bits of cotton or string. Lay a piece on the table in a crooked form (Fig. 2, E). Proceed as before, class imitating each step, and so elicit
that *a plan may be a crooked line.* Vary the num-
ber of crooked posi-
tions so as to fix and strengthen this idea. Then infer that *a plan
may show what a thing looks like.*

4. Place the string in the form of a curve (Fig.
3, F), then of a rough circle (G); into a square
(H); a triangle (K); and *so develop the idea of direction,* so as to lead on
to shape.

All these exercises should be copied by the children, one by one, as
they are performed. In each case they should place their own
strings in the desired shape, should discover its plan and draw
that plan.

**B.B. SUMMARY.**

1. *A plan may be a line.*
2. *The line may be straight or crooked.*
3. *A plan shows direction.*
4. *It shows what a thing looks like.*

**LESSON II**

**PLANS OF LEVEL SURFACES**

**Apparatus.**—Kindergarten sticks of varying sizes; Kindergarten or
other squares, triangles, circles, &c.; slates or squared papers.

**I. Skeleton Figures.**

The object is to connect this lesson with the previous one.

1. **THE SQUARE.**—Take four Kinder-
garten sticks of equal length. Lay
them in the form of a square
(Fig. 4, A). Class imitates. Pro-
ceed as in previous lesson, and elicit that *the plan of the four sticks is the shape
and size of a square.*
2. OTHER FIGURES.—Repeat with other figures, such as B and C (Fig. 5). In each case class to—
   a. Imitate the teacher.
   b. Discover and name the plan.
   c. Draw it on their slates or papers.

II. Plane Surfaces.
1. SQUARES.
   a. Distribute small squares (wood, cardboard, or stiff paper). Take a large square. Lay the B.B. on the table. Place the square on the B.B. Proceed as in I. 2, and elicit that the plan is a square (Fig. 6, D).
   b. Now hold the square firmly on the B.B. with one hand, and draw lines close round its sides with the other. Class imitates. Remove the square figure, and the plan is revealed as a square.
   c. Now place B.B. on the easel.

   This is the first step towards the subsequent and proper understanding of the wall map.

2. GROUND PLAN.
   a. Tell class that such a plan is sometimes called a ground plan, because it shows the size and shape of the ground the figure covers.

3. OTHER PLANE FIGURES.
   a. Repeat with other common plane figures; e.g. oblong (E), penny (F), triangle (G), &c. (Fig. 7).

   Proceed as previously directed. There will be no necessity to use such words as plane, oblong, or any technical-words at present. The words are used in the notes for convenience and the guidance of the teacher. For the children "smooth level" (plane), "box-lid shape" (oblong), &c., should be used.
b. Vary the figures as much as possible within the limits of the time allowed by the lesson, and finally get class to infer that a plan shows size and shape.

B.B. SUMMARY.

1. A plan shows size and shape.
2. A ground plan is so called because it shows the size and shape of the ground the figure covers.

LESSON III

FURTHER IDEAS OF A PLAN

Apparatus.—Large cube and square prism; Kindergarten cubes and oblong blocks for class; common objects of like shape (book, pencil-box, chalk-box, &c.); slates or squared paper; pictures of objects used.

I. A Cube.

Distribute Kindergarten cubes. Teacher should use a larger cube.

1. Place B.B. on table. Place cube on B.B. Class imitate each step as in previous lessons. Bring the eye straight over the centre of the cube. Elicit that the plan is a square (Fig. 8).
3. Vary the position of cube, and elicit that the plan is always a square (Fig. 9). Put B.B. on easel.
4. Explain by showing that all the sides of the square are of equal length.
5. Show picture of cube and compare with plan (Fig. 10).

II. The Square Prism.
Kindergarten blocks for children; large prism for teacher.
Proceed in exactly the same way as with the cube, but note that this time we may have two plans (Fig. 11, C and D). Compare with picture of prism, and then get class to infer that—
1. In a plan you can only show top-side or surface.
2. A picture shows objects as they appear to the eye.
3. A plan shows shape and size.
4. A plan does not show height or bulk.

III. Common Objects.
Give exercises with common objects of like shape; e.g. book, chalk-box, pencil-box, &c. Proceed in each case again as with cube and prism, limiting the exercises to the time at disposal.

B.B. SUMMARY.
(The four inferences above.)
LESSON IV

PLANS OF CURVED OBJECTS

Apparatus.—Sphere, hemisphere, cylinder, cone, inkstand, &c.; small india-rubber balls for boys (or marbles); slates or squared paper; pictures of objects used; an apple.

I. Half a Sphere.

1. Put B.B. on the school table. Take a large apple and cut it in halves (a proper hemisphere would be better). Lay the cut surface of the apple on the B.B. Ask class to say what the plan is.

2. The answer may or may not be correctly given. Proceed to draw round the base edges of the hemisphere or apple. Remove the apple. Elicit that the plan is a circle (Fig. 13).

3. Take the hemisphere (or half apple). Draw the concentric circle a b (Fig. 14). Elicit that it can be seen. Proceed in the same way with the other circles. They can all be seen. Ask which circle represents the plan—the bottom and largest circle, g h.
4. Then get class to infer that—
   a. The plan of a half sphere is the circle drawn round the widest part of the half sphere.
   b. That the nearer the circles approach the plan the larger they become; the nearer the top the smaller they become.
   c. The plan is the largest circle.
   d. The plan does not show height or thickness.

5. Compare and contrast with the picture.
   This is another important step, as it gives the children their first ideas of representing the plans of mountains.

II. A Sphere.
Large sphere for teacher; small india-rubber balls or marbles for class.

that the small circle drawn is not the plan—it is too small.
2. Take up the two parts of the apple. Put them together, and with this assistance elicit that the plan is the circle drawn round the centre of the sphere, i.e. it is the largest circle of the body.
3. Compare plan and picture of sphere, and then raise the B.B. on the easel.

III. Other Curved Objects.
Give similar exercises on the cylinder, the cone, the inkstand, ring, &c.

B.B. SUMMARY.
(The chief inferences in I. 4.)

LESSON V
COMBINED PLANS
(Introducing First Ideas of Proportion and Distance.)

Apparatus.—A box and ink-well (any other common objects will do equally well); any common simple objects for exercises; slates or squared paper; B.B.

I. Plans and Proportion.
1. Take a box and an ink-well. Place them as in Fig. 15.

Proceed to draw the plans on the B.B., drawing the ink-well out of all proportion (Fig. 16, B).
Class detects the error, points it out. Teacher corrects. Class approves, and infers that a plan must have all its parts the proper size.
2. With the aid of the corrected plan *recapitulate* that a plan shows—
   a. **The size of a thing** (length and width).
   b. **The shape of a thing** (as seen from above).

![Fig. 16](image)

**II. Plans and Distance.**

1. Take the same two objects again and draw the plan as in Fig. 17. Ask if the plan is correct.
2. If no error is pointed out, draw the plan as in Fig. 18.
3. Now get the class to compare them, and to point out their difference. Class then infers that—
   A plan shows the correct distance of one thing from another.

![Fig. 17](image)

![Fig. 18](image)

**III. Exercises in Combined Plans.**

The teacher should now give exercises in combined plans *with a view to the firm fixing of the ideas of a plan already obtained*. Any simple common objects can be used. The grouping should be graded. Two objects are enough for first groups. The number may be gradually increased as the plans are produced correctly.
B.B. SUMMARY.
1. A plan must have all its parts the proper size.
2. A plan shows the size of a thing (length and width).
3. A plan shows the shape of a thing (as seen from above).
4. A plan shows the correct distance of one thing from another.

LESSON VI

FURTHER IDEAS OF PROPORTION

Apparatus.—Coffee-pot; teacup; slates or squared paper for class; B.B.

I. Things out of Proportion.
1. Show a coffee-pot. Sketch it, making the spout too large (Fig. 19). Compare with object and invite criticism.
   Class tells that the spout is too large.

2. Try another sketch. Make handle too large (Fig. 20).
3. Repeat sketch. Make lid too large (Fig. 21).
   Proceed as in the first case each time.
4. Sketch the coffee-pot correctly (Fig. 22), and elicit that—
   a. The drawing is correct.
   b. In the previous cases the drawings were neither the true shape nor size.
   c. The parts must be a certain size with respect to each other; i.e. the parts must be in proportion.

II. Necessity for Measuring.
Ask class to draw some common object like a teacup from memory (any other common object will do). Allow a few minutes for the exercise, and then select a few drawings, show them to the class, and let them point out the errors in proportion. From these exercises argue, or get the class to infer, that—
   a. If we trust to memory our drawings are often out of proportion.
   b. Hence the necessity for measuring the sizes.

III. Exercises.
The children should now be given exercises on common objects, with a view to cultivating the idea of relative size. Slates, pencils, pencil-box, table, &c., might all be utilised. The sizes or dimensions should be roughly estimated at sight by the class, the answers being given in fractions or multiples of some line or object chosen as a standard.
The teacher should accept all answers that are approximately or even roughly correct.

B.B. SUMMARY.
1. The parts of a plan must be in proportion.
2. Memory drawings are often out of proportion.
3. The sizes should be measured.
LESSON VII

FIRST IDEAS OF SCALE

Apparatus.—*Three photographs or three pictures of the same person, place, or object, of different sizes; some small simple objects (Kindergarten blocks, cubes, inkstand, ink-well, &c.).*

I. Develop the Idea of Scale.

1. Show three photographs of the same person, but of different sizes, or three pictures of different sizes of the same place or object.

   *Note.*—Photographs or pictures are best (Fig. 23). But if they are not attainable, the teacher could easily prepare before the lesson three shaded drawings of a common object like the square prisms, or a cube. The drawings should be fairly accurate and of different sizes.

2. From an examination of the photographs (or pictures) get the class to note:

   a. Each is a likeness of the same person.
   b. The photographs are of different sizes.
   c. The size has nothing to do with the likeness.
   d. The proportion is the same in each case.
   e. We can have the photographs (or pictures) what size we like.

II. Introduce the word “Scale.”

1. Draw a plan of the school table on the B.B. (Fig. 24).

   *It is at once obvious to the children that it must be drawn less than its real size.*

   Let a boy come out and measure the table with a tape measure. Suppose the dimensions to be 3 feet by 2 feet.

2. Remind class that we can have the drawing what size we like. Suppose we have it *half size.*

   The teacher should now elicit that the dimensions become 1½ foot by 1 foot. The plan should then be drawn on the B.B.

3. Now call attention to the fact that—

   a. The plan is the shape of the object.
   b. The proportion is correct.
   c. But the size is different.

   Compare the sizes of the object and the drawing, and elicit that ½ foot or 6 inches on the plan represents 1 foot on the object. Then tell the class that such a plan is said to be drawn to *scale,* and that
the scale is said to be one-half, or 6 inches to the foot.

4. Call attention to the photographs (or pictures) again, and elicit that they were taken or drawn to different scales.


1. Introduce some simple small objects, such as can be drawn half size on the slates or squared papers of the class. In each case measure the object, dictate the dimensions, and tell the class to draw the plans half size, or to the scale of 6 inches to the foot. Correct by sample, and get the class to note—
   a. The size of the plans varies because the size of the objects varies.
   b. The scale is the same in each case.

Inference.—The plans of different objects vary in size with the same scale.

2. Recapitulate the previous idea of a plan, and get class to note that plans tell—
   a. The shape of bodies.
   b. Their position and distance from each other.
   c. Their relative sizes, but—
   d. Not always their real size, because they are sometimes drawn to scale.

Note.—a, b, c, and d could be used as a B.B. Summary.

LESSON VIII

FURTHER IDEAS OF SCALE

Apparatus.—Flat rulers for class; a workman's two-foot rule; common objects for exercises (slates, copybooks, reading-books, &c.); slates or squared paper for class.

I. A Flat Ruler.

Give a flat ruler to each scholar, and explain its construction.
I. Note the figures. Count them. There are 12.

2. Note that there is a short line drawn across the ruler close to each.

3. The space between any two lines is called an inch.

4. The length of the ruler is 12 inches or 1 foot.

5. Call attention to the smaller divisions, and explain their significance in a similar way.

II. A Workman’s Rule.

Show one. Note that it doubles up. Why? Otherwise it would be too long to carry in the pocket. Open it out and let class measure its length with their flat rulers. It is 2 feet long, hence generally called a two-foot rule.

By further questioning elicit that a workman needs a long rule, because he often has to measure large objects.

III. Scales Vary.—Proceed to demonstrate as follows:

1. Draw the scale A (Fig. 25) upon the B.B. Tell the class it represents 3 feet. Measure it. It is 3 inches.
   a. Class to discover that every inch represents 1 foot.
   b. Hence scale is said to be 1 inch to the foot.

2. Draw the scale B on the B.B. Tell the class it represents 6 feet. Measure it. It is 3 inches or 6 half inches. As before, class to discover—
   a. That every $\frac{1}{2}$ inch represents a foot.
   b. The scale is $\frac{1}{2}$ inch to the foot.

3. Proceed in the same way with C. In this case the scale will be found to be $\frac{1}{4}$ inch to the foot.

This is important, as it is the first step towards a proper comprehension of the scales of units attached to maps.
IV. Exercises on Scales.

1. By drawing the plan of some object partly to one scale and partly to another, show that the scale must be the same for the whole of the plan.

2. Let the class now measure some of the common objects around them with their flat rulers, and draw them to scale. The scale should be suitably fixed in each case by the teacher.

   The common objects might include the desk, the slate, the copy-book (or exercise book), the reading-book, &c. School floor (use two-foot rule).

3. The exercises should be so arranged that—
   a. The dimensions may vary with the same scale.
   b. The scale may vary with the same dimensions.
   c. Both scale and dimensions may vary.

   A whole lesson could be profitably spent on these varying exercises.

B.B. SUMMARY.

1. Rulers or rules are used for measuring objects.
2. Scales vary in size.
3. Only one scale must be used in drawing the same plan.

LESSON IX

PLAN OF GEOGRAPHICAL MODEL

Apparatus.—Flat geographical model; water; B.B.; slates or squared paper; clay and sand for mountain; relief model, showing coast, river, mountain, and lake.

I. Plan of a Flat Geographical Model.

1. Take a flat geographical clay model, showing the course of a river and a lake (Fig. 26). Pour a little water into the river and lake,
2. Lay the B.B. on the table and draw a plan of the model. Put B.B. back on the easel, and let the children compare the object with its plan. Represent the rivers by a line only, as they are thus represented on the map.

II. Plan of a Mountain.
1. Briefly recapitulate the plan of the hemisphere and sphere in Lesson IV.
2. Heap up clay and sand on a drawing-board to make a mountain. Let it be as large as possible.
   a. Let it represent 1000 feet.
   b. Mark or scratch rings round it to represent half the height.

3. Now proceed, as in the lesson on the sphere, to elicit that—
   a. The summit can be seen in the plan.
   b. The line marking 500 feet can be seen on the plan.
   c. Similarly the lines marking the base can be seen (Fig. 27).
4. Draw the plan as follows:
   a. Measure the greatest length and width of the base. Draw the two lines on the B.B. Class copies on slates or papers.
   b. Bring the model under the eyes of the class so that they may get a general idea of the shape of the base. Then insert the base round the base measurements.
   c. From an examination of the model elicit that—
      1. Each of the lines can be seen, therefore each should appear on the plan.
      2. The base line is the largest.
      3. The lines get smaller as they get farther from the base.
   a. Draw the lines on the B.B. plan. Children copy on to their own plans.

III. Plan of a Relief Model.
1. Show a relief model (Fig. 28), with coast, river, lake, and mountain, and let the class try to draw its plan.
   Correct and explain where necessary.

2. Explain the shading of the mountain by a reference to the shadows cast by a hill or bank.

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**Fig. 28.**
LESSONS X AND XI

PLAN OF A CLASSROOM

Apparatus.—Flat rulers for class; two-foot rule or tape-measure; slates or squared paper.

I. The Room.

1. Call out two children. Hand them the two-foot rule or tape measure. Let them measure two adjacent sides of the room. Dictate the dimensions to class. Suppose them to be 36 feet by 24 feet (Fig. 29).

Class should infer the size of the other two sides.

2. Now let class measure their slates (or papers). Suppose them to be 12 inches by 8 inches.

3. Get the class to work out a suitable scale.
   a. Suppose we represent each foot by one inch. We shall require a slate 36 inches long to draw the plan. The scale is too big.
   b. Represent each foot by \( \frac{1}{2} \) inch. We shall want 36 half-inches, i.e. 18 inches. We cannot put that on a 12-inch slate. The scale still too big.
   c. Represent each foot by \( \frac{1}{4} \) inch. We shall want 36 quarter-inches, or 9 inches in length, and 24 quarter-inches, or 6 inches in width.

4. Class should now draw a plan of the room on their slates. **Scale \( \frac{1}{4} \) inch to the foot.**

II. The Thickness of the Wall.

1. Open a window or door. Measure the thickness of the wall. Suppose it to be 1 foot. On the scale this equals?—\( \frac{1}{4} \) inch. Put in the thickness of the wall.
III. Windows and Door.

1. Locate position of the door. Let some scholar measure it. Class reduces the measurement to scale; e.g. width of door = 3 feet; scale = \(\frac{3}{4}\) inch. Show the door by dotted lines, as in the annexed B.B. sketch.

2. Note position of windows. Let scholar measure width of window. Suppose it to be 6 feet. Dictate to class. Also measure the distance from one end of the window to the corner of the room. This fixes the position of the window accurately. Suppose it to be 9 feet. Class to—

   a. Reduce 6 feet to scale = 6 quarter-inches = 1½ inches.
   b. " 9 feet " = 9 " = 2½ inches.
   c. Insert the window in their plans by three parallel lines as shown in B.B. sketch.

3. Repeat with the adjacent wall. Proceed exactly as before.

Dimensions.
   a. Window, 8 feet.
   b. Distance of window from corner, 12 feet.
       Shade the walls to distinguish them from doors and windows.

IV. Furniture.

1. DESKS.

   a. Elicit shape of desks and seats (Fig. 30).
   b. Let pupils measure their own desks (12 feet by 1 foot).
   c. Let them reduce these measurements to scale. 12 quarter-inches or 3 inches, and \(\frac{1}{4}\) inch.
   d. Let them measure the distances of the desks from each other and from the walls, and reduce the measurements to scale again.
   e. The desks should then be inserted in the plan (Fig. 31).

![Fig. 30 — Plan of a Desk.](image)

2. TEACHER'S DESK.—Proceed exactly as with desks. Deal with cupboard and table in a similar way, if the room contains them.
OBJECT LESSONS IN GEOGRAPHY

B.B. SKETCH.

Fig. 31
LESSON XII

PLAN OF THE SCHOOL

Apparatus.—Plan of the school; flat rulers for teachers and class; slates or squared paper; picture of school.

I. Measurements.

1. It is assumed that every school numbers a "Plan of the School" among its permanent apparatus. The dimensions should be taken from this plan.

   It would be very instructive for the children to make the measurements themselves, but it is hardly practical. By working from a plan already prepared, the lesson becomes both analytical and synthetical. The broad features of the plan only should be used.

2. The plan should be the plan of the children's own school, hence the measurements will vary in nearly every case. The school measurements should be substituted for those given here.

II. The Drawing of the Plan.—Teach as follows:—

1. Scale.—Call attention to the scale affixed to the plan. Let class interpret it. Assume it to be 1 inch to 10 feet.

2. Walls.

   a. Measure one of the long walls on the plan. Assume it to be 10 inches. *Class to convert measurements in each case; e.g.*, 1 inch stands for 10 feet.

      *10 inches stand for \(10 \times 10\) feet = 100 feet.

      *The school is 100 feet long.*

   b. Measure an adjacent wall—5 inches.

      1 inch stands for 10 feet.

      5 inches stand for 50 feet.

      *The school is 50 feet wide.*

      Choose such a scale as will give easy calculations. If the school plan should work out to awkward numbers, it would be better to take round numbers.

   c. The class should now infer the size of the two other walls from observation of the plan.

      We have now the dimensions for the ground plan.

   d. Now let the class draw the ground plan to a suitable smaller scale chosen by the teacher.

      Examine by sample, and correct where necessary.
3. **CLASS-ROOMS, &c.—** Follow the same method for the marking in of the class-rooms and porches; e.g.,

- a. Measure such walls as are necessary.
- b. Class to note that opposite walls are the same size.
- c. Scale measurements to be converted to real measurements by class.
- d. Plans then to be drawn by class to the smaller specified scale.
- e. Examination and correction to follow by teacher.

4. **DOORS.—** Proceed as follows:

- a. Point out the doors on the plan. Count them.
- b. They are all (or some) probably the same size. If so, call attention to the fact.
  
  It saves labour and economises time.
- c. Measure width of door. Class to convert to real measurements.
  
  It would be easy to test their calculation in this case by actual measurement. The children would derive great satisfaction on discovering that they were right.
- d. Then let class insert the doors in the plan to the smaller scale. Examine and correct as before.

5. **WINDOWS.—** Deal with the windows in a similar way.

*Note.*—It will be necessary to measure the distances between the windows, and between the window and the corner of the room, as well as the width of the windows themselves.

6. **PICTURE OF THE SCHOOL.—** The picture and plan should now be compared.

**LESSON XIII**

**PLAN OF SCHOOL AND PLAYGROUND**

**Apparatus.**—Prepared plan of the school; prepared plan of the school and playground; tape measure; flat rulers; slates or squared paper.

**I. Measurements.**—Playground work.

1. Take class into the playground some time previous to the lesson. Let two boys take the tape and measure two adjacent walls. All boys should watch.
The rest of the class should be provided with slates and pencils. The dimensions should be called out as they are taken, and the rest of the class should jot them down. The items should be added and the totals given. If incorrect, the dimensions should be taken again by two other boys.

2. If the playground is regular, the class should infer the dimensions of the two other walls.
3. The measurements of the school are already known from the previous lesson and from the prepared plan of the school.
4. The dimensions and positions of the offices and covered portion should be taken and noted.

II. Drawing the Plan.—Classroom work.

1. Pin up the plan of the school and the plan of the school and playground on the B.B. Class to note:
   a. The smaller scale to which the school is drawn.
   b. The reason for this—the plan shows a greater space.

   Inference.—So long as we do not increase the size of the paper on which the plan is drawn, the greater the space shown the smaller each part of the plan becomes.

2. Draw a ground plan of the school buildings; i.e. merely the shape of the ground on which the school stands.

   Omit desks, cupboards, &c. Such detail encumbers the plan, makes it difficult, is too expensive in time, and is hardly necessary. The object is to gradually rid the mind of that detail which has been associated with their ideas of a plan up to the present, and so to gradually prepare them for the broad general features of the map.

   Proceed as in previous cases:
   a. Choose a suitable scale.
   b. Class converts real to scale dimensions.
   c. Teacher copies on B.B.
   d. Class copies (to scale) on slates or papers.
   e. Examination and correction.

3. Insert plan of playground. Proceed exactly as in the previous case.
4. Show a picture (or photograph) of the school and playground, and have it compared with the plan (Fig. 33).
LESSON XIV

A BLOCK PLAN

Apparatus.—A number of Kindergarten blocks of different lengths; slates or squared paper for class; flat rulers; a block plan of the district.

I. First Plan.

1. Lay down a number of blocks of different lengths so as to form a model of several streets, and have the ground plan drawn by the class (Fig. 34), following the teacher's drawing on the B.B.
a. The streets selected should be in the vicinity of the school (if possible). Do not mention this fact at present.
b. The scale chosen should be such as will just allow the plan to be drawn on the slates. The measurements should be made by the teacher. Class should convert them.
c. Suppose each block to represent a house. Each varies in size. With so many houses in the plan it would be almost impossible to show all the parts of each house. Explain this.
d. Hence class is only asked to draw a ground plan.

2. Shade the plan. The shaded portion represents a large number of houses or other buildings.

Inference.—It is not always necessary to show every part of a plan.

Note.—This is an important step towards accustoming the class to the broad generalities of a map as distinct from the particulars of a plan.

II. A Larger Plan.—Lower the scale and enlarge the plan.

1. Take more bricks and enlarge the plan (Fig. 35). Put a double row of blocks this time in each case. Turn over the slates (or papers) and have the plan drawn. The class at once tells you that they have not room. Get them to suggest that the scale should be made smaller.
a. Dictate a suitable scale. Class again converts the real measurements to scale.

b. Get class to note the solid appearance given to the model by the double row of blocks.

*Note.*—Use a treble row, if necessary, but give the model a solid look.

c. The children will recognise that the plan is more difficult than the first one.

1. There are more blocks.
2. The scale is smaller.

![Diagram of a block plan of a town](image)

2. Now suggest that they should draw only the ground plan of each set of blocks, as in the previous case. Have the ground plan shaded (Fig. 35).

*Note.*—As before, the teacher should work on the B.B., the class following on slates or papers.

3. Now tell class that such a plan is called a block plan.

4. Show a block plan of the district, and let the class—

   a. Make out the various parts.
   b. Recognise the part they have been drawing.

*Inference.*—A block plan is used to represent a town or part of a town.
B.B. SUMMARY.

1. A block plan is a ground plan, i.e. it does not show parts of a plan, but only the shape of the ground on which the objects stand.

2. It is used to represent a town or a part of a town.

LESSON XV

PLAN OF A VILLAGE

Apparatus.—A prepared plan of the village; picture of the village; two B.B.s; slates or squared paper; flat rulers.

I. Interpret the Plan.

Pin up the prepared plan on a B.B. Have another B.B. ready for ordinary use. With the aid of a picture of the village get the class to recognise the various parts of the plan.

a. Locate the school. Note how small it seems.

b. Start from the school and make a tour of the village, recognising each local feature as it is approached, and naming it; e.g. roads, woods, fields, buildings, railway, &c.

c. From local knowledge locate the direction of each road. Correct by the aid of the points of the compass.

d. Elicit the locality of neighbouring villages or towns by pursuing the various roads beyond the area shown in the plan.

II. Test the Plan.

Start with the school as a centre. Carefully select two or three well-known spots, the distances of which will convert very easily from scale to real measurements.

Attention should be called to the scale, which should be named, attached to the plan. The teacher should measure and give the scale measurement. The class should convert the scale to real measurement, and the accuracy of the plan should be tested by class knowledge; a rough accuracy only is required.

III. Draw the Plan.

The plan should now be drawn with rough accuracy both by teacher and class.
Fig. 36.
a. Start with the school again.
b. From observation of the prepared plan, and from local knowledge, get the length of the road in which the school stands. Fix its direction, and draw on the B.B. Class copies on slates or squared paper.
c. Proceed in the same way with the other roads, and so get in a framework of the plan.
d. Next fix the localities and respective sizes of the various fields, woods, &c. This completes the skeleton of the plan.
e. Proceed to insert the buildings in the block plan style. This will complete the plan.

Note.—1. Be careful not to crowd the plan. Broad and well-known features only should be inserted.
2. The town teacher should proceed on exactly the same lines, only he should substitute the school district for the village.

B.B. SKETCH.
(See Fig. 36, on opposite page.)

LESSON XVI

PLAN OF A FIVE-MILE RADIUS

Apparatus.—A prepared plan; slates or squared paper; flat rulers; two B.B.’s.

I. Introduction.

1. Tell class that the plan of the village (or school district) is going to be extended for five miles round.

   Note.—a. The plan must be local if the lesson is to be effective. Hence each teacher must prepare a plan of his (or her) own district within the radius named.

   b. Five miles is chosen as the radius, as it is fairly assumed that in most cases the local knowledge and experience of the children will cover such an area. Another radius may be chosen.

   c. The lesson, if based on a local plan, forms an easy and intelligent transition from the plan to the map.

2. Fix on a suitable scale, and insert it on the B.B. All measurements to be made from it.

   An inch to the mile might be used; but the scale will depend on the size of the slates or paper used. The teacher’s “inches” on B.B. should be made larger. This could be explained as a mere matter of convenience.
II. Insert Towns, &c.

(Political features. Do not use "political").

1. Start with their own village or town. Mark it with a dot in the centre of the B.B. Class copies on slates.
   
   Note.—Throughout the whole of the lesson the class will work on their slates from the teacher's copy on the B.B.

2. Get the class to name some neighbouring village or town. Start from the school, and elicit—
   
   a. Its direction.
   b. How long it takes to walk to it.
   c. Its approximate distance.

   Having agreed on directions and distance, then—
   
   a. Measure the distance on the scale.
   b. Fix the direction of the road on the B.B.
   c. Draw the road with approximate accuracy of direction, bends, turns, &c. (large ones only).
   d. Mark village (or town) with a dot.

3. Start from the school in another direction, and proceed as in the previous case, step by step, to fix the distance and direction of another town or village. Continue thus until all the towns, villages, and hamlets are inserted.

   The plan at present is merely a series of lines and dots.

4. Question out the relative size of the towns and villages. Distinguish between towns, villages, and hamlets, and mark these distinctions on the plan.

   a. For relative size the class would simply be expected to say that A is bigger, or much bigger than B.
   b. Three kinds of type might be used on the B.B. to mark these distinctions. The class need not enter names at all.
      
      1. Small capitals for towns,
      2. Italics for villages.

   c. Towns might be shown by a block (■■).
      Villages by a large dot (●).
      Hamlets by a smaller dot (○).

   All this is important, as it is training the class to recognise the relative significance of names and symbols on maps.

5. Railways and canals (if any) should now be put in.

   a. Fix directions as before.
   b. Represent thus—
      
      1. Railways ■■■■■■■■■
      2. Canals ————
III. Insert Physical Features.
(Do not use "physical."

These will include hills, rivers, lakes, woods. Dis-

tance, direction, locality, and relative size should all
be elicited by questioning (if possible).

The children know how to represent some of these features from
previous plans. Hills (if any) may be inserted in the usual map
style.
IV. The Prepared Plan.
This should now be shown, and the B.B. plan compared with it.
   a. Distances and directions should be compared by observation.
   b. By measurement.
   c. Only gross errors (if any) should be corrected.

B.B. SKETCH.
(See Fig. 37, p. 35.)

LESSON XVII
FIRST IDEAS OF A MAP

Apparatus.—Prepared plan for the last lesson (5-mile radius); relief model of the Isle of Wight; relief map of Isle of Wight; flat rulers for class; blank sketch maps for class, containing scales of miles; blacklead pencils for class.

I. Revision.
1. Show the prepared plan of the last lesson. From observation, get the class to note that—
   a. It represents more ground than the previous plans.
   b. It shows more than one town or village.
   c. And that, consequently, such a drawing may be called a map or plan.

2. Class now to infer that (with the aid of a little recapitulation)—
   a. A plan shows a building, a number of buildings, a district, a town, or even a small district.
   b. A map is a plan showing larger areas than the ordinary plan.

II. The Relief Model.
1. Show a relief model of the Isle of Wight (Fig. 38). Compare it with the relief map (the picture of the model). Sketch an outline map on the B.B., and get the class to recognise that—
   a. It represents the ground or space covered by the model.
   b. It is therefore a ground plan, or plan of the model.

It would be best if the model could be made in a shallow tray, so that water could be poured round to represent the sea.
III. The Sketch Maps.

1. Let children compare their rough sketch maps with the outline map on the B.B. (Fig. 39), and get them to infer that—
   a. Each of their sketch maps is a plan of the model.
   b. They are drawn to a smaller scale than the B.B. map.

IV. The Meaning of a Map.

I. Physical Features.

(Do not use the word "physical."

a. The class is already familiar with the representation of rivers and mountains.

b. Class should observe the model and note the arrangement and extent of the mountains (Fig. 40).

c. They should then be compared with the mountains on the relief map.

d. The teacher should then insert them in the plan or map.

e. Children should copy on to their sketch maps.

f. Proceed in the same way exactly with the rivers.
g. Then introduce them to the coast on the model, and let them discover that it is land next to the sea.

h. Measure the length and breadth of the island to scale. Class should measure on their sketch maps. Ask for results and compare.
   Length nearly 23 miles.
   Width about 13 1/4 miles.

i. From observation of the model and the maps, get class to infer that the northern part is flat, the other parts hilly.

2. Political Features.
   (Do not use the word "political."

   a. Point to the position of the towns (they can be marked with pins and little paper flags, or with drawing-pins). Fix positions; enter on blank map; class to copy on to their own maps.

   b. Deal with the railways in the same way.

B.B. SUMMARY.

1. A plan is used for buildings or small areas.

2. A map is used for larger areas.

LESSON XVIII

NORTH AND SOUTH

Apparatus.—Plans of schoolroom, playground, and neighbourhood; Map of England; pictures of Arctic regions; tropical forests, &c.

I. Preliminary Observations.

On some suitable occasion at noon, previous to the lesson, the children should be taken into the playground, and made to note the position of the sun. A child should be told to stand and look towards the sun, and the direction of the child’s shadow should be noted. A line should be drawn on the playground to indicate the direction of this shadow, and the position of neighbouring objects as regards this line should be ascertained.

II. Classroom Work.—North and South Direction.

1. Recapitulate the short lesson given in the playground.
2. Have a line drawn on the school floor in the same direction as the line previously drawn in the playground.

3. Distinguish as to which end was towards the sun. Teach the term SOUTH.

4. Give the name NORTH to the other direction.

5. Tell one child to walk towards the north, another to walk towards the south, and thus show that the names north and south are used to indicate direction, and do not indicate any special spot.

III. North and South of Plans and Map.

1. Have the plan of the schoolroom placed upon the floor, so that the lines indicating the school walls on the plan are parallel to the actual school walls. Mark a north and south line upon the plan.

2. Deal in a similar way with the plan of the playground and the plan of the neighbourhood.

3. Have the Map of England placed on the floor in correct position as regards the points of the compass. Get class to notice that the "top" of the map lies towards the north, the "bottom" towards the south.

4. Contrast with the plans of the school and playground, in which the north may or may not be towards the "top."

[As school maps are usually hung upon school walls, children are apt to get the notion that "north" indicates an upward direction, and "south" a downward direction. Carefully guard against this idea by repeating and emphasising North and South Direction (5), and North and South of Plan and Map (3).]

IV. Northern and Southern Climates.

Contrast the winds coming from the north and south. Connect with positions away from and towards the sun. Follow the northern direction in imagination to the region of perpetual snow. Show a view of the Arctic Regions. Let children describe the picture. Similarly, follow the southern direction to warmer regions. Show a picture of a tropical forest, and encourage children to give in their own words what they see.
LESSON XIX

EAST AND WEST

Apparatus.—A half circle (half a child’s hoop will do), lid of tin canister (or anything circular to represent the sun).

I. Preliminary Observations.

On several previous occasions get class to notice through which window the sun comes in the morning, afternoon, and evening respectively.

Take children into playground at beginning of morning school; let them note the position of the sun.

Repeat at end of afternoon school. Have a line drawn on playground joining the morning and evening positions of the sun. Note direction as regards neighbouring objects.

II. Recapitulation of the Observations in the Schoolroom.

I. Have a line of similar direction drawn in the schoolroom. Note which is the “morning-sun end,” which the “evening-sun end.”
2. Place a half hoop over this line, not upright, but tilted somewhat towards the south. Let the canister-top represent the sun. Pass the lid of the canister along the half hoop (Fig. 43).

3. Infer that, just as the canister-top goes up one side of the hoop and down the other side, so the sun rises in one direction and sets in the other.

   [This apparent motion of the sun may for the present be treated as a real motion.]

4. Teach the term EAST for the direction in which the sun rises, WEST for the direction in which the sun sets.

5. Have east and west of schoolroom determined; also the east and west of plans and maps (see previous lessons).

SKETCH ON SCHOOL FLOOR.

West. { Evening Sun. } Morning Sun. } East.

Fig. 42.

MID-DAY SUN

Setting

Rising

Fig. 43.

LESSON XX

THE FOUR CARDINAL POINTS

I. How to Tell the Four Cardinal Points in the Playground.

1. Take children into playground; let them notice the positions of the north and south line, and the east
and west line respectively (Lessons XVIII. and XIX.).

2. Produce the lines until they meet, and let it be noted that the two lines cross “squarely” (or at right angles) to each other.

3. From previous lessons infer that if at noon a child stands with his back to the sun, he is looking towards the north; turning his back on the south, has his right hand towards the east and his left towards the west.

B.B. SKETCH.

II. How to Tell the Four Cardinal Points in the Schoolroom.

1. From Lesson XVIII. the children have learnt in which direction the north lies. Have the other points determined, as in the previous paragraph.

2. Have the four cardinal points indicated on the school floor.

3. Get children to name objects that are N., S., E., and W. in the room.
III. How to Tell the Four Cardinal Points on the Map.

1. Place B.B. on floor, so that the top of the board is towards the north. Get a child to draw the cardinal points upon it. Replace on easel, and explain that the north is generally placed at the top.

2. Place Map of England on floor in correct position as regards the cardinal points. Determine the four points on the map. Replace on wall, and get children to note the respective positions on N., E., S., and W. Guard carefully against the notion that the north is "up" and that the south is "down."

LESSON XXI

FOUR POINTS OF THE COMPASS THAT ARE NOT CARDINAL POINTS

1. Draw the four cardinal points of the compass on the schoolroom floor (B.B. Sketch, Lesson XX. Fig. 44).

2. Stand a child on each of the four "points." Let each hold a slate with his position indicated by the letter N., S., E., or W., as the case may be, and let each look in the direction indicated on his slate.

3. Tell another child to stand between the child looking north and the one looking east, and to look "outwards."

4. Get class to see that this child is looking neither north nor east. Further, get the direction described as half-north and half-east. Teach the term NORTH-EAST. Mark direction on school floor.

5. Have the north-east end of the room pointed out. Get class to name something which is north-east of the school.
6. Teach the direction **South-West** in a similar way. Mark direction on school floor.
7. Get class to observe that south-west direction is opposite to north-east direction, just as south is opposite north and east is opposite west.
8. Teach in a similar way the points **North-West** and **South-East**.
9. Copy on the B.B. the eight lines which are now inscribed on the school floor.
10. Get children to copy them on their slates, and afterwards place their slates with the north line pointing to the true north.
11. If the lesson has been well done, many of the children should now be able to "box the compass" in a rudimentary way thus: N., N.E., E., S.E., S., S.W., W., N.W., N.

**B.B. SKETCH.**

![Diagram showing compass directions: N, N.E., E., S.E., S., S.W., W., N.W., N.](image-url)
LESSON XXII

EXERCISES IN NAMING DIRECTION

Apparatus.—Any of the movable objects in the room.

Many and varied exercises should now be given in direction. The following are a few suggested exercises:

a. Let children place pencils on slate so that the point is directed towards N., E., &c.
b. Have a chair placed S., W., &c., of table.
c. Tell one child to stand N., N.E., &c., of another.
d. Tell a child to enter the room and walk in (say) a S.E. direction.
e. If I walk from the desk to the back of the class, what direction do I take?
f. What direction do the children take in walking from the playground entrance to the school door?
g. How is the school situated as regards the church? the church as regards the school?
h. What is the general direction of the highroad? the railway? the nearest stream? the nearest range of hills? &c.

LESSON XXIII

THE SHADOWS CAST BY THE SUN

I. Preliminary Observations.

A post should be erected in the playground, and the following observations should be made by the children:

a. The direction of the morning, noon, and evening shadows (Fig. 46).
b. The varying lengths of the noon-day shadows according to the season of the year.
c. The positions occupied by the shadows at stated times, say 9 A.M., 12 noon, 2 P.M., and 4.30 P.M. (Fig. 47).

II. Classroom Work.

After a sufficient number of observations, the results should be summarised and explained somewhat as follows:
1. The morning shadows are thrown westward because the sun is then in the east.

2. The evening shadows are thrown eastwards because the sun is then in the west.

3. The noon-day shadows are thrown northwards because the sun is then in the south.
4. The noon-day shadows in winter are longer than the noon-day shadows in summer, because the sun is higher in the sky in summer than in winter.

(These points can be well illustrated on a dark winter afternoon by means of a walking-stick and a candle.)

5. From the varying positions occupied by the shadows at different hours of the day a rudimentary idea can be given of a sundial (Fig. 48). Reference might be made to a sundial in the locality, or a picture of one might be shown.

B.B. SKETCH.

<table>
<thead>
<tr>
<th>Sun</th>
<th>Shadow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>In East</td>
</tr>
<tr>
<td>Noon</td>
<td>In South</td>
</tr>
<tr>
<td>Evening</td>
<td>In West</td>
</tr>
</tbody>
</table>

We can tell the time by means of the shadows thrown by the sun.

Note.—A lesson might now be given telling how the north can be determined at night by means of the Pole Star (Fig. 50).
LESSON XXIV

A VANE OR WEATHER-COCK

Apparatus.—Model of a vane (Fig. 51); pair of bellows.

I. Preliminary Observations.
   Direct children to notice the vane at the top of the school or church, or some other building.

II. Classroom Work.
   1. Introduce model of a vane (Fig. 51). Compare with the one the children have seen.
   2. Have the letters N, S, E, W, explained.
   3. Get the children to notice that the arms bearing the letters are fixed, whereas the arrow is easily moved.
   4. Blow the arrow with bellows; note that it moves; infer that the arrow in a real vane is moved by the wind.
   5. Blow with bellows in various directions; note the direction of the bellows and the subsequent direction of the arrow; infer that the vane tells us which way the wind blows.

III. Further Observations.
   Get children on suitable days to note the direction of the wind and the kind of weather experienced. After a series of observations, summarise as follows.
IV. Connection between Wind and Weather.
North winds bring cold weather.
South winds bring warm weather.
East winds bring dry weather.
West winds bring wet weather.

[The results will of course vary somewhat in different parts of the country.]

B.B. SKETCH.

North Winds (Cold)

West Winds (Wet)

East Winds (Dry)

South Winds (Warm)

Fig 52.

LESSON XXV

LODESTONE

Apparatus.—A piece of iron ore; a piece of lodestone; a "stirrup" for suspension of lodestone (Fig. 54); some threads of raw silk; some iron filings, blue labels, red labels.

<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Take a piece of iron ore and a piece of lodestone. Let children examine them.</td>
<td>Both are hard, dark-coloured, stone-like bodies.</td>
<td>They appear to be much alike. (Tell that each is a piece of iron ore.)</td>
</tr>
<tr>
<td>Observations and Experiments</td>
<td>Results</td>
<td>Inferences</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2. Dip each piece of iron ore into iron filings.</td>
<td>The iron filings cling to one piece of iron ore (Fig. 53), but not to the other piece.</td>
<td>One piece of iron ore is different from the other piece. (Teach the term lodestone.)</td>
</tr>
<tr>
<td>3 (a) Place the lodestone on a stirrup suspended by a thread of raw silk. Allow it to oscillate, and then come to rest. Note the direction in which it comes to rest. (b) Repeat the experiment several times.</td>
<td>The lodestone comes to rest in a definite direction. This direction is north and south.</td>
<td>The lodestone helps us to tell north and south direction.</td>
</tr>
<tr>
<td>4. Fix a blue label on one end of the piece of lodestone, a red label on the other end. Allow lodestone to oscillate and come to rest as in (3).</td>
<td>The end with the blue label upon it always comes to rest pointing in one direction; the red end always comes to rest pointing in the opposite direction.</td>
<td>One end of the lodestone always seeks the north (called the North-seeking end); the other end of the lodestone always seeks the south (called the South-seeking end).</td>
</tr>
<tr>
<td>5. Repeat (3) and (4), using the piece of ordinary iron ore.</td>
<td>The iron ore does not take any definite direction.</td>
<td>A piece of common iron ore does not help us to tell north and south direction.</td>
</tr>
</tbody>
</table>

**B.B. SUMMARY.**

(1) is a kind of iron ore. Lodestone (2) takes up iron filings. (3) helps us to find the north. Common iron ore will not do these things.
LESSON XXVI
A MAGNET

Apparatus.—A straight bar-magnet; a horse-shoe magnet; several knitting-needles (one at least magnetised); pen-nibs, nails, iron filings, raw silk threads, cork, water.

<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Take a magnetised and an ordinary knitting-needle; plunge each into box of pen-nibs, iron filings, &amp;c.</td>
<td>One needle picks up the pen-nibs, iron filings, &amp;c.; the other needle does not.</td>
<td>One needle has some power which the other needle has not. (Teach the term Magnet.)</td>
</tr>
<tr>
<td>2. (a) Suspend each needle by a thread of raw silk; allow each to oscillate and come to rest (Fig. 55).</td>
<td>The needle which is a magnet always comes to rest in one position (a north and south direction); the other comes to rest in any position.</td>
<td>A magnetised needle is useful for indicating direction.</td>
</tr>
</tbody>
</table>

(b) Repeat several times.
(c) Place a magnetised needle on a cork on water (Fig. 56).
(This is the easiest way in which to work the experiment successfully.)

The needle comes to rest in the same position as before.
A needle which is a magnet always points north and south.
A needle which is not a magnet does not always point north and south.

LESSON XXVII

THE POLES OF A MAGNET

Apparatus.—Lodestone, magnetised needles, bar-magnet, iron filings, cardboard, horse-shoe magnet.

1. Experiments.
   a. Dip lodestone into iron filings (Fig. 57).
   b. Repeat with magnetised needle and bar-magnet (Fig. 58).

   **Fig. 57.**
   **Fig. 58.**

   RESULTS.—The iron filings collect near the ends.

2. Experiment.
   Sprinkle some iron filings uniformly over a piece of thin cardboard. Place cardboard with filings over bar-magnet. Gently tap the cardboard. Or, place cardboard on magnet and afterwards sprinkle filings (Fig. 59).
RESULT.—The iron filings arrange themselves most closely over the ends of the magnet (Fig. 60).

3. Experiments.
   a. Try to pick up pen-nib with middle of lodestone.
   b. Repeat with magnetised needle and bar-magnet. Contrast power at ends and at middle of lodestone, &c.

RESULT.—The middle of the lodestone, &c., will not pick up the pen-nib, whereas the ends will.

Inference.—The strength of a magnet seems to be at its two ends.
(Tell that these ends are called the poles of the magnet. Repeat Ex. 3, Lesson XXIX., and name the poles the North-seeking and the South-seeking respectively. Connect the term "seeking" with "hide-and-seek.")
4. Experiment.

Introduce horse-shoe magnet: show suitability of the name (Fig. 61). Try to suspend it from poker, first with one end of magnet, then with both (Fig. 62).

**RESULT.**—The magnet cannot always be suspended by one end, but can always be suspended by two ends.

**Inference.**—A magnet seems to be made stronger when it is bent into a horse-shoe shape.

**B.B. SUMMARY.**

A magnet is strongest at its two ends or poles.
One pole is called the North-seeking pole; the other the South-seeking pole.

**LESSON XXVIII**

**COMPARISON AND CONTRAST OF LODESTONE AND BAR-MAGNET**

**Apparatus.**—Lodestone, bar-magnet, iron filings, red and blue labels, shilling, penny, brass, wood, iron, steel, &c., iron ore.

[This lesson is mainly recapitulatory.]

1. Recall, and if necessary re-work, experiments to prove that:

   a. Both pick up pen-nibs and iron filings (Ex. 2, Lesson XXV.; Ex. 1, Lesson XXVI.).
b. Both are strongest at their ends or poles (Ex. 1, 2, 3, Lesson XXVII).

c. Both, when allowed to move freely, point north and south (Ex. 3, Lesson XXV.; Ex. 2, Lesson XXVI).

Infer that both the lodestone and the bar-magnet are magnets.

2. Experiment.

Try to pick up shilling, penny, brass, wood, iron, steel, &c., with magnet or with lodestone.

Result.

The magnet or lodestone picks up only the iron and the steel.

3. How to tell a Magnet.

1. It is made of iron.
2. It will pick up iron and steel.
3. It points north and south when allowed to move freely.

These points should be gained from previous lessons. Take various articles and determine whether they are or are not magnets.

4. Appearance of Lodestone and Bar-Magnet.

The lodestone looks like a piece of stone; the bar-magnet is a piece of iron.

Compare lodestone with iron ore, and thus infer that the lodestone was found in the ground. Further infer that the lodestone was "found," whereas the bar-magnet had to be "made."

B.B. SUMMARY.

Lodestone 
1. Pick up iron.
2. Are strongest at ends.
3. Point north and south.

bar-magnet
1. Is made of iron.

A magnet
2. Picks up iron and steel.
3. Points north and south.

The lodestone was found in the earth.
The bar-magnet was made.
LESSON XXIX

HOW TO MAKE A MAGNET

Apparatus.—Lodestone, ordinary knitting-needles, darning-needles, some nails.

1. Experiments.
   
a. Take an unmagnetised nail; try to pick up another nail with it.
   b. Suspend nail from end of magnet; place another nail on end of first nail, &c. (Fig. 63).

   RESULTS.
   In a. no action.
   In b. the second nail clings to the first, &c.

   INFERENCE.—The bar-magnet has made the first nail into a magnet, the first nail has made the second into a magnet, &c.

   c. Remove the bar-magnet, and notice whether the first nail will now support the second, &c.

   RESULT.—The first nail does not support the second, &c.

   INFERENCE.—The nail is a magnet only so long as the bar-magnet is near it.

   The question will now arise: Can iron be made into a magnet which will keep its power?

2. Experiments.
   
a. Place darning-needle on table; rub magnet or lodestone along needle, always beginning at the eye of the needle and finishing at the point. Test darning-needle to see whether it is a magnet (Lesson XXVIII.).

   RESULT.—The darning-needle now answers the tests for a magnet.
Inference.—It is possible to make a needle into a magnet which retains its power when the magnet or lodestone is taken away.

b. Similarly, magnetise a knitting-needle, a steel bar, &c. (Fig. 64).

3. Let children make needles, pen-nibs, &c., into magnets, and test them.

![Fig. 64.—Method of magnetising a piece of steel.](image)

B.B. SUMMARY.

To make a magnet, rub a piece of steel with a magnet. Always rub the same way.

LESSON XXX

SOME USES OF A MAGNET

Apparatus.—Magnet, iron filings, powdered sulphur, a "tin" plate.

Experiments.

1. Drop some iron filings on the floor. Get a child to try to pick them up. Ask for an easier way of picking up the iron filings. Have them picked up with a magnet.

2. Mix powdered sulphur and iron filings. Show the impossibility of separating them with the fingers. Separate them with a magnet.

A magnet is useful to pick out iron when it is mixed with other substances.
3. Introduce a “tin” plate. The magnet picks it up, showing that the plate is made of iron coated with tin. **A magnet is useful for telling whether a thing is or is not made of iron.**

**Recapitulation of Lesson.**

Ask children for the different ways they have learnt of finding the north. Imagine a very dark and cloudy night. Ask if it would still be possible to find the north. **A magnet is useful for finding the north.**

Have the north again found by means of a magnetised knitting-needle (Lesson XXVII.).

**B.B. SUMMARY.**

**Uses of a magnet—**

1. To separate iron from other things.
2. To tell whether a thing is made of iron.
3. To find the north.

**LESSON XXXI**

**THE SCHOOL COMPASS**

**Apparatus.**— *A magnetised needle suspended from below* (Fig. 65) *(the needle from the school compass will do)*; *darning-needle stuck in a piece of cork; a glass jar or a box; a school compass.*

1. Introduce the magnetised needle; prove that it is a magnet.

![Diagram](Fig. 65)

2. Balance it on the darning-needle, and get class to notice that it is not so easily affected as the silk-suspended needle was (Fig. 55).
3. Place the magnetised needle, still balanced on the darning-needle (Fig. 66), under a glass jar or in a box, in order to protect it from injury.

4. Introduce the school compass (Fig. 67) or a pocket compass (Fig. 68). Let children examine it and describe its parts:
   a. **The case** or box to preserve the needle from injury.
   b. **The glass face** which allows the needle to be seen (cf. clock face).
c. The needle—a magnet balanced on

d. The pivot.

e. The card below the needle inscribed with the points of

the compass (Fig. 69).

5. Remove the glass, take out the needle, and prove

that it is a magnet (Lesson XXVIII.).

Fig 68.—Pocket compass.  
Fig. 69.—The face of a compass.

B.B. SUMMARY.

School compass


| Pivot. | Card with points of compass. |

LESSON XXXII

EXERCISES IN THE USE OF THE

SCHOOL COMPASS

Apparatus.—A school compass.

A few exercises in the use of the school compass are
given here. The ingenuity of the teacher will easily
suggest others. Each exercise is to be worked from direct
observation of the compass.

1. Determine the north.
2. Place a child in the middle of the room. Tell another to look at compass, and then go and stand north of him, &c.

3. Place two children (A and B) in definite positions on floor, and let a third child determine, after observation of compass, the position of A as regards B, and of B as regards A.

4. Determine which are the N., S., E., and W. walls of the room.

5. Determine the position of the playground as regards the school.

6. Determine the position of the church, bridge, the village pump, &c., as regards the school.

7. Discover the direction of the roads and the streams of the locality. Draw sketch map (Fig. 70).


B.B. SKETCH.

North.

South.

Fig. 70.
LESSON XXXIII

THE MARINER'S COMPASS

(First Lesson.)

Apparatus.—Vessel with water, cork, bar-magnet, knitting-needle ready for suspension.

1. Introduction.
   Describe a dark night at sea, and the anxiety of the sailor to know the direction in which the ship is going in order that he may avoid rocks, &c.
   From previous lesson the children have learnt that the north can be discovered by means of a suspended or floating magnetised needle.

2. Experiments.
   a. Suspend the needle in a draught. Note that it does not come to rest.
   b. Shake the stand from which the needle is suspended. Note that the needle does not come to rest.
   c. Show how when the needle is unprotected it is liable to injury.

3. Ask any child who has been on a boat on the sea to describe his experiences. Emphasise the motion of the boat and the presence of wind, and infer that a suspended needle like the one before them would be no good at sea, because it would be swung about and damaged by the wind and the motion of the ship.

4. Experiments.
   a. Introduce magnet floating on cork on water (Fig. 56). Place in draught. The magnet comes to rest in its proper position.
   b. Agitate the stand supporting the vessel which holds the water; tilt the vessel from side to side. Again compare with conditions on board ship.
   A floating magnet would be useless on board a ship owing to the motion of the ship.
Final Inference.

A magnetic needle, to be of any use at sea, must be:
1. Kept out of the way of winds, and anything that will damage it.
2. Kept as steady as possible notwithstanding the motion of the vessel.

B.B. SUMMARY.
The hanging magnet would be no good at sea, because:
1. It would be blown about and damaged by the wind.
2. It would be shifted by the motion of the ship.
The floating magnet would be no good at sea, because:
It would be shifted by the motion of the ship.

Lesson XXXIV

The Mariner’s Compass
(Second Lesson.)

Apparatus.—A small boat compass or a card with magnetic needle below it and balanced on a point; a wooden box across which is stretched a rod from which a weight is suspended.

1. Show the unsuitability of the school compass for use on board ship. The pitching and rolling of the vessel interferes with the action of the needle. Introduce the model (Fig. 71).

Fig. 71.

2. Show that whatever way the box is tilted, the weight maintains its original position (Fig. 72).

Fig. 72.
3. Explain that the mariner's compass is balanced something, but not exactly, like the weight in the model.

Introduce the ship's compass (Fig. 73) or the model, and get children to note:

a. The way in which the compass-box is balanced.

b. The box containing the compass.

c. The card with the needle below it.

(Compare and contrast with the school compass.)

Draw a sketch or show a picture of a binnacle (Fig. 74); get children to notice its parts. Show that it fulfils the conditions mentioned in the Lesson.
B.B. SUMMARY.

Mariner's compass
Is balanced so that it always keeps level.
Has the needle below the card.

LESSON XXXV

FURTHER IDEAS OF A MAP
(Physical Features.)

Apparatus.—Physical map of England; map of Isle of Wight; a map coloured to show difference in heights; a flat ruler; B.B.

I. The Meaning of a Map.

1. Recapitulate from Lesson XVII. The children already know the meaning of the marks which represent coast, hills, towns, railways, rivers, and lakes. They know also that—
   a. A map is the plan of a large area or surface.
   b. The position of places (towns) and objects (mountains, lakes) are marked on it.
   c. The direction of rivers (and roads) is shown.

2. Now extend these ideas as follows:—
   a. Make a mark on the map about the centre of England (Coventry). Tell class London is 90 miles away; roughly speaking, so is Manchester. If we knew no more than this, we might start for London and find ourselves at Manchester. Hence deduce the necessity for inserting the points of the compass; and infer that a map shows the position of one place in relation to another.
   b. In a similar way fix upon some river or road, and show that the map shows its direction as compared with some other river or road.
   c. Point to the mountains, and call attention to the fact that the map shows the height of one mountain as compared with another.

This may be done:—
   1. By colours—different colours indicating different heights. Show a map in illustration.
   2. By the shading—the darker parts representing the greater heights. Show map in illustration.
   3. By numbers—the figures being written on the mountains. Write the heights on one or two mountains.
d. Fix on any two places. Measure (by scale) the distance between the two, and so get class to infer that a map shows the exact distance between any two places.

II. The Teaching of the Map.

In addition to what has already been learned, get the class to see that many more things may be learned from the map.

1. Point to the mountains. Note their position and arrangement, and show the class how to infer such facts as the following:
   a. Flat or low ground is found between the mountains.
   b. Rivers rise in mountains and flow over the low lands into the sea. Some flow one way and some another. If the mountains are near one side of the country (point to the Pennines without naming them), the rivers on one slope will be long, and those on the other slope short. The mountains thus help to fix the direction of the rivers.
   c. That the river lines are thicker as they get to the sea.

2. Measure the length and breadth of the country by scale, and get the class to convert scale measurement to real measurement.

   This is merely an application of I. 2, d.

3. Show a map of the Isle of Wight. Point out this island on the map of England. Get class to note the difference in size. Show the amount of surface or ground the map of the Isle of Wight would cover on this map, and so elicit that the scale is different, but that—

   A map shows the size of one thing or area as compared with another thing or area.

B.B. SUMMARY.

1. A map shows the position of one place in relation to another.
2. A map shows the exact distance between any two places.
3. A map shows direction as compared with some other direction.
4. A map shows the size of one area as compared with another.
5. A map shows the height of one mountain as compared with another.
LESSON XXXVI

A POLITICAL MAP

Apparatus.—A coloured political map of England; uncoloured map of England showing counties; map of Europe.

I. The Use of Colours on a Map.—Get the class to see that colours are used for the sake of greater clearness and distinctness.

1. WATER.
   a. Point to the sea and the lakes. Class notes that they are coloured blue.
   b. Point to the land. Examine the colours. No blue. Class then to infer that—
      1. All the blue colour represents water.
      2. All the water is coloured blue.
   c. Now point to the rivers. They are water, yet they are not blue. *Why?*
      If the rivers were blue we could not see them so well, because a blue line is not so distinct as a black line. **Rivers are therefore marked black to make them more distinct.**

2. LAND.
   1. Point to the land. It contains many colours. Class to note that—
      a. Different portions of the country are marked with different colours.
      b. No two portions together are the same colour.
      c. The portions vary much in size.
   2. Now point to their own town or village (insert in the map if necessary).
      a. It is shown by a mere dot.
      b. It is on one of the coloured patches.
      c. The coloured patch represents "our" county.
         Explain "county" simply as a portion of the country.
   
      **Inference.**—**Then each patch of colour marks out the size of a county.**

3. Point to other patches of a similar colour, and explain—
   a. That these do not form part of "our" county.
   b. That the counties may be any colour so long as—
      1. No two counties next to each other are the same colour.
      2. The colours help us to distinguish the counties easily.
      3. The colours are not ugly (*e.g.* black).
         (Black and white may be reckoned colours for this purpose).
Fig. 75
II. Some other Marks on the Map.

1. Call attention to the dots which mark out the boundaries of the counties. Explain that this is the usual way of marking out the counties, and the only way practically on an uncoloured map.

Show an uncoloured map, with the counties thus marked, in illustration.

2. The children already know something about the marks used to show towns. Direct their attention to some of these marks, and get them to note their difference.

   a. For large towns larger marks (□ ○ ●) are used.
   b. For small towns smaller marks are used.

Inference.—The size and importance of a town can often be told by the size or kind of mark used to fix its position.

III. The Meaning of Type Differences.

1. WATER.—Examine a number of names and get class to observe that—

   a. The North Sea, English Channel, &c., are in small capitals.
   b. St. George's Channel, the North Channel, &c., are in thick italics.
   c. Openings like the Humber, Wash, and mouth of the Thames are in smaller italics.

By the aid of a map of Europe compare the relative sizes of these portions of water, and get the class to infer that—

The size of the letters in the name tells us something about the size of each portion of water.

2. LAND.—Proceed in the same way with the “land” names, e.g.—

   a. Counties are in small capitals. So is London, because of its great size.
   b. Very large towns (Liverpool, Manchester, Newcastle, &c.) are in large italics.
   c. Smaller towns are in smaller italics.

The class can then make a similar inference to that under the head of “Water.”
B.B. SUMMARY.

1. Colours are used on maps to make them clear and distinct.
2. Rivers are marked black to make them more distinct.
3. Each patch of colour marks out the size of a county.
4. The size and importance of a town can often be told by the size or kind of mark used to fix its position.

LESSON XXXVII

DIFFERENCES BETWEEN MAP, PLAN, AND PICTURE

(A Recapitulatory Lesson.)

Apparatus.—Some simple common object (box or square prism, &c.); a circular object; some prepared plans (those used in previous lessons); pictures and plans of same objects or places (those used in previous lessons will do again); a map.

I. Plan and Picture.

1. Take any simple common object, and have its plan drawn to scale. By the aid of the object, its plan, and some recapitulatory questions, elicit that—
   a. A plan is a drawing.
   b. It shows direction.
   c. It shows how things look when seen from above; i.e. it shows the top side or surface of an object.
   d. It shows shape and size (length and width), but does not show height, depth, or bulk.
   e. It shows the size and shape of the ground the object stands on, e.g. a ground plan.
   f. In a circular object (sphere, top, cone) the plan is the largest circle.
   Use a circular object for this.
   g. It shows the proper size of all the parts.
   h. It shows the correct distance of one thing from another.
   Use two or more objects to elicit this.
   i. It does not always tell you the real size at once, because it is often drawn to scale.
   j. It can be drawn to any scale.
   k. It does not always show every part, e.g. the block plan.
   Show a block plan.
   l. It is used to show single objects, buildings, a few streets, or a small area.
   Illustrate by showing some of the prepared plans used in the previous lessons.
2. Show some pictures and compare and contrast them with their plans. Make use of any pictures obtained for the previous lessons. Select your pictures, and introduce them in such an order as to bring out the difference desired. In this way elicit that—
   a. A picture is a likeness. A plan is not.
   b. A picture gives a front view. A plan gives a top view or ground view.
   c. A picture gives some idea of height, breadth, length, and bulk. A plan gives only length and breadth.
   d. A picture does not show the real size of an object, but only the size it seems to be. A plan does show the real size.
   e. Similarly, a picture does not show the real shape, but only the shape it seems to be. A plan shows the real shape.
   f. Some pictures make us feel glad, or sorry, bright, proud, &c. Plans rarely do so.

II. Plan and Map.
Deduce from observation of a plan and a map that—
   a. A map is a very large plan; i.e. it is the plan of a very large area. It may be the map of a country or even of the whole world.
   b. Some maps (relief maps—show one) are almost like pictures. No plan is like a picture.
   c. Maps give us ideas of high lands (mountains) and low lands (plains and valleys). A plan really does not do this; for when such ideas are given, the plan really becomes a map.

B.B. SUMMARY.
1. A plan is a drawing of a small area.
2. A map is a plan of a large area.
3. A picture is a likeness.

LESSON XXXVIII

CIRCLE

Apparatus.—Chalk compasses, string, nail, hoop, penny, cardboard circle.

I. Plans of Circular Piece of Cardboard.
Show circular piece of cardboard; ask what shape it is.
Draw plans on B.B. (Lesson IV).
Let class look at the cardboard from different points of view.
Infer that a circle is round when looked at in some directions, and not round when looked at in other directions.

II. Circumference.
Draw circle on B.B. with compasses. Note that it consists of one line. Draw triangle, square, oblong, &c., and note that they consist of more than one line.
Tell that the one line of the circle is called the Circumference. [Guard against the class supposing that a line must be a straight line.]

III. Centre.
Draw an oval on B.B. Note that it, too, consists of one line. Ask in what ways it differs from the circle. Again inscribe circle, and show that the circumference is everywhere equally distant from a certain point called the Centre.

IV. Diameter.
1. Draw a line terminated both ways by the circumference, and passing through the centre of the circle. Teach the term Diameter.
2. Insist upon the fact that a diameter (a) must pass through the centre, (b) must touch the circumference on both "sides." Show that such lines as 1, 2, 3, 4 (Fig. 76) do not fulfil both of these conditions, and therefore are not diameters.
3. Show by trial that the diameter is the longest straight line that can be drawn within a circle.
V. Relation of Lengths of Circumference and Diameter of a Circle.

1. Measure with string circumference of circular piece of cardboard. Measure diameter. See how many times greater the circumference is than the diameter.

2. Repeat with hoop, penny, &c.

3. Infer that the circumference of a circle is a little more than three times its diameter.

4. Make a line 12 inches long on B.B. Draw a circle of which that line is the diameter. Ask how long the circumference of the circle should be. Measure, and prove the truth of the rule.

5. Repeat with circles of varying sizes.

6. Children should be allowed to draw circles with compasses, to name the centre, diameter, and circumference, and to colour them.

B.B. SKETCH.

The circumference is a little longer than three times the diameter.

Fig. 77.

LESSON XXXIX

A SPHERE

Apparatus.—A ball, some clay, knitting-needles, cardboard circle, penny, pins, cylinder, cone.

I. Plan of Ball.

Draw plans of ball (Lesson IV.). Draw attention to the fact that all the plans are circles. Contrast
with the plans of the circles obtained last lesson.

II. Comparison and Contrast of Ball and Penny.
1. Spin a penny. Show that when the penny is going very fast, it appears to be the same shape as the ball.
2. Roll each. Note the difference.
3. Summarise somewhat as follows:
   A penny is round some ways, flat other ways; a ball is round every way.
Contrast ball with cylinder and cone.

III. Introduction of Term "Sphere."
1. Show that if we call a penny a circle, then it would not be correct to call a ball a circle as well, because the ball has been shown to be different from the penny.
2. Teach the term SPHERE, which may be defined as a solid which is circular in shape, no matter in which way we may look at it, or more roughly still as a "solid circle."
3. Ask for names of common objects spherical in shape.

IV. Relation of Lengths of Diameter and Circumference of Sphere.
1. Make a clay sphere. Push knitting-needle just through it; draw out needle, and thus measure the length of the diameter of the sphere.
2. Measure circumference with tape or string.
3. Establish relationship between lengths of circumference and diameter.
4. Show that the results are the same as were obtained in the previous lesson on the circle.

V. Axis.
1. Cause clay sphere to rotate on knitting-needle. Put pins in various positions on the sphere, and thus demonstrate how the sphere rotates about this diameter.
2. Put a number of knitting-needles through the sphere, and thus show that it might have many diameters.
3. Rotate sphere. Show that there can be only one diameter about which the sphere turns at one time.

4. Teach the term AXIS, and define it as the diameter round which the sphere rotates.

[Compare the term “axis of a sphere” with the axle of a wheel.]

[Let the children make clay models of spheres.]

B.B. SUMMARY.

A solid, which is a circle no matter which way we look at it, is called a sphere.
The axis of a sphere is the diameter round which the sphere turns (or rotates).

LESSON XL

A CIRCLE AND A SPHERE

Apparatus.—String, peg, and chalk for drawing large circle in playground, a large clay sphere, a few tin soldiers.

I. A small part of the circumference of a large circle seems almost like a straight line.

Draw a number of concentric circles on B.B. Rub out all the circumferences except those indicated by the lines (Fig. 78).

Draw a large circle on floor of schoolroom, or, better still, in the playground. Cut out a piece of paper a foot long which is the shape of a foot of the circumference. Show that the paper is nearly straight. Infer that a small part of a very large sphere must seem nearly or quite flat.
II. The Differences of Shadows cast by Circle and Sphere.

[A dark afternoon in winter should be selected for working these experiments.]

**Fig. 79.**

**Fig. 80.**

**Exp. 1.**—Suspend or hold ball between light and white cardboard screen (or wall).

Note that the shadow is always a circle (Fig. 79).

**Exp. 2, 3, 4.**—Suspend or hold cardboard circle (or plate) in the positions shown in Figs. 80, 81, 82.
Note that the shadows vary in shape.
Infer that a sphere always throws a circular shadow, a circle does not always throw a circular shadow.

**Fig. 81.**

**Fig. 82**

**B.B. SUMMARY.**
A sphere always throws a circular shadow.
LESSON XLI

OBJECTS VIEWED ON A SPHERE APPEAR DIFFERENT FROM THE SAME OBJECTS VIEWED ON A FLAT BODY

1. Introduce a large clay sphere; place it about on the level of the eyes of the class. Stick four tin soldiers on sphere (Fig. 83). Get a child in a suitable position to describe that he sees the whole of the first tin soldier, the head and "body" of the next, the head only of the third, and that he cannot see the fourth at all.

2. Rotate sphere towards the class and note results as regards the appearance and disappearance of the soldiers.

3. Place the same four tin soldiers along the table at varying positions from the class. Get class to note that the whole of each soldier can be seen,
the only difference being that the farther the soldier is distant the smaller he appears to be.

4. Contrast with appearances of the tin soldiers on the clay sphere.

5. Further illustrate by contrasting the appearances presented by bicyclists approaching along a level road with those appearances presented by the same bicyclists approaching over a curved railway bridge.

6. Summarise results as follows:

The whole of a distant thing can be seen at once when we look at it over a flat surface. Only the top of a distant thing can be seen when we view it on the farther side of a sphere.

B.B. SKETCH

Fig. 84.
STANDARD II
# Lesson I

## Evaporation and Condensation

**Apparatus.**—Towel, water, flasks, spirit-lamp, evaporating basin, cork, slate.

<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weigh a wet towel, dry before fire, weigh again.</td>
<td>Second weight is less than the first.</td>
<td>The water has not soaked into the towel.</td>
</tr>
<tr>
<td>2. (a) Boil water in a flask (Fig. 85); observe what happens to the steam. (b) Ask if anything can be seen between the boiling water and the “cloud” issuing from the top of the flask (Fig. 85). Draw attention to the apparently empty space between the spout of the kettle and the cloud of steam (Fig. 86).</td>
<td>Water disappears in the air. Nothing can be seen.</td>
<td>Air can absorb (or suck up) water.</td>
</tr>
<tr>
<td>3. (a) Pour equal quantities of water into the evaporating dishes. Apply heat to one and not to the other (Fig. 87). (b) Ask class whether the rain after a shower dries up quicker on a warm day or on a cold day.</td>
<td>The water in the dish which is heated disappears first. The rain dries up quicker on a warm day.</td>
<td>The greater the heat the more quickly the water disappears in the air. (Teach the terms Evaporate and Evaporation.)</td>
</tr>
</tbody>
</table>
4. (a) Have ready flask of boiling water; take another empty flask, heat over spirit-lamp (turning about to prevent cracking); invert second flask over flask of boiling water; cork second flask, continue to warm it over flame.

(b) Cool flask; wipe outside of flask.

(c) Place cold slate in steam of kettle (Fig. 88).

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Nothing can be seen in the flask.</td>
<td>Cold causes water-vapour to return to water. (Teach the terms Condense and Condensation.)</td>
<td>Hot air can hold more invisible water-vapour than cold air. (Care should be taken to carefully distinguish between the air and the water-vapour which the air contains. The air may be compared with a sponge, the water-vapour to the water which the sponge sucks up.)</td>
</tr>
<tr>
<td>Little drops of water from inside the flask.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Insist on the facts that water-vapour is invisible, and that what we call "steam" is water-vapour beginning to come back to water.

6. Examples of Evaporation or Condensation.

The teacher should endeavour to get the children to furnish facts within their observation which illustrate one or both of the phenomena. A few illustrations must suffice:

1. The evaporation of ink in school ink-wells. Why does the ink require to be more frequently renewed in summer than in winter?
2. The drying of clothes on washing-day.
3. The chapping of hands in the early spring.
4. The moisture on the window panes of a railway-carriage or crowded room.
5. The reason a glass of cold water brought into a warm room becomes covered with moisture.
6. The reason we can see our breath on a winter but not on a summer morning.
B.B. SUMMARY.

Air contains invisible water-vapour.
Hot air can hold more water-vapour than cold air.
The greater the heat, the greater the evaporation.
When hot air containing much water-vapour becomes colder, the vapour condenses and becomes water.

LESSON II

CLOUDS

Outdoor Observations.—This lesson should preferably be given in the spring or early summer. For some time previous to the lesson the children should be encouraged to observe the state of the sky and the weather, both on going to and returning from school. Each day the teacher should question the children, and after a suitable interval a classification should be given.

I. Kinds of Clouds.

1. Heap Clouds (those most prominent in Fig. 89); the common type of cloud; seen especially in the morning.
2. Bed Clouds (on the horizon in Fig. 89); seen especially in the evening.
3. Feather Clouds (top right-hand corner); seen especially in the summer; as a rule denote fine weather.
4. Black Clouds (top left-hand corner); indicate the approach of rain.

II. Recapitulation of Lesson on Evaporation and Condensation.

Special importance should be attached to the following points:

a. Heat converts water into invisible water-vapour.
b. Hot air can hold more water-vapour than cold air.
c. On cooling, the water-vapour becomes visible as water.

III. The Formation of Clouds.

Compare steam from kettle or locomotive with cloud in sky as follows:

a. Both are white.
b. Both have a more or less curly shape.
c. Both are light and float in the air.
Steam is made up of little drops of water; infer that a cloud is made up of little drops of water too. Now get class to give the outlines of the theory of the formation of clouds as shown in B.B. sketch.

B.B. SUMMARY.

Clouds are made up of little drops of water.

How clouds are made:

1. Heat of sun turns water into water-vapour.
2. Water-vapour rises in air.
3. Air becomes cold, is not able to hold so much vapour; some turns into little drops of water which form a cloud.
LESSON III

RAIN

Apparatus.—Kettle of boiling water, slate, thistle-head.

This lesson should be given during or immediately after a shower of rain.

I. Connection of Clouds and Rain.

Recapitulate lesson on clouds. If necessary, again condense steam from kettle by putting cold slate into it. Compare a hill with the slate. Make a diagrammatic sketch of Fig. 90.

Explain the suspension of water particles in clouds and the descent of raindrops as follows:—

Take a thistle-head; show that it drops easily through the air. Break case enveloping seeds and let them escape; note that they float in the air. Argue that water particles in clouds are so light that air can support them, but when several particles run together and form a raindrop, the drop becomes so heavy that the air can no longer support it.

II. Theory of the Formation of Rain.

The class should now be able to give this. The following points should be carefully noted:—

1. Air containing water-vapour strikes against a hill.
2. The hill is cold, the air becomes colder and cannot hold so much watery vapour.
3. Some of the water-vapour gets turned into water particles which form a cloud.
4. The water particles run together, become too heavy for the air to hold up, and fall as rain.

III. Some Reasons why Rain does not Fall in Equal Quantities Everywhere.

1. Ask whether air near the sea or air far from the sea is likely to contain more water-vapour.
2. Ask whether air laden with water-vapour blowing over hills is likely to give rise to more or less rain than the same air blowing over plains.

Infer that hilly country near the sea is likely to
Fig. 90.—Clouds striking the Hills and falling as Rain.
have more rain than flat country far from the sea.
3. Take the map of England and further infer that more rain is likely to fall in the west than in the centre of England.
4. The rainy and dry winds of the locality should be noted.

LESSON IV

A PUDDLE

As many of these points as possible should be got from the personal experience of the children. Suitable opportunities before the lesson should be seized for the observation of the chief facts dealt with. A puddle at the base of a gentle slope will yield the best results, but probably no one puddle will yield all the results noted in the lesson.

I. Puddles are made up of Running or Still Water.
   If the puddle is made up of running or still water it may be compared with a Lake, and the entering and issuing gutter may be compared with the River that feeds the lake.
   If the puddle is made up of still water it may be compared with a Pond.
   The puddle thus forms a capital starting-place for teaching the definitions Lake, Pond, and River.

II. Puddles occur after Rain.
   The dependence of rivers, lakes, and ponds upon rain for their water supply may be thus inferred.

III. The Drying-up of the Puddle.
   From lesson on Evaporation infer that some of the puddle-water is evaporated.
   Ask children to describe the condition of a half-dried-up puddle. The bottom of the puddle is moist or muddy. Hence infer that some of the puddle-water soaks into the ground.
   From (i) the children have also learned that some of the puddle-water runs over the ground.
IV. Summarise as follows:

Part of the rain which falls is evaporated, and perhaps forms clouds.
Part of it sinks into the ground, and perhaps forms springs.
Part of it runs off the ground, and perhaps forms streams and rivers.

V. Examination of a Dried-up Puddle.

Dried-up puddles in the school playground or adjacent roadway should, if possible, be examined. Sections should be made with a spade or large knife.

a. Note the bed of the upper gutter or streamlet (Fig. 91, b) entering the bed of the puddle. A tongue of sand, gravel, or coarse mud (c) (according to locality) is deposited.

b. Make a perpendicular section of the bed of the puddle. Get children to notice that the finer sediment is at the top, the coarser at the bottom, &c.

VI. Classroom Work.

a. Explanation of the Tongue of Sand or Gravel (Fig. 91, b).—The quickly moving water of the runnel was arrested by the comparatively still water of the puddle, and was compelled to drop some of its sediment. Draw Fig. 91 on B.B. Extend this knowledge to the formation of Deltas

Fig. 91.—Stream (b) running into a Lake (a) and forming a Delta (c).

and Bars at mouths of rivers. Make the children clearly understand that the term delta is applied to the land brought down by the river, not to the river itself, i.e. it is a term relating to land, and not to water. If the children live near a river mouth, get them to explain the necessity of the various dredging operations carried on.
b. Explanation of the Section.—Make a sketch of the section (Fig. 92). Get the children to infer that the stones at the bottom must have been deposited during or soon after the shower when the water was running fairly fast, and that after the rain stopped, and the water flowed less and less rapidly, the less coarse layers were deposited.

Get children to note that water always deposits its
sediment in layers. Show pieces of shale and sandstone (Fig. 93), and get children to reason that they must have been deposited by water. Should suitable instances occur in the locality, get children to observe the layer-like formation (i.e. stratification) seen in a cliff (Fig. 94), quarry (Fig. 95), road, or railway cutting.

Fig. 95.—Stratified Rocks.

LESSON V

SPRINGS

Apparatus.—Clay, sand, gravel, chalk, slate, flower-pots, water, stout cardboard cylinder or wooden box, flower-pot with sponge at bottom, filled with sand, through which water has many times been passed so as to convert it into a fairly efficient filler (Fig. 100).

1. (a) Mould clay into shape of small basin, pour in water. Note result.
(b) Place a layer of clay at bottom of flower-pot, pour in water. Note result.
(c) Repeat (b) with sand.

Water does not run through clay, but does run through sand.

2. (a) Place the end of a piece of chalk in red ink. Note that it sucks up the ink.
(b) Scoop a basin-like hole in a large piece of chalk; pour in water. Note that the water soaks into the chalk and by-and-by runs through it.

3. Repeat similar experiments with gravel, slate, &c., and divide rocks into two classes:

   a. Those rocks which allow water to run through them.
   b. Those rocks which do not allow water to run through them.

   Sand.
   Gravel.
   Chalk.
   Clay.
   Slate.

   [Called Pervious Rocks.]
   [Called Impervious Rocks.]

4. Place a layer of clay at the bottom of a flower-pot, and some sand above. Pour in a little water (Fig. 96). Note that the water disappears in the sand, but does not run out of the flower-pot.
5. Fill the lower part of the cardboard cylinder or small wooden box with clay. Place a thick layer of sand over this. Mark on the outside the junction of the clay and sand. Note that the water issues or springs from the hole.

Bore other holes lower down. Note that no water issues from these holes (Fig. 97).

6. Draw Fig. 98, and apply the knowledge gained above to the formation of springs.

![Diagram](image)

Get children to reason that **springs are likely to be found at the junction of sand, gravel, or chalk (i.e. a pervious rock), and clay or slate (i.e. an impervious rock).**

Show a picture like Fig. 99.

7. Repeat experiment in (5). Note that the spring of water ceases soon after the pouring in of the water stops. Refer to Fig. 98, and get children to infer that such a spring as that represented in the diagram will flow best during and immediately after rain, and that the water will cease flowing in dry weather.

Tell class that there are other kinds of springs, which are never dry.
Fig. 93.—A Spring issuing from a Hillside.
8. Pour some dirty water into the specially prepared "filter." (See apparatus above.) Note that the water is much cleaner when it leaves the "filter" (Fig. 100). Infer that water becomes purified by soaking through sand and chalk, and that spring water is usually pure, good water.

![Filter Diagram](image)

**Fig. 100.**

**LESSON VI**

**A RIVER**

*(First Lesson.)*

**I. Outdoor Work.**

In order that the maximum benefit may be derived from the following lessons on a river, the children's attention should be directed (by a school excursion or otherwise) to the nearest stream (Fig. 101), and as many of the following points as possible should be observed:

1. The water in the stream flows.
2. The water flows faster in the middle than at the sides. (This may be noticed by observing boats, twigs, &c., floating in the stream.)
3. The direction of the stream is not straight, but winding. Attention should be drawn to the various obstacles to a straight course.
4. The stream widens in the direction of the flow, and becomes narrower in the opposite direction.
5. The stream is joined by watercourses from fields.
6. Beds of sand and gravel are found at the sides; in the middle, beds of stones.
7. The size, shape, and arrangement of the pebbles may be noticed; also their similarity to, or dissimilarity from, surrounding rocks. Characteristic pebbles might be collected.
8. Several bottles of water should be obtained from the stream.

II. Class-room Work.

A clay model should be made of the basin of the neighbouring stream, and a large map of the district should be drawn on the B.B. (Fig. 102).

The facts observed may now be accounted for in a manner somewhat as follows:—
1. The Water in the Stream Flows. — Pour water into a level trough; note its stillness. Tilt the trough. The water flows. Compare the tilted trough with the bed of the stream, and infer that the bed of a river is higher at and near its source than anywhere else.

![Image of the Basin of the River Ouse](image_url)

Fig. 102.—The Basin of the River Ouse.

2. The Stream Flows Faster in the Middle than at its Sides. — Pour sand down a slightly tilted trough. Get children to note that some of the sand is prevented from falling by the sides of the trough. Infer that in a somewhat similar way the motion of the water at the sides is retarded, owing to the friction of the banks of the river.

3. The Stream Has a Winding Course. — On a slightly tilted board covered with sand place a few
pieces of clay. Carefully pour water from the upper end and note the winding of the stream. Infer that the stream "eats" its way through the softer rocks and avoids the harder ones. (Draw Fig. 103 on B.B.)

![Diagram of a river bed worn out of the rocks.](image)

**B.B. SUMMARY.**

The stream flows because its source is the highest point of its course.
The stream flows faster in the middle than at the sides, because at the sides the water rubs against the banks.
The stream winds because it is easier for the water to make a bed in soft than in hard rock.

**LESSON VII**

**A RIVER**

*(Second Lesson.)*

**Apparatus.**—A glass vessel containing water, stones, gravel, sand, pebbles; bottle of river water.

**I. The Stream Widens in the Direction of the Flow.**

This fact may be illustrated by reference to the model (Fig. 104) and the map, and should be connected with the next heading.
Fig. 104.—The Course of a River from its Source to the Sea.
II. The Stream is joined by Watercourses from Fields.
These watercourses add to the volume of water and cause the widening of the stream. (Teach the term Tributary.)

III. Beds of Sand and Gravel are found at the Sides, &c.
Have some sand, small and large stones in a pail of water, or, better still, in a stout glass vessel. Stir rather gently. Get class to notice that the sand is carried round by the water, whereas the stones are unaffected. More vigorous stirring brings the stones into a state of suspension, first the small ones and afterwards the large ones. Suddenly stop stirring, and note that the large stones are dropped first, then the smaller ones, and last of all the sand.
Infer that the gravel and sand point to slowly moving water, the stones to more rapidly moving water.

IV. The Pebbles found in the Bed of the Stream
(Fig. 106).
These may be classified somewhat as follows:—
a. Stones more or less angular, which have probably been in the stream for a comparatively short time.
b. Stones rounded on one side and flat on the other, which have probably rested in the bed of the stream for some time.
c. Stones rounded on all sides, which have probably been transported for a long way by the stream.

V. The Water brought away from the Stream.
The bottles should be allowed to stand, and the fine sediment which is deposited should be noticed (Fig. 107).
A portion of the clear water above should be evaporated and the residue shown (Fig. 108).
If the class has previously had a lesson on Solution, the difference between matter in suspension and matter in solution might be pointed out.
Fig. 105.—Section of a Hillside, to show how Springs and Rills are caused.

Fig. 106.
VI. Recapitulation.

By questioning on the knowledge already gained, by reference to the model and map, and by the use of pictures, recapitulate the natural history of a river, introducing the terms source (Fig. 105), bed, banks, basin, tributary, mouth, &c.

Get children to draw up a definition of a river, which should be somewhat as follows:

A river is a stream of water which rises in high land and flows into the sea.

Rivers should be pointed out on the map of England.

VII. Formation of Rivers.

1. When rain is falling, part of the water runs off the surface of the land into little channels. These run together where opposite slopes meet, and so form streams. These streams unite to form rivers. Illustrate by reference to the state of the road and the gutters on a very rainy day, and get the class to infer that—

Rivers are formed mostly by surface drainage.

2. Take a shallow tray and heap up some damp sand at one end. Tilt the tray slightly, and from a toy watering-can pour water gently on to the sand until it is saturated and the water begins to trickle out of the sand.
LESSON VIII

A WATERFALL

Apparatus.—A large vessel of water, pail, clay model of waterfall, shallow dish, pictures of waterfalls, B.B.

I. Preliminary Observations.

1. On a very rainy day the water falls in a stream from a roof without a gutter. This stream of water is a waterfall.

2. On very rainy days, also, the water runs along the roadside channels or gutters down to the sinks. The fall of the water into the sink is a waterfall.

If there is any little waterfall, natural or artificial, in the neighbourhood, the children should be taken to see it. The playing of fountains often affords opportunities for viewing artificial waterfalls.

II. A Waterfall.

1. Take a large vessel of water; place it on the edge of the table. Place a pail on the ground nearly under it. Tilt the vessel of water steadily into the pail. A waterfall is formed.
2. Make a clay model, and further develop the idea of a waterfall.
   a. Model should show both plateau and plain.
   b. The fall need not be high, but it should be steep.
   c. A river bed should be dug both on plateau and plain.

   Fig. 110.—A Waterfall.

   d. The plateau should be slightly sloped (should have a gentle fall) to facilitate the flow of the water.
   e. A little water should be poured gently and continuously (for a short time) into the river bed of the plateau.
   f. The model should be built in a shallow dish.

3. Show a picture of a waterfall.
4. Class should now be asked to define a waterfall.

A waterfall is a steep and sudden fall of a stream or river from a higher to a lower level.

5. From knowledge gained in previous lessons, elicit that soft rocks are worn away very quickly by running water. Then argue that if the rocks were soft they would eventually be worn away, and there would be little or no waterfall.

Inference.—Waterfalls occur principally in mountainous districts where the rocks are hard.

III. Some Characteristics of Waterfalls.

1. Show some pictures of waterfalls. They are picturesque and grand-looking.

2. From the pictures class should note that the volume of water is generally small when compared with a river.

   In some the volume of water is large, as Niagara, Rhine. In others the volume is small, as the Swallow Falls (North Wales), the Falls of Lodore (Lake District).

3. The height of the fall is often very great.

   The Tosa Falls (Alps) fall 590 feet. Show picture, if possible.

4. The falls change with the seasons.

   a. Heavy rains \{ Falls full.
   b. Melting of snow \[ Falls much less in volume.
   c. Summer . Falls much less in volume.

5. Show picture of Rhine Falls. Contrast with high falls in mountainous districts.

   a. The falls are broad, but not high.
   b. The volume of water is immense—formed by a river.
   c. The district around is fairly level.
   d. Generally, the following inference will be true.

   In a fairly level district, with a small fall, the volume of water is greater.

B.B. SUMMARY.

1. A waterfall is a steep and sudden fall of a stream or river from a higher to a lower level.

2. Waterfalls are found mostly in mountainous districts where the rocks are hard.
LESSON IX
SPECIAL KINDS OF WATERFALLS

Apparatus.—Pictures of cataracts, rapids, cascades, and mountain stream; clay model of rapids; another of a cascade; pail; drawing-board; shallow dish; jug; water; B.B.

Revision.
Recapitulate previous lesson and elicit—

a. What a waterfall is.
b. Where waterfalls principally occur.

I. Cataract.
1. Show any pictures of cataracts, e.g., Nile, Niagara, Rhine. Class to note or infer that—

a. The river is large.
b. The plateau must be edged with sharp rocks.
c. The volume of water is great.
d. The fall is not high.

![Image](fig_iii)

2. Show a picture of a mountain stream. Class to note:

a. The water is rushing down furiously.
b. Generally, any furious rush of water is called a cataract.
c. Specially, a cataract is a waterfall formed by a large river.
II. Rapids.

1. Make a clay model on a drawing-board.
   a. Let the surface of the clay have a good slope.
   b. Hollow out channel for water.
   c. Place a pail on the floor to receive the water.

   d. Place model on the table with its low end near the edge of the table.
   e. Pour in water. *The water rushes down the channel very quickly. The water is very rapid.*
   f. Tilt the board. Pour water again. The water rushes faster still.
2. Associate the rate or flow with the gradient of the slope or fall, and get the class to infer that—

A rapid is a swift current in a river where the channel slopes.

III. Cascade.
1. Make a rough model in a shallow tray.
   a. The model should have several falls or terraces.
   b. A channel or bed should be made on top for the stream.
   c. The channel should have a slight slope.
   d. Pour water gently into the river channel. Class to note the result: The water falls from one platform to another.

![Fig. 114.](image)

2. (a.) Argue that the fall is not a simple one. It is interrupted or broken by the ledges or terraces.
   (b.) It is really a series of waterfalls.
   (c.) Such a series of waterfalls is called a cascade.

Casades are very beautiful sights, especially when the sun is shining on their clouds of foam.

B.B. SUMMARY.

1. A cataract is a waterfall formed by a large river.
2. Any furious rush of water is also called a cataract.
3. A rapid is a swift current in a river where the channel slopes.
4. A cascade is a series of waterfalls.
LESSON X

ISLAND, MAINLAND, AND CONTINENT

Apparatus.—Clay model of mainland and island; Map of the World; B.B.

I. Island.

Make a clay model in a shallow dish showing an island and the mainland. Pour in water to represent the sea.

1. Point to the island.
   Show that it has water all round it.

Class then to define an island.

Definition.—A piece of land with water all round it.

2. Turn to the Map of the World. Point to—
   Great Britain.
   Ireland.
   Iceland.
   America.
   Eastern Hemisphere.

   a. Each has water round it.
   b. Each is an island.

   a. Each has water round it.
   b. Neither is an island.

Inferences.—
1. Former definition is not correct.
2. An island is a small piece of land with water all round it.

3. Turn to the Map of the World again. Point to—
   Borneo, Sumatra, Celebes, New Guinea, Madagascar.
   a. These are all islands.
   b. None of them are small.

Inference.—The definition is not yet correct.

II. Mainland.

1. Point to the model, to the island, then to the other land. What is the other land called?
   a. Note that it is larger than the island.
   b. It is the chief, principal, or main part of the land in the model.
   c. It is called the mainland.
2. Class now to define both mainland and island.

Mainland.—The chief or main part of the land, and larger than an island.

Island.—A piece of land surrounded by water, and smaller than the neighbouring mainland.

The teacher might here explain the terms isle and islet.

III. Continent.

1. Turn to the Map of the World. Point out that—
   a. Great Britain is the mainland to the Isle of Wight.
   b. That the Eastern Hemisphere is the mainland to Great Britain.
   c. That there is no other larger portion of land to be a mainland to the Eastern Hemisphere.
   d. The Eastern Hemisphere is therefore called a continent.

2. Class should now define a continent.

   Continent:
   a. One of the largest divisions of land with no larger mainland; or,
   b. A division of land so large that there is no larger division to be a mainland to it.

IV. The Five Continents.

1. Point out the five continents.
   Europe, Asia, Africa, America, Australia.

   Note.—Most of the names given in the lesson are purely for the teacher's guidance. It is not necessary, or even advisable, that the children should be burdened with them. An exception may be made, however, in the case of the five continents.

2. Explain that it is the custom to speak of five continents.

3. Explain the disputed position of Australia in this list.
   a. It has water all round it.
   b. Although it is very large, yet it has a still larger portion of land (Asia) to be a mainland to it.
   c. It is, therefore, really an island.
   d. But it is the custom to speak of it as a continent, because it is so very much larger than any other island.

4. Continents are divided into countries. A country is a part of a continent in which a nation of people lives; e.g. England, France, Holland.

5. Our country is divided into counties. A county is part of a country; e.g. Yorkshire, Kent.
B.B. SUMMARY.
1. An island is a piece of land surrounded by water, and smaller than the mainland near it.
2. A mainland is the chief or main part of the land, and larger than an island.
3. A continent is one of the largest portions of land, with no larger piece to be a mainland to it.

LESSON XI

PENINSULA AND Isthmus

Apparatus.—Clay model (shallow dish, clay, water), Map of England, B.B.

I. Definitions.
1. Take the clay model of last lesson, or make a similar one. Pour in water as before, and note the water all round the island.
2. Join the island to the mainland by a narrow neck of clay. Note:—
   The water is nearly all round the piece of land and the neck that joins it to the mainland.
3. Tell the class that the piece of land is called a Peninsula. The narrow neck of clay is called an Isthmus.

   Put both words on the B.B., and have them distinctly enunciated.
4. Class should now give the definitions.
   a. Peninsula.
      1. A piece of land nearly surrounded by water.
      Tell that "peninsula" means almost an island.
   b. Isthmus.
      2. A narrow neck of land joining one piece of land to another.
5. Now introduce another island into the model. Join it to the model by a broad piece of land. Note again that—
   a. The water is nearly all round it.
   b. The second portion is not so much surrounded by water as the first portion.

Tell that, nevertheless, because it has water all round it, excepting one side, it is called a peninsula.

6. Now elicit that peninsulas may have—
   a. A narrow neck (Isthmus), or
   b. A broad neck (Base).

II. Illustrations from the Map.

   NARROW NECKS (Isthmuses).  
   Land's End Peninsula.  
   The Lizard Peninsula.

   BROAD NECKS (Bases).  
   England.  
   Cornwall.  
   Cornwall and Devon.

III. The Formation of Peninsulas and Isthmuses.

1. Refer briefly to the denuding agencies in lessons on Hills and Valleys and the Formation of Hills, p. 120.

2. Explain more fully the action of waves, which in this case are the chief cause. Point out—
a. In some places the waves dash with great force against the rocks, hurling stones against them, and gradually wearing them away (Fig. 118).
b. Where soft rocks lie under hard rocks, the waves gradually wear away the soft rocks, and at last masses of the harder rock fall down.
c. Where soft rocks and hard rocks lie side by side, the soft rocks are worn away, and the harder rocks are left standing out in the sea as capes or peninsulas.
d. In the model the teacher may suppose the islands once to have been joined, and to represent hard rocks. The space between them may be assumed once to have been occupied by softer rock, and to have been worn away by the action of the waves. The result is the formation of peninsulas and isthmuses.

B.B. SUMMARY

1. A Peninsula is a piece of land—
   a. Nearly surrounded by water; or,
   b. Almost an island.
2. An Isthmus is a narrow neck of land joining two pieces of land together.
3. A Peninsula may have—
   a. A narrow neck (Isthmus), or
   b. A broad neck (Base).

LESSON XII

A CAPE

Apparatus.—Shallow dish, clay, water; picture of a cape; Maps of England and Ireland; a bird's bill (if possible); B.B.

I. Develop the Idea of a Cape.

1. By the aid of a shallow dish, some clay, and some water, develop the idea of a cape.
2. Show a picture of a cape. Compare with model. Note that the cape is small compared with other portions of land.
3. Ask class to define a cape. A cape is a small piece of land stretching out into the sea.
II. Kinds of Capes.

1. Take some clay and rapidly make rough small models of—
   a. A Cape.
   b. Bill.
   c. Naze or Nose.
   d. Head.
   e. Foreland.
   f. Point.

   Note.—
   1. Explain each in its turn and as it is made.
   2. Take your models from the map of England and of Ireland.
   3. Point out the cape on the map in each case. Then tell the class that you are going to make a model of it.

2. CAPE.—Model of this as already made (I. 1). Point out on map of Ireland Cape Clear. Explain term.

   Word cape comes from a foreign language. It means head. Refer to the capes worn by people, and tell that formerly these capes used to have a covering for the head attached to them. They are still worn on the Continent. They were considered head coverings rather than body coverings. Point to the position of their heads with respect to their bodies. They stick out from their bodies.

3. BILL.—Point to Selsea Bill and Portland Bill (Fig. 121). Make an enlarged drawing of the latter on the B.B., and mould the model from it.

   a. Point out its resemblance in shape to a bird's bill. Sketch a bird's bill, show a picture of one, or better still, show a bird's bill if possible. Then compare the cape and the bird's bill.
   b. Point out the position of the bird's bill with respect to the rest of the body. Compare with the cape. The meaning of the term is then obvious.

4. NESS.—Point to the Naze, Foulness, Dungeness, Hope's Nose (near Torbay). Naze (a foreign word for Nose), Ness (shortened form). Make a model of Hope's Nose (Fig. 122).

   a. Note the rough resemblance of the cape to the human or animal noses.
   b. Note the position of the nose with respect to the face.
c. Infer the suitability of the name.
d. Say a few words about the hardy Norsemen of old, who called the "nose" naese.

5. HEAD.—Point to Flamborough Head, Spurn Head, Beachy Head, &c. A common name for English capes.
   The idea of "Head" has already been developed under "Cape." It has been suggested that when at sea a piece of bold projecting land often looks like a great beast lying down with its head to the sea, and that it was some such fancy as this which led sailors in early days to call such pieces of land "heads" or "headlands."

6. FORELAND.—Point to N. and S. Forelands. Take a bit of clay and affix it before or in front of the mass of clay. This will illustrate a foreland.

7. POINT.—Hartland Point, Start Point, &c. A common name for English capes.
   The previous names are based on fancied likenesses. In this name there is not only likeness, but proportion or magnitude also. Compared with the great mass of land, a "Point" is a very small area indeed.

B.B. SUMMARY.
1. A cape is a small piece of land stretching out into the sea.
2. There are various kinds of capes:
   Cape.   Bill.   Naze or Nose.
   Head.   Foreland.   Point.

LESSON XIII
HILLS

Apparatus.—Two apples of equal size, one baked and allowed to cool; relief model of England; blank Map of England; sketch blank maps for class (prepared before the lesson).

I. Develop the Idea.
1. By local knowledge and experience. The children know a hill when they see one, although they may
not be able to define it. Question for local examples.

2. By references to such things as heaps, dung-hills, mole-hills, ant-hills.

3. Get the children to note from observation of local hills that—
   a. The land rises more or less, sometimes to a great height.
   b. The top of the hill is generally rounded.
   c. Sometimes there are no other hills near.
   d. The ground rises more or less steeply.
   e. It is a natural rising of the land.

   Contrast with banks, which are hills made very often by man.

4. Class should then give a definition of a hill.

   A hill is a portion of land rising more or less steeply and naturally from the surface of the land to a great height.

   The word "great" is here used comparatively with reference to the elevation of ant-hills, banks, &c. Write on B.B. and have it learnt.

II. Formation. (See also Lesson XIV.)

1. Take a baked apple; call attention to the hollow crumpled nature of its surface. Use this as an

Fig. 123.—A Baked Apple, to show how the Skin Wrinkles when Cooled.
illustration to explain the formation of some hills. Proceed somewhat as follows:

a. Compare the baked apple with an unbaked one.
b. The unbaked apple is smooth and unbroken. The baked one is shrunken and wrinkled (Fig. 123).
c. The shrinking and wrinkling were caused by heat and cooling.
2. Apply this to explain the uneven surface of the earth.
   a. Speak of the heat inside the earth. Illustrate by reference to volcanoes, hot springs, and mines.
   b. Tell that the earth was once very hot. It began to cool. Result, an uneven "skin" or crust like the apple.
   c. The parts of the crust that rise up above the others are called hills or mountains. Illustrate with the baked apple.

III. Some Hills in England.
   1. Take a relief model of England. Point to the elevations. Some are greater than others. The class will now readily infer that the smaller ones are the hills.
      a. Point out some of these hills on the model, e.g.—
         The North York Moors.
         Edge Hills (Warwickshire).
         Clent Hills (Worcestershire).
         Clee Hills and Wrekin (Shropshire).
         Malvern Hills (Worcestershire).
         Mendip Hills (Somersetshire).
         Quantock Hills (West Somerset).
      b. Now insert these hills in the blank map.
      c. Class should copy on to their sketch maps.
   
   Note.—
   1. These hills are of various formations. The teacher must not let the class assume that they are all formed in the method described in this lesson.
   See next lesson, also p. 215.
   2. The teacher will be able to form the relief model from the picture of a relief model (relief map) attached to this lesson.

LESSON XIV
HILLS AND VALLEYS

Apparatus.—A freezing mixture; bottle; water; cork for bottle; string to tie cork; piece of very rusty iron; Map of Pennines (or of England); B.B.; coloured chalks.

I. Revision.

Revise "Formation of Hills" from the previous lesson.
The internal heat of the earth is supposed to be cooling. This gives a wrinkled crust to the earth.
   a. By forcing the land up. } Compare with baked apple.
   b. By letting it sink.
II. The Making of Hills and Valleys.

Other forces are at work making the crust of the earth uneven:

1. RAIN.—Call attention to the state of the roads after or during a shower of rain.
   a. Rain-water is fairly pure.
   b. The water in the roads and gutters is dirty.

   **Inference.**—*The rain washes or wears away the roads.*

   Refer to the condition of the ground beneath the water-tap, the pump, the rain-spout.
   a. If the ground is gravel, it is washed or worn away very much. Show a little gravel; it is soft.
   b. If it is stone, it is worn away much less. Stone is hard.

   **Inference.**—*Water washes away the soft ground more quickly than the hard ground.*

2. FROST.—Prepare a freezing mixture by mixing equal parts of pounded ice and salt.
   a. Let child feel the freezing mixture.
   b. Insert a tightly-corked bottle full of water into the mixture. The cork should be tied down with string.
   c. Allow the bottle to remain in the mixture about a quarter of an hour.

   **Result.**—Water has turned to ice, and the bottle has broken.

   *Compare with the bursting of pipes in frosty weather.*

   **Inference.**—*Ice takes up more room than water.*

   Now explain that the frost freezes the rain-water which collects in the cracks of the rocks, and forces the rocks asunder (Fig. 127, A, B, C).

3. WIND.—In dry, windy weather clouds of dust often trouble us. In the summer months our roads are watered to "lay the dust."
   a. Use this illustration to explain the formation of sand-hills in some districts.
   b. The sharp particles of sand, when driven by winds against rocks, wear away their surface in a very remarkable manner (Fig. 125).

4. AIR.—Show a piece of rusty iron. It is covered with reddish-brown scales. Elicit that *the air rusts the iron.* Call attention to the fact that the rusting
is a wearing away process. Refer also to decaying mortar in houses, to decaying stone (show a piece of "weathered" stone) in any buildings near, and get the class to infer that—

**The air wears away the rocks.**

Explain rock (if necessary) to include soft bodies like sand, earth, &c., as well as hard stone.

![Fig. 125.—Action of Wind upon Rocks.](image)

5. **RIVERS.**—Recapitulate the essential points in the lessons on rivers, and elicit that—

a. They wear away the surface of the ground.

b. They help to form hollow spaces.

**III. Summary.**

1. Recapitulate and gather that the surface of the land is worn away by rain, frost, wind, air, and rivers.

![Fig. 126.—Strata nearly Horizontal carved into Hills and Valleys. West Riding of Yorkshire.](image)

2. That the soft rocks are worn away more quickly than the hard.
3. That the worn-away portions form valleys, the others hills.

4. Illustrate by a reference to the Pennine Chain.
   Explain the diagram (Fig. 126).
   
   Note.—
   1. The names are given for the teacher’s guidance only. They must not be used to the class.
   2. Use coloured chalks to show the different strata.

B.B. SUMMARY.

1. The surface of the land is worn away by—
   Rain, Frost, Rivers, Wind, Air.
2. The soft rocks are worn away first.
3. Where the rocks are most worn away we get valleys; where least worn away we get hills.

A.—Rock with hole filled with water.
B.—The water has turned to ice, which has split the rock.
C.—The ice has thawed, the detached portion of rock is no longer held to the main portion by the ice and has fallen away.

Fig. 127.

LESSON XV

MOUNTAINS


Very few English children will have seen a mountain, but many will have seen a hill. The object of this lesson is to endeavour to get the children to form by constructive imagination a correct mental image of a mountain.

I. Development of the Idea of a Mountain.

1. Get the children to name a hill or hills in the neighbourhood of the school. Ask how long it takes them to get to the top. Now endeavour to get
children to imagine a "hill" so high that three, six, twelve, or more hours are required to reach its summit.

2. In the early morning or on a dull day, the children may have noticed a cloud resting on the top of the hill. Picture a "hill" so high that a cloud rests on its summit even on some fine days, and, if possible, show a picture of a mountain partly covered with clouds.

3. The children may have observed that the grass, &c., does not grow so freely on the top of the hill as in the valley. Describe the ascent of a very high "hill," the gradual stunting and final disappearance of the trees, the gradual disappearance first of grass and then of moss, and lastly a summit absolutely bare of vegetation.

4. The children may have observed that in winter the snow often remains on the top of the hill some time after it has melted in the valley, or they may
have noticed that the top of the hill is white with frost or snow in the early morning when there has been no frost or snow in the valley beneath.

5. Summarise by drawing a word-picture of a very high "hill," the ascent of which takes some hours, which has a summit sometimes enveloped in clouds, bare of vegetation, and covered the whole or the greater part of the year with snow. The term "Mountain" may now be taught.

6. Show some pictures of mountains (Figs. 128 and 129); also of parties of mountaineers making ascents, &c. Vividly describe the ascent of a snow mountain.

Definition.—A mountain is a very high hill.

II. Examination of the Model of England.

1. Direct attention to the model, and get children to see that the mountainous parts of England are in the north and west.
2. Point out the position of Snowdon. Show picture. Let the thickness of one book represent the height of the church spire (say 100 feet), then take five books to represent the height of the nearest hill (say 500 feet), and lastly pile thirty-five books against the wall to represent the height of Snowdon.
3. Get children to observe that some of the mountains in the model are arranged in a "line," some in a "crowd" or "ring." Teach the terms Chain and Group. Draw Figs. 130 and 131 on B.B. Have the positions of the chains and groups of mountains in England pointed out.

III. Examination of Map.

Show how mountains are marked on the map.

Note.—The term "Watershed" may be taught in connection with term "Chain."

B.B. SUMMARY.

A mountain is a very high hill.
Some mountain tops are always covered with snow.
A mountain chain is a line of mountains.
A mountain group is a crowd of mountains.
Snowdon is the highest mountain in England and Wales.

LESSON XVI

PLAINS


I. Revision.

Recapitulate from previous lessons, so as to bring out some of the various forces at work altering the shape of the earth's crust, e.g.—

a. Rivers bring down soil (in suspension) and deposit it at their mouths (Delta, &c.).

b. The depression of the earth's crust (shrinking and cooling). Use the "baked apple" illustration.

c. Action of glaciers in wearing out valleys.

d. Action of rain, frost, wind, air, &c. (denuding agents).

Associate these forces with the existence of low tracts of ground, and argue that they have helped to form these tracts.
II. Develop the Idea of a Plain.

Make a clay model, showing a plain and a tableland.

One side of the tableland is to be steep, the other gently sloping.

1. Show model (Fig. 132); point to plain. Class should note that—
   
   a. The land is not perfectly flat, but there are no large hills or mountains. The surface is little varied by inequalities.
   
   b. The land is low.

2. Contrast with the highlands.

   a. The land is not *all* high, but much of it is (called Highlands).
   
   b. In the plain most of the land is low (called Lowlands).
   
   c. Speaking generally, the one is composed of Highlands, the other of Lowlands.
   
   d. One is very uneven; the other is only slightly uneven.
3. Class should now be asked to define a plain.
   a. A low stretch of land, entirely or almost flat.
   b. A low stretch of land with a slightly wavy surface.
   c. The name for all those parts of the land which cannot be properly called hilly or mountainous.

4. Point to the relief map. Class to—
   a. Distinguish the plains.
   b. Note that rivers may run across them.
   c. Note that hills may be found on them.

5. Select a few sentences illustrating the adjectival use of the word, and so further develop the idea of "plain," *e.g.*—
   a. It's all *plain* sailing,
   b. The view is *plain*,
   c. A *plain* man, &c.,

and so develop the cardinal ideas of clear, open, simple, unadorned.

![Fig. 133: Relief Map]

6. Point to the Map of the World, and let the class note some of the special names for a plain, *e.g.*—
   a. Steppes (*Asia*).
   b. Pampas (*S. America*).
   c. Prairies (*N. America*).
   d. Savannahs (*N. America*).
   e. Deserts (*Africa, Asia*).

Hence get class to infer that—

Plains differ greatly in fertility according to climate and soil.

Very briefly describe each.

Proper names are inserted only for the teacher's guidance, and not for the class.

III. Tablelands (or Plateaux).

1. Point to the raised portion of model. Class to note that—
   a. It is a stretch of high land.
   b. It is unbroken by valleys.
   c. Its sides may be steep or sloping.
2. Stick bits of clay round the edge of the tableland, and a row of bits across it. Let these represent mountains. Class to note that it may have mountains around it, e.g. Quito (S. America) and the Pamir (Asia).

3. Scoop out a bit of clay. Pour in water to represent a lake. Note again it may have lakes. Point to Victoria Nyanza.

4. Take a piece of cardboard and a row of books. Build up a series of terraces (Fig. 134).
   a. Tell the class that tablelands sometimes rise in terraces.
   b. Point to Map of World in illustration.
   1. From the Equator to the Zambezi.
   2. From India to Thibet.

5. Point out a few important tablelands. Follow the course of the mountains on the map to show their elevated position, e.g.——
   b. Europe—Central Spain.
   c. America—Oregon, Great Salt Plain.
   d. Africa—Barbary, Abyssinia, Equatorial Regions.
   e. Asia—Asia Minor, Armenia, Persia.

6. Class should now define a tableland——
   A stretch of high ground unbroken by valleys.

B.B. SUMMARY.
1. Highlands—Most of the land is hilly or mountainous.
2. Lowlands—Most of the land is low and level.
3. Plain—Low stretch of level land.
4. Tableland—A stretch of high ground unbroken by valleys.
LESSON XVII

A GLASS OF SEA-WATER

Apparatus.—Sea-water or a fairly strong solution of salt and water, scales, flask, fresh water, fresh egg, cylindrical glass vessel, globe, maps.

(Introduce by reference to visit to seaside.)

1. Ask a child to taste sea-water. It tastes salt. Infer that sea-water has salt dissolved in it.

2. (a) Weigh flask full of sea-water, then same flask full of fresh water. Note difference in weights.

(b) Pour sea-water into long glass vessel; colour some fresh water, carefully pour above the sea-water (Fig. 135).

Infer that salt water is heavier than fresh water.

3. (a) Place new-laid egg in fresh water. It sinks to the bottom (Fig. 136, A).

(b) Place same egg in salt water. The egg floats in the salt water (Fig. 136, B).

(This experiment should have been carefully rehearsed before the lesson, so that the water may be sufficiently salt to float the egg.)
(c) Get an older boy who has swum in both salt and fresh water to describe his experiences. Infer that sea-water has greater floating power (i.e. more buoyancy) than fresh water.

I. The Sea.

Show Map of England. Have the land and the sea pointed out. Introduce globe or map of the two hemispheres. Get children to observe that there is more water than land. Draw a square (Fig. 137). Divide it into four equal squares. Colour a space a little larger than one of the four squares brown, to represent land; colour the rest blue to represent water. Teach that the sea covers nearly three-quarters of the earth. Get children to point out on globe the large masses of water and the smaller ones. Teach the terms Ocean and Sea.

II. The Action of the Sea on the Land.

If the children live near the sea, draw upon their personal observation. If they do not, describe a
storm at sea, also the ebbing and flowing of the tide. Draw Fig. 138 on B.B., and get children to infer that the sea is slowly wearing the land away.

Fig. 138.

LESSON XVIII

LAKE, SEA, OCEAN

Apparatus.—Clay models of pond, lake; water; salt; Bunsen burner or spirit lamp; evaporating dish; Map of England; Map of the World.

I. A Puddle.
Recapitulate lesson on a Puddle, and elicit that—

a. A puddle is formed in one of the small hollows worn in a road.
b. It is often discharged by little runnels.
c. It is formed by rain.
d. It is still water and fresh.
e. It has land all round it.

Definition.—A small portion of fresh, still water, with land all round it.

II. A Pond.
Make a model of a pond (Fig. 139).

Let there be a slight fall to it.

Class to observe from the model that—

a. The pond has land all round it.
b. It is still, fresh water.
c. It has no outlets.

d. It drains the land. Explain as follows:
   1. Rain sinks into the ground.
   2. It runs downwards through the soil.
   3. Forms a pond in a hollow.

   The teacher might also recapitulate for these facts from the lesson on "Springs."

**Definition.** — A pond is a very large puddle.

### III. A Lake.

Enlarge the pond to represent a lake. Place a few mountains round it (Fig. 140). Class to observe that:

- a. It has land all round it.
- b. It is composed of fresh, still water.
- c. It has outlets and inlets (rivers).
- d. It drains the land.

- e. It generally has mountains round it, and receives the streams from the mountains.
- f. It is a very large pond.
OBJECT LESSONS IN GEOGRAPHY

Definition.—To be given by class—
A large portion of fresh, still water surrounded by land.

Map Illustrations.—Windermere, Derwent Water.
Contrast lake with island.

IV. A Sea.
Turn to the map, and follow a river from its source to the sea. Class to note that—
a. The sea is very large.
b. Its water is salt (p. 131).
c. The land is nearly all round it.

Definition.—A very large space of salt water with the land almost all round it.

Map Illustrations.—Irish Sea, Baltic Sea, Black Sea.
Contrast sea with country.

V. An Ocean.
Turn to the Map of the World. Point out some seas, and show that they are merely portions of larger seas, which are called oceans. Show from the map that they are the largest divisions of water, and form the chief part of the globe.

Definition.—An ocean is one of the largest divisions of water.

Map Illustrations.—Atlantic, Pacific, Indian.
Contrast ocean with continent.

VI. Why the Sea is Salt.
Argue and demonstrate as follows:

a. All water that runs into the sea is fresh.
b. Salt is one of the most common things in the world. It is found in every plant and animal, and in the crust of the earth.
c. Plants and animals die and decay, and form part of the earth's crust.
d. Rain washes the soil (which contains salt) into the rivers.
e. The rivers carry it into the sea.
   1. Rivers contain so little salt that it cannot be tasted.
   2. Seas contain enough to give the water taste.
f. Experiment.—Put a little salt into some water and evaporate over a Bunsen burner. The water goes, the salt is left. Compare with the sea. The salt is left in the sea. It is not evaporated as the water is.
g. The sea gets no salter. Animal life in the sea absorbs most of it.
VII. A Salt Lake.
Argue as follows:—

a. Suppose a lake to have no outlets.
b. Rivers carry salt in, but none out.
c. Evaporation goes on. Salt gets left behind.
d. Lake becomes salt, and is called a salt lake.
e. Point out the Dead Sea.

B.B. SUMMARY.

1. A puddle is a very small portion of fresh, still water, with land all round it.
2. A pond is a very large puddle.
3. A lake is a very large pond.
4. A sea is a very large space of salt water with the land almost all round it.
5. An ocean is one of the largest divisions of water.

LESSON XIX

GULF, BAY, STRAIT, CHANNEL, CREEK

Apparatus.—A clay model illustrating the portions of water named in the lesson; diagrams illustrating these terms; Map of England; Map of the World.

From observation of the model and diagrams, class notes the following facts:—

I. Bay.

a. It is an inlet of the sea.
b. It has a wide entrance.
   1. Generally it is wider at the entrance than anywhere else.
   2. Compare with a bay window.
c. It is an expanse of water between two capes or headlands.

Definition.—To be given by the class—

A bay is a wide-mouthed inlet of the sea, not running far into the land, and lying between two capes or headlands.

Point out some bays on the Map of England.
Barnstaple, Cardigan, Morecambe.
II. Gulf.
   a. It is an inlet of the sea.
   b. It cuts more deeply into the land than a bay.
   c. It has a narrower entrance than a bay.

Definition.—To be given by the class again—
   A gulf is an inlet of the sea with a narrow entrance, and going farther into the land than a bay.

Map Illustrations.—The Scotch and Irish lochs or firths afford the best.

Turn to the Map of the World and the Map of Ireland, and point out the
   Gulf of Lyons.          Dingle Bay.
   Gulf of Genoa.         Bantry Bay.
   Gulf of Siam.

Let the class carefully observe the shape of these, and measure the accuracy of their titles by the definitions of Bay and Gulf. The class will then observe that—
   a. These gulfs are more like bays.
   b. The bays are more like gulfs.
   c. In some cases the names seem to be given indiscriminately.

Contrast bay and gulf with promontory, cape, &c.

III. Straits.
   a. They are a portion of water with land on each side.
   b. They are narrow.
      1. Strait means narrow.
      2. They are sometimes called Narrows. {Tell this.
   c. They are open at both ends.
   d. They join two larger portions of water.
Definition.—A narrow portion of water joining two larger portions.

Map Illustrations.—Dover, Menai, Gibraltar.

Why Straits and not Strait?

The notion of two banks or sides is always present to the mind.

Contrast strait with isthmus.

IV. Channel.
The class will observe that a channel is like a strait, only it is larger and broader.

Map Illustrations.—English, St. George’s, North.

Contrast the Bristol Channel with the others, and so lead the class to observe that the name is not always accurately used.

V. Creek.
a. It is a very small inlet.
b. It is something like a small river.
The name is sometimes so used (Deptford Creek).
c. It is also something like a tiny gulf.

Definition.—A very small and narrow inlet of the sea.

B.B. SUMMARY.

1. A bay is a wide-mouthed inlet of the sea, not running far into the land, and lying between two capes.
2. A gulf is a narrow inlet of the sea, going farther into the land than a bay.
3. A strait is a narrow portion of water joining two larger portions.
4. A channel is a larger and broader strait.
5. A creek is a very small and narrow inlet of the sea.

Lesson XX

Harbours

Apparatus.—Map of England; coloured chalk; model of a harbour; pictures of rocky coasts and of harbours.

1. Get children to imagine that they are suddenly caught in a rain and wind storm. They might run for shelter into a house, or barn, or shed. Or failing any of these, they would take shelter on that side of a wall, or hedge, or tree that was away from the wind.
2. Show a picture of a rocky coast. Describe a storm at sea, and the imminent danger which a ship would run of being dashed against rocks. The ship wants a shelter, just as the children required shelter in the rain storm. Such a shelter is called a **harbour**.

3. Introduce model of a harbour with two small boats, one inside and one outside the harbour. Agitate water outside the harbour. Get class to notice that the boat inside is but little affected.

4. Let children examine Map of England and point out some places that they would imagine would be suitable for harbours. Review lessons on **Bays** and **Gulfs**, and get children to realise that a **bay or gulf** often forms a capital **harbour**.

5. Show position of **Milford Haven**. Draw Fig. 142 on B.B., and show that, being very nearly land-locked, Milford Haven is very suitable as a harbour. Contrast the exposed position of a ship in St. Bride's Bay with the sheltered position of a similar ship in Milford Haven.

6. Show position of **Plymouth Sound and Harbour**. Draw Fig. 143 on B.B. Contrast the comparatively wide entrance to the Sound with the nearly closed entrance to Milford Haven. Tell how this has been
partly remedied by the erection of the enormous Plymouth Breakwater. Show the appropriateness of the term break-water.

7. Deal in a somewhat similar way with Portsmouth Harbour (Fig. 144).

8. Get class to compare the number of gulfs and bays on the East Coast with those on the South and West
Coasts, and infer that the harbours are not very good on the East Coast.

9. Draw Figs. 145, 146, on B.B. Show that the sand-banks act something like the Plymouth breakwater, and afford protection to ships. Such protected places are often called Roadsteads or Roads. Show the position of the Yarmouth Roads and of the Downs. Carefully distinguish from the North and South Downs.

10. The necessity for artificial harbours, as at Dover, Folkestone, &c., may be dealt with.
LESSON XXI

WAVES

Apparatus.—*A large vessel of water; bellows; Map of England; tumbler; pair of scales; piece of string; large glass vessel; two small weights; two bits of string; two small corks; B.B.*

I. Develop the Idea.

1. Take a large vessel. Fill it (nearly) with water. Blow on it. *Ripples are formed.* Class to define ripples.

**Definition.**—Ripples are small waves caused by wind blowing on the surface of the water.

2. Drop a stone or some solid body into the vessel. *Concentric ripples appear.* Put the hand a little way into the water. Move it about. *Waves are formed.* Ask for river experiences. Steamboats, &c., disturb the surface of the rivers and cause waves.

3. Blow harder on the surface of the water (use a pair of bellows). *The ripples or waves are larger than in (1).*

4. Ask for seaside experiences, and elicit that—
   a. On calm days there are no waves.
   b. With a little wind the waves are small.
   c. The greater the wind, the greater the waves.
   d. On very windy, stormy days, the waves break and dash on to the beach and are broken into foam. They are called *Breakers.*

5. Class should now define waves and breakers.

Waves are large ripples, or risings and fallings of the surface of the water caused by some disturbance of the water.

Breakers are large waves which dash on to the beach and break up into foam.

6. Tell the class that breakers are met with right out at sea, where there is no shore or beach.
   a. Point to the *Dogger Bank* (in North Sea), and the *Goodwin Sands* (off Kent coast).—Sandbanks.
   b. Point to the *Eddystone Lighthouse.*—Rocks.
7. The definition of breakers should now be modified.

Definition.—Breakers are waves which dash on to the beach, a sandbank, or a rock, and are broken into foam.

The breaking of the wave might be explained by the friction of the beach on its bottom part, and by the backwash of the previous wave. The top part, meeting with no such friction or obstacle, rushes on faster than the lower part, and so topples over.

![Fig. 147.](image)

II. Explanation of Wave Movement.

1. Take a small vessel (tumbler will do). Fill with water. Press hand on the water. Water overflows. Argue that when the surface of the water is pressed down at one point, or in one place, the other parts rise.

In other words, the equilibrium of the water is disturbed. The teacher might further illustrate by a pair of scales. Their ordinary position is one of equilibrium (scales level). If one scale is pressed down the other rises.

2. Argue that the force of the wind forces down the surface of the water at one place, and the equilibrium being disturbed, it rises at another place.

3. But the waves seem to move forward. Elicit this fact by questioning.

Let two boys hold a piece of string. Tell one boy to shake his end. Wave-like motions are produced. A bit of wood should be tied to one part of the string, and the class should be invited to observe that the wood does not move forward, but up and down only.

Argue from this experiment that the water of the wave seems to move forward, but does not really do so.
III. Names of the Various Parts of Waves.

Explain by diagram on the B.B.

A, B, C = crests or tops of waves.
T = hollows or troughs of waves.
AB or BC = the length of a wave (the distance from one crest to the next).
AD or BE or CF = the height of a wave (the perpendicular distance from trough to crest).

![Diagram of Waves](image)

IV. Waves are Surface Movements.

This fact can be demonstrated by the following experiment:

Get a glass vessel. Nearly fill it with water. Take two small weights and tie a piece of string to each; lengths to be such that one will just reach the surface of the water, the other not. Tie a small cork to the free end of each string. Put both in water. Note—

a. Both are motionless.
b. Blow on the surface of the water gently. A moves, B does not.
c. Increase force of wind until B moves. A is moved more violently.
d. From these experiments argue that waves are confined to the surface and a relatively small depth below.

![Experiment Diagram](image)

B.B. SUMMARY.

1. Waves are regular risings and fallings of the surface of the water.
2. Breakers are waves which dash on to the beach, a sandbank, or a rock, and are broken into foam.
3. Waves seem to move forward.
LESSON XXII

BEACHES

Apparatus.—Clay model of a beach; water; shallow tray; two pins; some very small stones; some pebbles; sand; flint stones; piece of chalk rock containing flint; sandstone; B.B.

I. Introduction.

Elicit by questioning that—
1. Some of the children visit the seaside or the lakes.
2. They spend some of their time on the beach or shore, some on the coast.
3. Some beaches are stony, some sandy, some muddy.
4. The nature of the coast varies very much at different seaside places—high, low, rocky, grassy, &c.

Note.—If the teacher is placed in a district where none of the children have ever been to the seaside, he must, with the aid of pictures and diagrams, help the class through this introductory part of the lesson.

II. Definitions.

1. In a shallow tray quickly make a clay model to show land, beach, and water. Mould the clay, but do not yet pour in the water.

2. Try a little further questioning, and elicit that—
   a. Sometimes the sea was high up the shore—high water.
   b. Sometimes it was low down—low water (Fig. 150).

   If there is a tidal river in the school neighbourhood, use it in illustration of these facts.
c. Sometimes they could get on to only a little strip of the beach, or not on to the beach at all—at high water. The water would flow over them, or the waves would wash over them.

3. Now pour in a little water into the tray. Let it represent low water. Mark the point on the clay by a pin stuck into the clay horizontally. Pour in more water to a sufficient height to represent high water. Mark with pin again.

4. Compare the model with the seaside, and elicit that when they were on the beach they were always somewhere between the two points marked by the pins, i.e. between high and low water (or between high and low tide).

5. Class should now be called upon to define a beach.

Definition of Beach.—The shore between high-water mark and low-water mark.

Definition of Coast.—The land next to the beach.

III. Kinds of Beaches.

A. Shingle Beaches.

1. Pour out the water from the model. Take some minute stones, cover the beach with them. Tell that such a beach is called a shingle beach. Ask class to name some shingle beaches (Brighton, &c.).

2. The definition should now be given by the class—

A shingle beach is one covered with stones.

3. Now show some smooth round pebbles. Tell class that these came from a beach, or are like the stones on a beach.

4. Definition should now be amended to—

A shingle beach is one covered with smooth, roundish stones.

B. Sandy Beaches.—Remove stones. Cover beach with sand. Ask for examples (Ramsgate, &c.), and have the definition given.

C. Mud Beaches.—Proceed as in the previous cases. Elicit (if possible) that some beaches may be a combination of two or more of these.
IV. Formation.

1. Show some pebbles. Let class handle them.
   a. They are hard.
   b. Rub two together; little or no powder comes from them.
   c. Class then to infer that—

   A shingle beach is formed where the coast rocks are hard.

2. Show flint stones, also pieces of chalk rock containing flint. Let class scratch them; rub them together.
   a. The flint is hard.
   b. The chalk is not so hard.

   Explain that the waves wash away the soft chalk and leave the flints on the shore.

   Inference.—Shingle beaches are formed where the coast is made up of soft and hard rocks.

3. Proceed in the same way with a piece of sandstone.

   It is soft.

   Inference.—Sandy beaches are formed where the rocks are soft.

4. Explain mud beaches in the same way.

   B.B. SUMMARY.

   1. Beach—shore between high and low water.
   2. Coast—land next to the beach.
   3. Shingle beach—formed from hard rocks by the waves.
   4. Sandy and mud beaches—formed from soft rocks by the waves.

LESSON XXIII

CORAL REEF

Apparatus.—Some hydrias; hand-lens; coral; large sketch of piece of coral; some chalk; clay models of fringing and barrier reefs; model of an atoll; B.B.; coloured chalks; red coral necklace.

I. Coral.

1. Show some hydrias to the class.

   Note.—Hydrias are small, varying from a quarter to five-eighths of an inch in length. When they draw themselves in (retract themselves), they look like small rounded particles of jelly. They are found attached to water-weeds by a foot which acts like a sucker, or hanging free, with the foot at the surface of the water and tentacles spread out below. They thrive well in a small window aquarium with water-weeds. Transfer some to a shallow vessel, and observe with a hand-lens. If hydrias are not available, show a sea-anemone.
Note their long cylindrical bodies and their tentacles. Tell class that the _hydra_ is the same kind of animal as the _coral_, and very much like it.

2. Show piece of coral; sketch on B.B. (Fig. 152).
   a. Class will note that the word "coral" is used both for the animal and for the rock which it forms.
   b. A good large sketch of the piece of coral might be prepared before the lesson. It would be more accurate than the B.B. sketch. Show a piece of red necklace, and explain that the coral that made this is not the island-building coral.

![Fig. 151.—Hydra.](image1)

![Fig. 152.—Small piece of coral, magnified, showing the extended Tentacles of the Coral Polyps.](image2)

Note the following points from the sketch:

a. The tentacles, by which it gets its food.

b. The lower portion. This is embedded some distance in the piece of coral. It "makes" chalk (carbonate of lime) from the sea by means of this portion.

   Show some chalk.

c. On the left, in the centre, the scar of one, which has died and dropped off.

d. The trunk-like body (piece of coral). This is a piece of limestone, and has been deposited by the coral animals.

3. Now contrast the coral and the hydra. They are both animals, but class should note the following differences:
Coral.  Hydra.
1. A salt-water animal.  A fresh-water animal.
2. Fixed.  Floats about.
4. Lower portion embedded.  Lower portion not embedded.
5. Smaller than hydra.  Larger than coral.

II. Kinds of Coral Reefs.—All built by the coral animals.

I. FRINGING REEFS.—Make a clay or sand model of a fringing reef. (Do not mention name yet.)

Note.—Mould an island in a shallow tray. Build a fringe reef round it close to the land. Powder the reef with chalk. Pour in water.

Class should note from the model that—

a. The reef extends outwards from the shore (Fig. 154).

b. There is no room for ships to sail in between the reef and the shore (Fig. 154).

c. The reef is like a fringe round the shore (Fig. 154).

d. It is called a Fringing Reef.

II. ROCKY ISLAND.—Make a model of a barrier reef.
(Do not mention name.)

Note.—
1. Build the island lower than in the fringing reef.
2. Place the barrier reef round the island some distance from the shore, and parallel or concentric with it.
3. Powder reef with chalk.
4. Pour in water.
Class to note the above facts from the model, and then define a reef—

A reef is a chain or range of rocks lying at or near the surface of the water.

3. ATOLLS.—Ring-shaped islands.

III. Where Coral is Found.
In the oceans and seas of the Torrid and warm Temperate Zones. (The teacher could point to the islands of Polynesia and the barrier reefs of Australia.)

B.B. SUMMARY.
1. A reef is a chain of rocks lying at or near the surface of the sea.
2. There are three kinds of coral reefs—
   a. Fringing Reefs—those close to the shore; no channel for ships.
   b. Barrier Reefs—farther from the shore, parallel to it; a channel for ships.
   c. Atolls—ring-shaped islands.

LESSON XXIV
DESERTS

Apparatus.—Map of World; pictures of camel, oasis, &c.

1. Contrast state of roads, meadows, brooks, &c., after periods of rain and drought. Connect the absence of rain with partly or completely dried-up brooks or rivers and partial or complete absence of vegetation.

2. If the children live near some sand dunes, get them to contrast the scanty vegetation on them with the more luxuriant vegetation on other soils.
3. Tell class that in some parts of the world there are large tracts of country where vegetation is more or less scanty or at times altogether absent. Tell the term **Desert**.

4. Show the position of the *Sahara* on the Map of the World. Get class to note the absence of rivers, and infer the more or less complete absence of rain and vegetation.

5. A great part of the *Sahara* is a sandy waste (show the appropriateness of the term a *sea of sand*), but in parts, fertile spots called **Oases** are found, and at times after rain (which in some parts does sometimes fall), beautiful flowers suddenly spring up, only to be as suddenly destroyed in the succeeding period of drought.

6. Ask children to compare their experience of walking along a hard road with that of walking over soft snow, or through a ploughed field, or over heaps of dry sand. Their feet sink into the snow, &c. A horse's feet would sink into loose sand in the same way.

Hence infer that **neither a horse nor a man is suitable for crossing a desert**.

Describe the broad snowshoes which men employ in cold countries for walking over the snow.

7. Introduce picture of *Camel* (Fig. 156); draw attention to the large pads on the feet (Fig. 157); tell that the foot spreads out when placed on the ground.

8. Other peculiarities of structure that make the camel suitable for crossing a desert are:—

   a. Its capacity for storing up water in its second stomach, which enables it to go for nearly a week without drinking.

   b. Its hump, consisting chiefly of fat, which keeps the camel alive when there is no food. At the end of a long journey without food the hump almost disappears.

   c. Its shaggy overhanging eyelids, which protect its eyes from the sand and sun.

   d. Its nostrils, which close to a narrow slit, and thus exclude the blown sand.
9. Draw a word-picture of a journey across a desert —the loading of the camels, the weary march, the scorching sun, the blinding sand, the cold nights, the intolerable thirst, the delights of the oasis, &c.

10. **Other Meanings of the Term "Desert."**

The term "desert" is often used to denote a more or less flat district which is uninhabited (i.e. deserted). Thus the Steppes of Russia, the Pampas of South America, the Prairies of North America are sometimes termed Deserts.
LESSON XXV

PUMICE-STONE AND VOLCANOES

Apparatus.—Pumice-stone; coal-dust; tobacco-pipe; iron slag; piece of coke; wooden box with a hole about an inch in diameter; a flour-dredger or pepper-box; sand; Maps of Europe and England; picture of a volcano in eruption.

1. (a) Heat some coal-dust in a clay tobacco-pipe or in an iron vessel (see Lesson XIII. Standard III.). Compare the product with a piece of coke. Draw attention especially to the "air-holes" in the coke.

(b) Show a piece of iron slag. Get class to see that it has "air-holes" very similar to those in the coke.

(c) Show a piece of pumice-stone. Get class to notice that it is like the coke and the slag, insomuch as it possesses "air-holes."

The children have seen the coke made by subjecting the coal to heat. Some of them will know that the iron slag was produced by heat in a furnace. Get them to infer that the pumice-stone was probably formed by the action of heat.

2. Proceed to explain that the heat that formed the pumice-stone is found in the interior of the earth.

The earth was once red-hot, and has gradually cooled. The outside has cooled first, while the inside has retained much of its heat. Compare with a pudding, which may be comparatively cold on the outside, but which when cut is found to be quite warm inside.

3. Draw Fig. 158 (without the vent), but do not let class suppose that the whole of the interior of the
earth is a mass of fire. Much of the earth's interior probably consists of very hot rock.

4. The heat in some way or other causes a crack or hole in the earth's crust. *(Compare with the cracking of lamp chimney by heat.)* This hole or vent in the earth's crust is called a **Volcano.** *(Complete Fig. 158 on B.B.)* Through this hole, steam, ashes, &c., are forced up. The ashes rise in the air and fall again round the hole.

5. Introduce box with hole in lid. Sprinkle sand from flour-dredger or pepper-box from above. Let class note the way in which the sand arranges itself round the hole.
   a. Some falls directly into the hole or vent.
   b. Some falls on or near the top and slips down the short slope towards the hole or vent.
   c. Some falls on or near the top and slips down the long slope away from the hole or vent.

![Fig. 159. Diagram showing the way in which the Sand arranges itself round the Hole in the Box.](image)

Draw Fig. 159 on B.B., and compare with the manner in which the ashes, &c., fall round the vent of a volcano (Fig. 160).

![Fig. 160. Diagram of a Volcano.](image)

In time, a hill or mountain will be formed from the matter thrown out of the volcano. Teach the term **Crater** or **Cup.** Show appropriateness of term **cup.**
6. Show a picture of *Vesuvius* or any other volcano in eruption. Show position of Vesuvius on Map of Europe.

7. Explain that some volcanoes send forth melted rock or lava, which when cool may become pumice-stone.

Lava is so called because it *washes* the sides of the volcanic cone. Compare *lavatory*.

I. Kinds of Volcanoes.

1. **Living** (or active) volcanoes, which eject ashes, &c., almost continuously.

2. **Sleeping** (or dormant) volcanoes, which erupt at intervals.

3. **Dead** (or extinct) volcanoes, which have not erupted for ages.

Part of Snowdon is the remains of a "dead" volcano.

II. Definition of a Volcano.

A volcano is a hole in the earth's crust from which steam, lava, or ashes are or have been thrown.

**Some Mistakes about Volcanoes:**

1. *A volcano is a burning mountain.*—As we have seen, a volcano need not be a mountain, or even a hill. When things burn they become smaller. When a volcano is active, it throws out matter which causes its cone to become larger. A volcano need not be a mountain, and it never burns.

2. *A volcano throws out flames.*—The red-hot matter at the bottom of the vent or hole throws a red reflection on the clouds of steam, &c., above the volcano, just as the reflection in the sky of a building on fire causes the sky to seem on fire too.

B.B. SUMMARY.

A volcano is a hole in the earth's surface out of which steam, lava, or ashes are or have been thrown.

**Kinds:**

- Living volcanoes—Stromboli.
- Sleeping volcanoes—Vesuvius.
- Dead volcanoes—part of Snowdon.
Apparatus.—Ice, water, freezing mixture of equal parts of pounded ice and salt, medicine bottle, cork, string.

1. Fill the medicine bottle full of water. Cork it, and tie the cork down with string. Insert in the freezing mixture. Do this in view of the class about a quarter of an hour before the lesson commences. At commencement of lesson let a child feel the freezing mixture and take the bottle out.

The water has turned into ice and the bottle has broken.

Cold causes water to turn into ice, which takes up more room than water.

2. Place pieces of ice, cork, and wood in water. Ice, cork, and wood float in water, but the ice floats deeper down in the water than the wood or the cork.

Ice is lighter than water, but not much lighter. Connect with the experiment in (1).

3. Measure about how much ice is above, how much below the water (Fig. 161).

About nine times as much ice is below as above the water.

4. Show picture of an iceberg (Fig. 162). Compare and contrast the iceberg in the picture with the piece of ice floating in the water (Fig. 161). Explain the term Ice-berg.

5. Point out the great danger icebergs are to ships.
I. Formation of Icebergs.

Refer to *Glaciers*. Picture a glacier being forced into the *sea* instead of being forced down a valley. Draw a figure on B.B. like Fig. 163.
Push cork down to the bottom of some water; note that owing to the upward pressure of the water, the cork is forced up directly the pressure is removed.

Apply this to that part of the glacier which has been thrust into the sea. Get children to explain that the upward pressure of the sea will force the ice upwards (see lesson on *A Glass of Sea-Water*), and at last snap it off. The farther end (i.e. the seaward end) has been partly melted by the sea. The nearer end (i.e. the landward end) is the heavier, and when the mass snaps off will turn downwards, forming an iceberg.

**II. Where Icebergs are found.**

In the Frigid Zones. Some, however, float about halfway into the Temperate Zones, where they melt. (See lesson on *Zones and their Characteristic Products*, p. 178.)
LESSON XXVII

SNOW AND GLACIERS

Apparatus.—Snow in pail; loaf-sugar; chalk; model of a glacier (powdered chalk can be used to represent the ice); picture of a glacier (Fig. 164); maps of Europe and England.

(This lesson should be given in snowy weather.)

I. Snow.

1. Ask children for colour of snow; compare with loaf-sugar, contrast with chalk.

Snow is white and sparkles much like sugar.

Fig. 164.—Glacier Landscape, showing the origin in distant snowfields and the river flowing out from the archway of ice at the end. On the surface are seen great fissures (crevasses), lines of rubbish (moraines), and a pillar of ice capped by a block of stone (glacier table). In the foreground are shown ice-worn hummocks of rock (roches moutonnées) and transported blocks of stone.
Sugar is made up of crystals, therefore **snow is composed of crystals**.

Draw a few of the forms in Fig. 165 on B.B.

2. *(a)* Make some snow into a snowball; press very hard; cut the snowball into halves.

A hard core of something very like ice is found inside.

*(b)* Ask boys which is the harder to clear away—the top or the bottom of a snowdrift. The bottom is "caked," and therefore harder to clear away.

The pressure of snow above hardens the snow below, and at last turns it into ice.

II. Recapitulation of Lesson on Mountain.
Recapitulate lesson on mountain, dealing especially with that part detailing how some mountains are covered with perpetual snow. Tell that the higher valleys also will have perpetual snow.

III. A Glacier.
A. **Upper Part.**
1. Introduce model. Draw attention to the higher valleys between the peaks. Draw Fig. 166 on B.B., and by means of previous experiments with snow, get children to understand that the pressure of the upper layers of snow harden the lower layers into ice.

2. Place a piece of ice on a slightly sloping board, press upon it from above, and demonstrate that the ice slips from under the pressure and slides down the board.

B. **Middle Part.**
1. Draw attention to the *lines of rock rubbish* in the glacier model; show also pictures in illustration.
2. Recall lessons on a River, especially the fact that stones, &c., were deposited as the water began to slow down.

![Diagram of a River](image)

**Fig. 166.**

Compare with glacier, and argue that the heaps of rubbish are obtained from the land over which the glacier moves, and that the *side rubbish heaps* are deposited at the sides because there the glacier moves very, very slowly.

Tell class that a glacier moves very slowly—at most, only a few feet in a year.

3. Explain formation of *middle rubbish heap* as the junction of two or more side rubbish heaps of "tributary" glaciers (Fig. 167).

![Diagram of a Glacier](image)

**Fig. 167.**

4. Try to bend a piece of ice. It cracks. Press pieces together. They commence to "stick" to each other. Draw Fig. 168, and infer that the ice in trying to bend over will crack.

Explain that these *ice-cracks* are very dangerous, and also the reason people are often roped together when crossing a glacier. If possible, show picture in illustration.
C. LOWER PART.
1. Draw attention to the end rubbish heap on model.
2. Ice when melted becomes water. As the ice of the glacier is pushed farther down the valley, it reaches warmer and warmer regions, and by-and-by melts, giving rise to rivers. The river is not able to carry all the "rubbish," and so a great part of it is left behind.

![Fig. 168. Longitudinal Section of a Glacier, showing large Crevasses at b on the steep slope.]

IV. WHERE GLACIERS ARE FOUND.
In many mountainous countries, especially in Switzerland.
Show position on Map of Europe.

![Fig. 169. Striated Block or Scratched Stone from a Glacial Deposit.]

Explain that in these countries many rocks are found scratched, as shown in Fig. 169. Draw on B.B. Tell that we know that this scratching was done by a glacier.
V. Where Glaciers used to be Found.
Tell class that in Wales and in Cumberland (show on map) rocks scratched in an exactly similar way are found. Ask what we can infer—that glaciers were once found in England. Make a further inference as to the climate at that time.

LESSON XXVIII

RIVERS AND GLACIERS

(Comparison and Contrast.)

This lesson is mainly recapitulatory. The teacher should gather the points one by one from the class, and arrange them as shown in the B.B. sketch.

I. Points of Resemblance.
1. Both begin in high ground and finish lower down.
   Compare and contrast "snow-basin" and "end rubbish heap" of glacier with source and mouth of river.
2. Both move.
3. Both move faster in the middle than at the sides.
   Connect the "side rubbish heaps" of glacier with the stones, gravel, &c., frequently found on the banks of rivers.
4. Both "wear out" the country over which they travel.
5. Both transport rocks large and small from one part of the country to another.
   Compare the delta of a river with the "end rubbish heap" of a glacier.

II. Points of Difference.

<table>
<thead>
<tr>
<th>RIVERS.</th>
<th>GLACIERS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composed of water.</td>
<td>Composed of ice.</td>
</tr>
<tr>
<td>Move more or less quickly.</td>
<td>Move very slowly.</td>
</tr>
<tr>
<td>Found in all parts of the world.</td>
<td>Found only in the upper</td>
</tr>
<tr>
<td>Are of all lengths, up to</td>
<td>valleys of high mountains.</td>
</tr>
<tr>
<td>about 4000 miles.</td>
<td>Are rarely more than 10 or</td>
</tr>
<tr>
<td>Are very useful as means</td>
<td>12 miles long.</td>
</tr>
<tr>
<td>of communication.</td>
<td>Are not useful as a means</td>
</tr>
<tr>
<td></td>
<td>of communication.</td>
</tr>
</tbody>
</table>
III. Definition.

A glacier is a river of ice.

B.B. SUMMARY.

<table>
<thead>
<tr>
<th>Rivers</th>
<th>Glaciers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin high, finish low.</td>
<td>Wear out country over which they go.</td>
</tr>
<tr>
<td>Move faster in middle than at sides.</td>
<td>Ice.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water.</th>
<th>Ice.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move quickly.</td>
<td>Move slowly.</td>
</tr>
<tr>
<td>Found everywhere.</td>
<td>Not found everywhere.</td>
</tr>
<tr>
<td>Often long.</td>
<td>Always short.</td>
</tr>
</tbody>
</table>

Fig. 170.—A Glacier or Ice River.

LESSON XXIX

THE SHAPE OF THE EARTH
(First Lesson.)

Apparatus.—Cardboard circle; sphere; tin soldier; sketch on B.B. (Fig. 172).

It will be necessary for the teacher to give lessons on the circle, sphere, &c. (p. 72). If not already given, they may be well included in the Standard II. course.
I. Preliminary Idea of the "large size" of the Earth.
Ask children if they have ever heard of any one going abroad to live; further ask for names of countries to which those people have gone. Tell approximate time it would take to reach some of the countries mentioned, and infer that the earth must be a big place.

II. Only a small part of the Earth can be seen at the same time.
Ask for the names of the most distant objects that can be seen from the school. Ask, or if necessary tell, class how long it would take to reach those objects. Contrast with the time taken to reach some of the countries mentioned, and hence infer that we can see only a small portion of the earth at once.

III. The fact that the Earth seems flat is no proof that it is flat.
The canal is level, so is the river, the road, &c., and many boys and girls imagine the earth is flat. They have seen that a small part of the circumference of a large circle seems almost or quite straight (Lesson XL. Standard I.). They can see only a small part of the earth, so argue that although the part of the earth they can see seems flat, yet it might be a part of a very large circle.

IV. The Earth cannot be a circle, but must be a sphere.
1. Introduce cardboard circle. Put a tin soldier on the cardboard. Make him walk round part of the circumference, then make him walk at right angles (or squarely) to his former direction. Note that he falls off.
Ask children if they have ever heard of any one falling off the earth like the tin soldier has fallen off the cardboard. Argue that if the earth is circular, it must be "a circle every way." Ask for name of such a solid, and infer that it seems that the earth is a sphere.
2. Revise that part of Lesson XL. Standard I. dealing with the shadows cast by circle and sphere. Explain that the sun sometimes throws a shadow of the earth on the moon, just as the candle threw a shadow of the circle and sphere on the screen or wall. Explain that the shadow thrown on the moon is always circular (or round) (Fig. 171). Hence infer that the earth must be a sphere.

3. If children live near the sea, get them to describe the varying appearances of the same ship when seen at different distances on the sea.

If they do not live near the sea, draw on B.B. a picture like Fig. 172, and describe it. Recall Lesson XLI. Standard I., and argue that these appearances could not be seen on a flat body (Fig. 173), but only on a sphere.
B.B. SUMMARY.
The earth is large. We can see only a small part of it. The earth's shadow is always a circle. Ships at sea appear and disappear, just like the soldier did on the clay sphere.

LESSON XXX

THE SHAPE OF THE EARTH
(Second Lesson.)

Apparatus.—Clay sphere; tin soldier; cube, cone.

1. Get children to tell that the shape of the sun, moon, and stars is circular or round. Tell that we know that the sun, moon, and stars are spheres, and that if we could look at the earth from the moon, the earth would seem a sphere too. Show a picture like Fig. 174.

Fig. 174.—The Earth in Space.
2. (a) Take a clay sphere, ball, or globe. Make the tin soldier "walk" straight on along the sphere. Show how he would come back to the spot from which he originally started, no matter where he starts from and in what direction he goes, provided he keeps straight on in that direction.

(b) Make him "walk" in different directions along a cube, a cylinder, a cone, and contrast results with those obtained with the sphere. In some direction or other he "falls off" the cube or cylinder or cone, because he comes to a part where the body takes a sudden "turn." But the sphere has a gently "sloping" surface in every direction; there are no sudden "drops" or "turns," and so the tin soldier never falls off.

3. Tell children that a ship could set out from London and sail on, on, on, keeping as straight as possible, and would at last come back to London again. The ship would have sailed round the world.

Infer that we know that the earth is a sphere because ships can sail all the way round it and come back at last to the first starting-place.

B.B. SUMMARY.

The sun, moon, and stars are spheres.
The earth is also a sphere.
Ships can sail round the earth.

LESSON XXXI

SUMMARY OF THE PROOFS THAT THE EARTH IS A SPHERE

Recapitulate thoroughly the two previous lessons before giving this one. Advantage should be taken of comparison and contrast as shown below.
We know that the earth is a sphere because—
1. Its shadow is always a circle.
2. When a steamer approaches the land, we see the smoke first, next the funnels, and lastly the hull (i.e. we see the top thing first).
3. If a ship is steered as far as possible in the same direction, it comes back at last to its first starting-place.
4. The sun, moon, and stars are spheres.

If the earth were flat—
1. Its shadow would not always be a circle.
2. The hull would be seen first, next the funnels, and lastly the smoke (i.e. we should see the biggest thing first).
3. The ship would some time or other fall over the "edge."
4. The sun, moon, and stars would probably be the same shape as the earth.

B.B. SUMMARY.
The matter contained in the first column above.

LESSON XXXII
THE SIZE OF THE EARTH

Apparatus.—Clay sphere, or ball of wool or worsted, or hollow rubber ball; tape measure; pin; cricket-ball; paper circles of various sizes.

I. Recapitulation.
Recapitulate "The earth is a big place" (p. 165).

II. The Diameter of the Earth.
1. Recapitulate what is meant by the Diameter of a Sphere. Measure diameter of clay sphere (Standard I. Lesson XXXIX.).
2. Tell class that the length of the diameter of the earth is 8000 miles.
Try to give some idea (which will be at best but a poor one) of what is meant by a distance of 8000 miles, by some such exercises as the following, worked upon the B.B.

a. It takes a child about twenty minutes to walk a mile and about an hour to walk three miles. Show on B.B. that if his home were at the North Pole and his school at the South Pole, and he did not stop walking day or night, it would take him about 100 days to walk to school.
b. How long would it take a man to walk 8000 miles if he walked twenty miles every day?
c. If a train goes forty miles per hour, how long would it take to go 8000 miles? &c.

III. The Circumference of the Earth.
1. Revise what is meant by the Circumference of a Sphere, also the relationship of the lengths of the circumference and the diameter of a sphere (Standard I. Lesson XXXIX.).
2. From Standard I. Lesson XXXIX. infer that if the diameter of the earth is 8000 miles, the circumference should be a little over 24,000 miles.
3. Tell that the circumference of the earth is 25,000 miles.
4. Endeavour to give some idea of that distance by working on the B.B. sums showing—
   a. How long it would take a man to walk 25,000 miles at the rate of twenty miles per day.
   b. How long it would take a train to go 25,000 miles at the rate of forty miles per hour.
   Tell class that a fast steamer would take about eighty days to go round the world.

IV. The Sizes of the Sun, Earth, and Moon compared.

a. Distant objects appear smaller than they really are.
   1. Cut out two paper circles of equal size. Place one near the class, the other at the far end of the schoolroom. Note apparent size. Cut out a third circle, which, when placed before the eye, completely covers the distant circle.
   2. Repeat in playground.
   3. Get children to supply examples in illustration; e.g. the farthest house of a row of houses of equal size appears much smaller than the nearest one; the church spire appears higher than the distant hill, &c.

b. The sun is much larger than it appears to be.
   1. Take children into playground; provide them with cardboard circles of suitable size (about
the size of a halfpenny), and let them notice the apparent size of the sun. Ask if they imagine the sun is as small as it appears to be, and get them to reason that its apparent small size is due to its distance.

2. Tell children that the sun's diameter is over a hundred times greater than the diameter of the earth.

3. Draw on playground a circle 2 inches in diameter. Let this represent the earth. Draw another 17 feet in diameter, and tell the class that this circle would then represent the sun. The moon could be similarly represented by a circle half an inch in diameter.
4. Repeat in class-room on B.B., representing the sun, earth, and moon by circles, one-sixteenth of an inch (i.e. a dot), a quarter inch, and 25 inches in diameter respectively.

5. Illustrate still further thus: If we represent the earth by a pin's head, we can represent the sun by a cricket-ball (Fig. 175).

B.B. SUMMARY.

Earth. \{ Diameter, 8000 miles.  
\{ Circumference, 25,000 miles.

The diameter of the sun is over 100 times greater than the diameter of the earth.
The diameter of the moon is a quarter of the diameter of the earth.

LESSON XXXIII
THE EARTH IS NOT A PERFECT SPHERE

Apparatus.—Orange; knitting-needles; foot or yard measure; 305 sheets of paper (a book containing about 305 sheets, i.e. 610 pages, will do); a stick; a piece of string sufficiently long to attach to the stick and to draw a circle 25 feet 5 inches in diameter.

I. The Orange is not a Perfect Sphere.

Introduce an orange. Have the positions of the equator and the poles marked on it. Thrust knitting-needles through the orange, and thus determine the length of the diameters at the "poles" and at the "equator."

Infer that an orange is not a perfect sphere, but is flattened at the "poles."

II. The Earth is not a Perfect Sphere.

Draw Fig. 176 on B.B. Tell class that the figures represent the diameters of the earth at the equator and poles respectively.

Infer that the earth is not a perfect sphere.
III. But the Earth is much nearer a Perfect Sphere than the Orange is.

By subtraction let class discover that the difference in the diameters is 26 miles. Multiply the difference by 305, and the product (7930) is approximately the diameter of the earth at the equator. If we represent this diameter by 305, we should represent the diameter at the poles by 304.

Illustrate somewhat as follows:

\( a. \) Take 305 pages of foolscap or exercise-book paper. Suppose that pile of paper to represent the diameter of the earth at the equator (Fig. 177). Lift up one sheet. Then the remaining 304 sheets will represent the diameter at the poles (Fig. 178).

\( b. \) On school floor or playground draw a line 25 feet 5 inches (305 inches) long. Draw another line at right angles bisecting this line and bisected by it. Let its length be 25 feet 4 inches (304 inches). Draw circle, and represent the necessary flattening at the poles. (The "flattening" will be little more than the thickness of the chalk line.)

\( c. \) A man walking at the rate of 26 miles a day would take 305 days to walk a distance equal to the diameter of the earth at the equator, and 304 days to walk a distance equal to the diameter of the earth at the poles.

Measure the diameters of some oranges. The results will vary largely according to the orange.

IV. Summary.

Get children to see:

\( a. \) That the shape of the earth resembles the shape of the orange, insomuch as each is flattened at the poles.
b. That if we say that "the earth is round like an orange," we must recollect that the orange is very flat at its "poles," whereas the flatness of the earth at its poles is very, very small indeed.

B.B. SKETCH.

Fig. 176.

LESSON XXXIV

SOME TERMS CONNECTED WITH THE GEOGRAPHY OF THE EARTH

Apparatus.—Clay spheres; knitting-needles; school globe; picture of Arctic regions; tropical regions; coloured chalks; the world in hemispheres; school compass.

I. Axis.

Revise as in Standard I. Lesson XXXIX.

II. Poles.

1. Explain that the positions marking the ends of the axis are termed the "Poles."

2. Teach the terms NORTH POLE and SOUTH POLE. Connect with the north-seeking and south-seeking poles of a magnetic needle (Standard I. Lesson XXVII.).

   [There is no need at this stage to mention that the magnetic and geographical poles do not coincide.]

3. Show a picture of the polar regions, and detail the difficulties men have encountered in their search for the Poles.

   [Dwell upon the fact that the Poles are not things, but only names to indicate position.]

III. Equator.

1. Revise the term Circumference (Standard I. Lesson XXXVIII.).

2. Trace various circumferences on a clay sphere.

3. Introduce school globe. Note that it has on it
one specially marked circumference (the equator) equally distant from the North and South Poles.

4. Show that there are many "circumferences" but only one Equator of the earth, because the Equator is that circumference equidistant from the Poles (Fig. 179). Connect the term **Equator** with the word "equal."

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**Fig. 179.**—Globe, with Great and Small Circles.

**Fig. 180.**—Diagram to illustrate North and South Hemispheres; also Western and Eastern Hemispheres.
5. Insist upon the fact that the Axis and the Equator are imaginary lines; that the Poles are imaginary points; that they help us to mark direction, and are not real places.

IV. Hemisphere.

1. Trace equator on a sphere. Cut the sphere into halves, making two hemispheres, a north and a south hemisphere (Fig. 180). Have these two hemispheres pointed out on the globe. Get the class to observe that the north hemisphere is nearly all land, and the south hemisphere nearly all water.

2. Also cut a clay sphere into halves through the poles, making an eastern and a western hemisphere. Have these two hemispheres pointed out on the globe.

[An orange may be substituted for the clay sphere.]
3. Show maps of Eastern and Western Hemispheres, and indicate the position of England (Figs. 181, 182).

Fig. 182.—The Western Hemisphere.

B.B. SKETCH.
LESSON XXXV

THE GREAT ZONES AND THEIR CHARACTERISTIC PRODUCTS

Apparatus.—A ball, coloured chalks, bananas, coffee beans, dates, wheat, piece of white bear-skin, pictures of white bear, arctic and tropical scenes.

The Great Zones.
1. Children already know that the regions round the poles are very cold. Colour these regions white on the ball; tell that they are called the Freezing (or Frigid) Zone.

2. Tell that the region round the equator is very hot, and is called the Burning (or Torrid) Zone. Colour it red. Show picture of tropical forest.

3. Ask for position of England to be pointed out on the map of the eastern hemisphere. Show that it is neither in the frigid nor in the torrid zone. Let children contrast climate of England with climates of frigid and torrid zones. Summarise somewhat as follows: Neither our hottest nor our coldest days are too hot or too cold for work. Deduce that England has a mild climate. Name the zone in which it is situated as the Mild (or Temperate) Zone. Colour this zone green.

4. Draw attention to the bands of white, green, and red on the ball. Teach that the term zone means band or belt or girdle. Illustrate by belt round waist.

Characteristic Products of these Zones.
1. Introduce bananas, coffee beans, dates, corn. Ask which children have seen growing. Infer that corn is a product of the Temperate Zone.

2. Appeal to children’s experience that plants, &c., grow little, if at all, in cold weather, whereas they thrive well in warm weather; and get them to infer that the bananas, coffee beans, and dates come from the tropical and not from the frigid zone, and that
they would expect to find practically no plants in the frigid zone.

3. Introduce piece of white bear-skin or bear-skin muff. Show its suitability for keeping the hands warm. Infer that it must have belonged to an animal that lived in a very cold place (e.g. in the frigid zone). Show picture of polar bear amid the ice, and dwell on the suitability of the colour of its coat to its surroundings.

4. Name the horse as a characteristic animal of the temperate zone, the lion and tiger as characteristic animals of the torrid zone.

5. Let children copy the B.B. sketch in coloured crayons next drawing-lesson.

**B.B. SKETCH.**

```
NORTH POLE

FRIGID ZONE
(White Bear)

TEMPERATE ZONE
(Corn - Horse)

TORRID ZONE
EQUATOR
(Bananas, Coffee, Dates - Lion, Tiger)

TEMPERATE ZONE

FRIGID ZONE

SOUTH POLE
```

Fig. 184.
LESSON XXXVI
THE FORCE OF GRAVITY—THE PLUMB-LINE
(First Lesson.)

Apparatus.—Piece of wood; sheet of paper; piece of lead; string; school globe.

<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (a) Hold a piece of wood in the hand; let it go.</td>
<td>The wood falls to the earth.</td>
<td>All bodies, unless they are prevented, fall to the earth.</td>
</tr>
<tr>
<td>(b) Hold a sheet of paper out flat; let it go.</td>
<td>The sheet of paper falls slowly to the earth.</td>
<td>Sometimes we prevent bodies from falling to the earth by holding them.</td>
</tr>
<tr>
<td>(c) Roll the sheet of paper up into a ball; let it go.</td>
<td>The ball of paper falls more quickly to the earth.</td>
<td>Sometimes the air holds things up and prevents their falling to the earth.</td>
</tr>
</tbody>
</table>

2. (a) Place a piece of string on table; note that it is not straight. | ... | A piece of crooked string can be made straight by pulling it (i.e. by force). |
| (b) Let two children pull ends of string. | The string becomes straight. | Some force must be pulling this string straight. |
| (c) Suspend piece of lead attached to string. Note result (Fig. 185). | The string is straight. | |

Fig. 185. Fig. 186.
<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. (a) Suspend the lead and line from a support (for instance a gas-bracket). Burn string with lighted match or gas flame (Fig. 186).</td>
<td>The lead falls to the ground.</td>
<td>The force that was pulling the string straight was the same force which was pulling the ball towards the earth. [Teach the term Gravity.]</td>
</tr>
<tr>
<td>(b) Again suspend the lead and line (or weight and line) at a measured distance (say three feet away from the wall). Burn string. Note distance from wall of spot on which weight falls,</td>
<td>The lead strikes the ground three feet away from the wall.</td>
<td>Heavy things in falling to the earth fall in a perfectly straight line.</td>
</tr>
<tr>
<td>(c) Suspend lead and line over water (Fig. 187). [Show a plumb-line (Fig. 188) and explain its use.]</td>
<td>...</td>
<td>The direction of the plumb-line is a perfectly upright line.</td>
</tr>
</tbody>
</table>

Fig. 187.—Plumb-line Perpendicular to the Horizontal Surface of Still Water.

Fig. 188.
### Observations and Experiments

4. *(a)* Introduce clay sphere or school globe; stick pins in various parts of the sphere to represent the direction taken by the plumb-line in various parts of the earth.

*(b)* Draw diagram on B.B. (Fig. 189). Produce the lines \(a, b, c, d, e\) as dotted lines to centre.

### Results

The lines meet in what represents the centre of the earth.

### Inferences

All bodies fall or try to fall towards the centre of the earth.

The plumb-line points to the centre of the earth in a perfectly upright line.

---

**Fig. 189.** — O is the centre of the earth. The arrows \(a, b, c, d, e\) represent the directions in which things would fall at different parts of the earth’s surface.

---

**B.B. SUMMARY.**

Gravity is the force which draws all things to the centre of the earth.

The plumb-line points to the centre of the earth in a perfectly upright line.
LESSON XXXVII

THE FORCE OF GRAVITY

(SECOND LESSON.)

Apparatus.—School globe; clay sphere; a knitting-needle; some pins; two tin soldiers.


2. Introduce school globe. Let children find position of the British Isles upon it, and also a place (New Zealand) as near as possible on the opposite side of the globe.

3. Find two corresponding positions on the clay sphere, and stand a tin soldier on each spot. From observation of this model get children to reason:—
   a. That the people in New Zealand have their feet opposite to our feet.
   b. That the people in New Zealand seem to us to be hanging head downwards, and to be in danger of falling off the earth.
   c. That we seem to the people of New Zealand to be hanging head downwards, and to be in a similar danger of falling off the earth.

4. Get children to understand (from what they have learned in the preceding lesson) that a stone dropped by a New Zealander would fall towards the centre of the earth, and the New Zealander would say that the stone had dropped down.

Infer that:—

DOWN means towards the centre of the earth.

UP means away from the centre of the earth.

5. Further argue that it is not right to say that the New Zealander is hanging head downwards. His head is away from the centre of the earth, his feet towards the centre of the earth, just as our heads and feet are. When we are talking about the whole earth, we should not think whether a thing is up or down, but whether it is towards the centre of the earth or away from it.
6. From the previous lesson the children have learnt that the earth draws or tries to draw everything to its centre. Men are included among the things on the earth, and are everywhere being drawn towards its centre by the force of gravity, and consequently they do not fall off the earth.

7. Add some such example as the following: Push a knitting-needle through the clay sphere. Suppose that in the same way we could push an enormous pole through the earth. We should say that we were pushing the pole down, but the New Zealanders would say that they saw the pole coming up. Insist that “down” and “up” have reference to the centre of the earth.

8. Review: “A small part of the circumference of a very large circle seems like a straight line” (Standard I. Lesson XL.), and get children to reason that a man in going round the earth seems to be always travelling along a flat surface, because at any one time he can see only a very small part of the large circumference of the earth. He is in reality travelling along a surface which is curving so slightly that he does not notice the curve at all. Everywhere he has been he has looked up (i.e. away from the centre of the earth) at the sky, and down (i.e. towards the centre of the earth) at the sea and land. At last he reaches a spot where his feet are opposite to the feet of the people standing on the spot from which he started. But he does not think of this, because the earth’s surface has curved so gradually that he has not noticed it, and because “up” and “down” have always had the same meaning on every spot over which he has travelled.

B.B. SUMMARY.

New Zealanders stand with their feet opposite to our feet. Their heads do not hang downwards any more than our heads hang downwards.

Their heads are away from the centre of the earth (that is, UP), and their feet are towards the centre of the earth (that is, DOWN), just as our heads and feet are.
LESSON XXXVIII

DAY AND NIGHT

(First Lesson.)

1. Remind children of the following facts of common knowledge:

a. That in the morning they get up, breakfast, and come to school; at noon they go home to dinner; in the afternoon they return to school; in the evening they have tea; and at night they go to bed.

b. That it is light in the morning, noon, and afternoon; that in the evening the light becomes less and less; and at night it is quite dark.

c. That the morning, noon, afternoon, evening, and night are together twenty-four hours long, and that twenty-four hours make a day.

d. That a day is made up of two distinct parts—a period of light (called the day), and a period of darkness (called the night).

Note the double meaning given to the word “day.”

e. That in the winter they have to get up in the dark, and that they have to go home from afternoon school in the dark.

f. That in the summer they get up in the light, return from afternoon school in the light, and sometimes go to bed before it is quite dark.

g. That in the spring and autumn they get up in the light, and return from afternoon school when it is beginning to get dark.

h. That the days get longer and longer as spring advances, and shorter and shorter as autumn advances.

2. Summarise:

In summer the days are long and the nights are short.
In winter the days are short and the nights are long.
In spring the days get longer and longer and the nights shorter and shorter.
In autumn the days get shorter and shorter and the nights longer and longer.

3. Recapitulate Lesson XIX. Standard I., and connect the day with the sun and the night with the absence of the sun.

4. Recapitulate Lesson XXIII. Standard I., and dwell upon the fact that the sun is higher in the sky in summer than in winter.
5. Represent the path of the sun across the sky in winter and in summer (Fig. 190), showing that in winter the sun describes a small "half circle" and in summer it describes a larger "half circle."

B.B. SUMMARY.

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Days</th>
<th>Nights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>Getting longer</td>
<td>Getting shorter</td>
</tr>
<tr>
<td>Summer</td>
<td>Long</td>
<td>Short</td>
</tr>
<tr>
<td>Autumn</td>
<td>Getting shorter</td>
<td>Getting longer</td>
</tr>
<tr>
<td>Winter</td>
<td>Short</td>
<td>Long</td>
</tr>
</tbody>
</table>

![Figure 190](image)

**LESSON XXXXIX**

**DAY AND NIGHT**

(Second Lesson.)

**Apparatus.**—Candle or lamp; ball on knitting-needle; cone of black paper to represent shadow (Fig. 192).

**Note.**—The experiments should be worked on a dark afternoon. They can be repeated in the light by using the cone of black paper to represent the shadow.
Observations and Experiments.

1. (a) Place ball before lighted candle or lamp.
   (b) Note the direction and shape of the shadow (Fig. 191).
   (c) Substitute the cone of black paper for the shadow (Fig. 192).
   (d) Let the ball represent the earth and the candle or lamp the sun.

Results.

Half of the ball is illuminated by the light, half remains in darkness. The shadow is away from the light, and is conical in shape.

Inferences.

If the earth and the sun were quite still, half of the world would have perpetual day, and the other half perpetual night.

But this does not happen.

Therefore either the earth or sun moves.

2. Stick several pins in the ball; let the ball remain still; move the light round it at a uniform rate.

Every part of the ball is lighted up during half the time the lamp is moving round the ball.

The motion of the sun round the earth might be the cause of day and night.

3. Let the light remain still; rotate the ball on its axis, keeping the axis perpendicular.

Every part of the ball is lighted up during half the time of one rotation.

The rotation of the earth on its axis might be the cause of day and night.
<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Review the apparent daily motion of the sun (Lesson XXIII, Standard I.)</td>
<td>The sun rises in the east and sets in the west.</td>
<td>It seems as though the sun moves round the earth, and thus causes day and night.</td>
</tr>
</tbody>
</table>

**Fig. 192.**

5. Get a child to describe the appearance of trees, telegraph poles, &c., when viewed from a smoothly-moving railway train.

The trees, telegraph poles, &c., seem to be running away from the train, although we know that the train is running away from the trees and telegraph poles.

The fact that the sun seems to move is no proof that it does really move. It is quite possible that the earth moves and that the sun stands still.

6. Tell children that we are certain that the sun is still and that the earth rotates on its axis once in every twenty-four hours.

**B.B. SUMMARY.**

The earth rotates (turns) on its axis. The rotation of the earth causes day and night.
LESSON XL AND XLI

DAY AND NIGHT

(THIRD AND FOURTH LESSONS.)

Apparatus.—Ball and knitting-needle; black cone used in last lesson.

<table>
<thead>
<tr>
<th>Observations and Experiments</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. (a) Keep the knitting-needle perpendicular and rotate ball on axis before the lighted lamp; or, (b) Use the black cone described in the preceding lesson. Compare with earth and sun (Fig. 193).</td>
<td>Every point on the ball is for half of the rotation in the light, and for the other half of the rotation in the dark.</td>
<td>If the axis of the earth were upright (perpendicular) we should always have a day twelve hours long and a night twelve hours long. But days and nights in England are not of equal length. Therefore the axis of the earth cannot be perpendicular.</td>
</tr>
</tbody>
</table>

Fig. 193.—Diagram showing that if the Earth rotated on an Axis which was perpendicular, Day and Night would be of equal lengths in all parts of the World.

2. (a) Place the knitting-needle in a horizontal position and rotate ball on axis before the lighted lamp; or, | Half of the ball is always in the light, half is always in the darkness. | If the axis of the earth were horizontal, half of the world would have perpetual day, the other half perpetual night. |
Observations and Experiments.

(6) Use the black cone without the lamp.
Compare with earth and sun (Fig. 194).

Results.

Inferences.

From (1) and (2) it is evident that the axis of the earth is neither perpendicular nor horizontal.

\[ \text{SUN} \]

Fig. 194.—Diagram showing that if the Earth rotated on an Axis which was horizontal, one half of the World would have perpetual Day and the other half would have perpetual Night.

3. (a) Place knitting-needle in a slanting position towards the lighted lamp; rotate ball; or,
(b) Use the black cone without the lamp.
(c) Mark the positions of England and New Zealand on the ball. Sketch Fig. 195 on B.B.

(a) Ask at what seasons of the year we have long days and short nights.

The points near the north pole are always in the light; those near the south pole are always in the darkness.

The spot marked England is for a long time in the light, and for a short time in the darkness. New Zealand is for a short time in the light and for a long time in the darkness.

If the axis of the earth were always inclined towards the sun, the north pole would have perpetual day, England would always have long days and short nights, New Zealand would have short days and long nights, while the south pole would have perpetual night.

When it is summer in England the axis of the earth is inclined towards the sun.
Fig. 195.—Diagram showing that if the Earth rotated on an Axis which was inclined towards the Sun, the Days in England would be long and the Nights short. In Summer in England the Axis of the Earth is inclined towards the Sun.

Observations and Experiments.

<table>
<thead>
<tr>
<th>Observations and Experiments</th>
<th>Results</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. (a) Place knitting-needle in a position slanting away from the lighted lamp; rotate ball; or, (b) Use the black cone without the lamp. (c) Refer to positions of England and New Zealand on the ball. Sketch Fig. 196 on B.B.</td>
<td>The points near the south pole are always in the light; those near the north pole are always in the darkness. The spot marked England is for a short time in the light and for a long time in the darkness, &amp;c.</td>
<td>If the axis of the earth were always inclined away from the sun, the north pole would have perpetual night, England would always have short days and long nights, New Zealand would have long days and short nights, while the south pole would have perpetual day. In winter the axis of the earth is inclined away from the sun. Further infer that the earth must revolve or move round the sun as well as rotate on its axis.</td>
</tr>
</tbody>
</table>

Fig. 196.—Diagram showing that if the Earth rotated on an Axis which was inclined away from the Sun, the Days in England would be short, and the Nights long. In Winter in England the Axis of the Earth is inclined away from the Sun.

B.B. Sketch.

Fig. 195. | Fig. 196.
Lesson XLII

A Recapitulatory Lesson (Land)

Apparatus. — Clay model to illustrate definitions; picture and plan of clay model (a large coloured diagram will be better than the plan); Map of England; Map of the World.

From the clay model, the picture, and the diagram elicit that—

1. A Continent is the largest division of land. It contains a number of countries; e.g.—
   Europe, Asia, Africa, America, Australia.

2. A Country is a part of a continent under the same ruler; e.g.—
   England, France, Holland, Russia.

3. A County (or Shire) is part of a country; e.g.—
   Yorkshire, Kent, Devonshire.

Fig. 197.—Picture showing Definitions.
4. An **island** is a portion of land surrounded by water, and smaller than the neighbouring mainland; e.g.—
   Ireland, Great Britain, Anglesea, Man, Wight.

5. A **peninsula** is a portion of land nearly surrounded with water; e.g.—
   Cornwall, Caernarvon, Denmark.

6. An **isthmus** is a narrow piece of land joining a peninsula to the mainland; e.g.—
   Darien, Corinth, Suez.

7. A **cape** is a small portion of land jutting out into the sea; e.g.—
   North Foreland, Beachy Head, Land's End, Spurn Head.

8. A **mountain** is land that rises high above the land that surrounds it (Fig. 199);
   Snowdon, Scafell, Helvellyn, Skiddaw.

9. A **hill** is high land that does not rise so high as a mountain (less than 2000 feet); e.g.—
   Cotswold Hills, Downs, Chiltern Hills.

10. A **plain** is flat or nearly flat land that does not stand high above the sea; e.g.—
    Plain of York, Central Plain, Salisbury Plain.
11. A **Tableland** or **Plateau** is fairly level land lying high above the sea; *e.g.*—
*Dartmoor, the Peak.*

12. A **Valley** is low land lying between mountains and hills; *e.g.*—
*Vale of York, Vale of the Severn, Wye Valley.*

13. A **Beach** is that portion of the shore which lies between high and low water marks.

14. A **Coast** is land immediately next to the beach.

15. A **Desert** is a barren plain or tableland; *e.g.*—
*Sahara, Gobi, Central Australia.*

16. A **Volcano** is a hole or fissure in the earth's crust, through which smoke, flames, ashes, and lava are thrown.
These may collect round about the opening and form a conical hill or mountain.

**LESSON XLIII**
**RECAPITULATORY LESSON (WATER)**

*Apparatus.* — *As in previous lesson.*

From clay model, pictures, and diagrams elicit that—

1. An **Ocean** is one of the largest divisions of salt water; *e.g.*—
*Atlantic, Pacific, Indian, Arctic, Antarctic.*

2. A **Sea** is a very large space of salt water with land almost all round it; *e.g.*—
*Baltic, Mediterranean, Irish, Black.*

3. A **Lake** is still water surrounded by land; *e.g.*—
*Windermere, Derwent Water, Superior.*

4. A **Bay** is a wide-mouthed expanse of water running not far into the land, and lying between two headlands; *e.g.*—
*Tor, Cardigan, Morecambe, Mount's.*

5. A **Gulf** is an inlet of the sea with a narrow entrance, and going farther into the land than a bay.
*The Scotch, Irish, and Norwegian Fiords afford the best illustrations.*

6. A **Strait** is a narrow portion of water joining two larger portions; *e.g.*—
*Dover, Menai, Gibraltar.*
7. A **Channel** is a larger and wider strait; *e.g.*—
   *English, North, St. George's.*

8. A **Harbour** is a portion of water which is a place of security for ships from the storms and dangers of the sea; *e.g.*—
   *Portsmouth, Ramsgate.*

9. A **Roadstead** is a part of the sea near the shore where ships can anchor in safety; *e.g.*—
   *Yarmouth Roads, Solent.*

10. A **Seaport** is a town near the sea where ships go to load and unload their cargoes; *e.g.*—
    *London, Liverpool, Bristol, Plymouth.*

11. A **River** is a running stream of water, which seeks the lowest level, until it empties itself into another river, a lake, or a sea; *e.g.*—
    *Thames, Severn, Trent, Ouse.*

   a. The **Source** is the beginning of a river.
   b. The **Bed** of a river is the land over which it flows.
   c. The **Banks** are the land on either side immediately next to the river.
d. The **Right Bank** is the land bordering on the river on the right hand of a person facing the mouth of the river, or looking in the direction in which the stream flows.

e. The **Left Bank** is the land on the left hand of a person facing the mouth of the river.

f. A **Tributary** is a smaller river flowing into a larger one; *e.g.*

- Thames and Ouse tributaries.

g. A **Confluence** is the junction of one river with another.

h. A **Delta** is land lying between the various mouths of a river; *e.g.*

- Nile, Ganges.

i. The **Mouth** of a river is the part joining it with the sea.

j. An **Estuary** is a wide mouth of a river; *e.g.*

- Thames, Mersey, Ribble.

k. A **River Basin** is the land drained by a river and its tributaries.

l. A **Watershed** is the slope along which rivers flow.

m. A **Water-parting** is the summit of the opposite and neighbouring slopes forming two watersheds; *e.g.*

- Pennines, Cheviots.
STANDARD III
Cross of St. George.

Cross of St. Andrew.

Union Jack

Jack.

Cross of St. Patrick.
LESSON I

THE UNION JACK

Apparatus.—A Union Jack; pictures of “Herald” or of a Crusader; coloured chalks; strips of coloured paper for children; five-shilling piece; outline map on B.B. (see B.B. sketch).

I. Explanation of the term Union Jack.

Show a Union Jack. Explain the term Jack as the name of a coat once worn by a herald. Show picture of a Herald with an ornamented coat, or a picture of a Crusader. (Cf. Jack-et.) Proceed to explain that the patterns on these “Jacks” or coats were afterwards used to ornament flags.

Ask for a word similar to Union. Show that the expression Union Jack shows that two or more “Jacks” or flags have been united.

II. Preliminary Examination of a Union Jack.

Proceed to endeavour to separate the various flags. Get class to note the red and white upright cross, the red and white diagonal cross, the blue ground.

III. The Cross of St. George.

Select this as the most prominent feature of the Union Jack. Draw on B.B.

Show St. George and the Dragon on a five-shilling piece. Narrate story. Explain that he is the “patron saint” (i.e., the guardian saint) of England.

Ask child to show position of England on the B.B. map.

IV. The Cross of St. Andrew.

Trace the white cross on the Union Jack. Sketch the St. Andrew’s Cross on B.B.

Explain that St. Andrew is the patron saint of Scotland.
Have position of Scotland pointed out on map. Note its situation as regards England. Compare sizes of Scotland and England.

V. The Union of England and Scotland.

Explain that once England and Scotland had different kings, but that about 300 years ago the king of Scotland became king of England, the two "Jacks" or flags were united, and the two countries became known as GREAT BRITAIN. Show that Great Britain is an island.

VI. The Cross of St. Patrick.

Let children point out the cross that has not been dealt with.

Draw on B.B. Explain that St. Patrick is the patron saint of Ireland, hence the reason "Pat" is a favourite nickname for an Irishman.

Have position of Ireland pointed out on B.B. map. Compare sizes of Ireland and England. Show that Ireland is an island. Ask how we should get from London to Ireland.

VII. The Union of Great Britain and Ireland.

Explain that about 100 years ago Great Britain and Ireland were brought under the same government; the flag of St. Patrick was added to the Jack, and the Union Jack as we now have it was adopted.

VIII. Position of the British Isles as regards Europe.

Distinguish the term British Isles from Great Britain by showing the constituent countries of each. Name capitals. Have the boundaries named as indicated in B.B. map. Get class to define position as regards the Continent.

[The children can be now directed to make the various flags with coloured strips of paper, and the next drawing lesson they can draw the Union Jack, &c., with coloured crayons.]
B.B. SKETCH.

BRITISH ISLES.

Fig. 200.

British Isles. Great Britain. Ireland.
England and Wales. Scotland.
LESSON II

ENGLAND (Introductory)

Apparatus.—Relief model of England and Wales; Maps of England and Wales, the World; a paper triangle about the same size as the model.

[If the size of the class permit, it would be well to have the model on the floor (with the north of the model placed towards the north), and the class grouped around it.]

I. Size.

1. Place one pin on the model at Berwick-on-Tweed and another at the Lizard. Stretch a piece of cotton between. Have the length of the cotton measured by the scale of miles. Thus determine that England is about 420 miles long.

   Endeavour to give some idea of this length by some such questions as the following:—

   If the cotton represented a straight road from one end of England to the other, how long would a man take to walk along it at the rate of twenty miles per day? How long would a bicyclist take at the rate of sixty miles per day? How long would a train travelling at the rate of forty miles per hour take?

2. Show England on a Map of the World, and let the children point out some countries that are larger than England.

3. Draw a square with sides 1 ft. 3 in. long (Fig. 202). At A draw a square of \( \frac{1}{2} \)-inch sides. Tell the class that if the large square represents all the land on the globe, then the small square represents the size of England. [The area of England is about \( \frac{1}{9000} \) of the area of the land of the globe.]

   This illustration may perhaps help the children to understand the small area of England.

II. Shape.

Place the paper triangle over the model, and thus get class to notice that its shape is triangular.
III. Surface.

Direct attention to the model. Get children to point out where England is mountainous, where it is more or less flat.

**SUMMARISE** thus: **England is mountainous in the north and west, flat in the centre and east.**

IV. Rivers.

1. Get children to pick out the range of mountains that forms, as it were, the "Backbone of England." Draw attention to the distance of this range from the west and east coasts respectively.

![Fig. 202.](image_url)

2. Draw section on B.B. (Fig. 203) and get children to locate the long and the short rivers of the six northern counties.

3. Continue investigation for the rest of the country.

**SUMMARISE.**—The long rivers generally flow east, the short rivers west. Only one long river (the Severn) is on the western side.

V. Recapitulation.

Recapitulate lesson, this time using the Map of England, and summarise as shown in B.B. sketch.
Fig. 203.

B.B. SKETCH.

Fig. 204.
LESSON III

SLATE

Apparatus.—Specimens of shale of varying degrees of hardness; pieces of slate; fish glue; several tumblers or beakers; water; chalk; wall map; sketch map on cardboard or cartridge paper.

I. What Shale is.

Show a piece of soft shale; compare with hardened mud. Scrape some shale into clear water. The water becomes cloudy and muddy. Infer that shale is hardened mud.

II. Shale Compared and Contrasted with Slate.

1. Compare a piece of hard shale with a piece of slate. Scrape each into water. Note that in each case the water becomes more or less cloudy. **Shale resembles slate.**

2. Examine pieces of hard shale and slate more closely. Note that at the broken edges the shale is dull, whereas the slate is semi-crystalline. **Shale differs from slate.**

Explain that slate is an altered shale, and that the alteration has been produced probably by heat and pressure.

[Note.—Shale splits into layers in the plane of its stratification, slate in some direction other than that plane. To compare slate with shale because they each split into layers is tempting, but unfortunately not accurate without further explanation beyond the capacity of young children.]

**Summarise.**—**Hardened mud may become shale. Shale may become slate.**

III. Slate Contrasted with Chalk.

Examine each as regards hardness, and get children to observe that slate is hard, whereas chalk is comparatively soft.
If the children live in a chalk district, ask why roofs of houses are covered with slate (which has to be brought a long distance), and not with chalk (which is near at hand). If they do not live in a chalk district, then infer directly that chalk being soft, wears away under the action of the weather, whereas slate being hard withstands the weather.

IV. Where Slate is Found.

Extend the observations in the last paragraph to the effect produced by the weather on a hill made of slate and on a hill made of chalk. The slate hill would be comparatively unaffected by the weather; the chalk hill would become rounded, and, after a long, long time would become worn down to the level of the surrounding country.

Ask whether slate is likely to be found in a mountainous district or in a more or less flat region.

Further ask where the mountainous parts of England are, and infer that slate should be found in those parts.

The most mountainous parts of England are:

1. North Wales.
2. Cumberland.
3. Cornwall.

The slate-producing districts of England are:

1. North Wales (especially near Penrhyn).
2. Cumberland (especially near Keswick).
3. Cornwall (especially near Camelford).

Ask children to point out these districts on wall map, also corresponding positions on sketch map. Glue pieces of slate on the sketch map on the positions pointed out.
B.B. SUMMARY.

Slate.

Mud hardens and becomes shale.
Shale may become slate.
Slate is very hard, and is not worn away by the weather. It is found in mountainous parts.

LESSON IV

A SLATE QUARRY

Apparatus.—Wall map of England; sketch map showing distribution of slate; picture of a slate quarry; a block of slate; hammer; chisel.

Revision.—Ask where slate is found. Let children draw rough sketch map, showing positions of slate-producing districts.
[If the children live in a slate-producing district, a visit should be made to a slate quarry.]

I. Description of a Slate Quarry.
Show picture of slate quarry, and get children to notice:

1. The Quarry is open to the sky and is worked by
Fig. 206.—The Penrhyn Slate Quarries.
natural light, whereas a *Mine* is worked by artificial light.

2. The slate is worked in terraces, because the slate beds lie in more or less horizontal rows. Get children to reason that slate was originally deposited as mud in water (p. 206).

3. The "columns" left standing which are composed of useless slate or of some other rock.

4. The heaps of slate of poor quality hewn out in getting at the good slate.

5. The lines and trolleys for the conveyance of the slate.

II. Brief Description of Slate-Quarrying.

1. **Hewing.**—Take a block of slate; split block by means of chisel and hammer. Infer that in a somewhat similar way slate can be split from the mountain-side.

2. **Blasting.**—A hole is bored in the slate and filled with gunpowder which is exploded, and huge masses of slate are detached.

3. **Splitting and Sawing.**—*Roofing slates* are split from the masses of slate. *Large slabs* intended for table tops, cisterns, &c., are cut out by saws. *Writing slates* are polished generally with pumice-stone.

**B.B. SUMMARY.**

Slate Quarry—Open to sky.
Slate-Quarrying—Slate quarried in terraces.

1. Hewn or blasted.
2. Split for roofing slates.
3. Sawn for large slabs.
LESSON V
NORTH WALES

Apparatus.—Map of England; model of North Wales district; pictures of North Wales scenery.

General Directions.—Connect with the lesson on slate quarries. Describe an ascent of Snowdon. Any guide-book to Wales will give a readable account of such an ascent. Fill in sketch map as lesson proceeds.

I. Views from Snowdon.—[Get as many of the details as possible from observation of the model.]

Snowdon is the highest peak of a range of mountains—often called the Snowdon Range—which forms, as it were, the backbone of Carnarvon. From the summit to the north can be seen Anglesea, separated from Carnarvon by the Menai Strait, which is crossed by two bridges—one for foot-
passengers, called the Suspension Bridge, and the other a railway bridge, known as the Britannia Tubular Bridge. Both bridges start on the mainland from Bangor. Show picture. Nearer, Carnarvon Castle may be seen. Show picture of castle, and tell story of the first Prince of Wales. To the south may be seen Cader Idris, the giant of the Cader Idris range. Farther south still, and blue in the distance, rises Plinlimmon, the highest peak of the Plinlimmon Range. Have these pointed out on model and map.

II. The Heights of Snowdon, Cader Idris, and Plinlimmon.

From model infer that these are the three highest peaks in North Wales. Tell the height of Snowdon, 3571 feet. Get these figures recollected as follows: If the odd numbers 1, 3, 5, 7 be taken, and the 1 be put last, we have the height of Snowdon (3571) in feet.

Compare heights of other peaks as shown in B.B. Sketch.

III. Other important Facts connected with North Wales.

Rhyl, Llandudno, Dolgelly.—Favourite seaside resorts. Point out the proximity of sea and mountain.

Holyhead.—The packet-station for Ireland. Trace the course of the mail from London to Ireland.

Harlech.—Famous for its old castle. Let class read or sing "Men of Harlech."

Bala Lake.—The largest lake in Wales.

Welshpool.—Famous for its flannel.
LESSON VI

GRANITE

Apparatus.—A piece of granite for each child; several varieties of granite; chalk; some quartz crystals; some felspar; a few large flakes of mica; a sheet of glass; Map of England; pictures of London Bridge; Plymouth Breakwater, &c.

I. Granite contrasted with Chalk (Figs. 210, 211).

Get class to contrast granite with chalk, and note that chalk appears to be composed of the same kind of substance throughout, whereas granite seems to be composed of several substances.
II. Closer Examination of Granite.

Get some children to examine granite with penknives, and discover that some parts can, and other parts cannot, be scratched with a knife.

1. **Those parts that cannot be scratched with a knife.**—Infer that these portions must be the hardest parts, and note that they consist of clear glassy-looking material. Give the name quartz, and show some quartz crystals (Fig. 212). Demonstrate the hardness of quartz by showing that it will scratch glass.

2. **Those parts that can be scratched with a knife.**—A short examination will show that these parts are made up of two distinct substances:
   - a. One part that comes off easily in thin transparent layers, called **Mica**. Show specimen of mica.
   - b. Another part which consists of longish white, grey, or flesh-coloured layers, and which are scratched with difficulty with a knife, called **Felspar**. Show specimen of felspar.
III. Where Granite is Found.

Draw a diagram something like Fig. 213 on B.B. The children already know that water and air are agents in wearing away rocks, and will readily understand that the softer layers of rock will be worn away quickly, whereas the hard rock will be worn away very little. Consequently, after a time a mountain or hill of hard rock (Fig. 214) will be left, because the softer rock surrounding it has been worn away.

Argue that granite, being a hard rock, will be found in hilly or mountainous districts.

Ask for the mountainous parts of England and Wales, and tell class that, of the parts correctly named, those most famous for granite are Westmoreland, Cornwall, and Devon.

Have these places pointed out on the map.

Uses:
1. For structures that have to withstand the action of water and the weather, such as bridges, breakwaters, piers, &c. Cite instances in the locality.
   Show pictures of London Bridge, Plymouth Breakwater, and have positions pointed out on map.
2. For roadmaking.
3. When polished, sometimes used to decorate the interiors of large buildings.
B.B. SUMMARY.

Quartz. Very hard—not scratched by knife.
Felspar. Hard—scratched by knife.
Mica. Soft—splits into thin layers.

Granite. Found in mountainous districts.
Used for bridges, breakwaters, &c.

LESSON VII

THE LAKE DISTRICT

Apparatus.—Map of England; model of Lake District; pictures of famous scenes in Lake District.

General Directions.—Have position of the Lake District pointed out on Map of England. Connect with the lesson on slate. Take class in imagination on a tour in the Lake District. Get as much information as possible from the model. As the lesson proceeds, fill in details as shown in B.B. sketch. The children may also be provided with blank maps, and fill in the particulars from the B.B. sketch.
Fig. 216.
WINDERMERE.—Let child point out the largest lake on the model. Start from south end, and take steamboat trip to Ambleside on the north. Get child to measure length of lake—over ten miles. Show picture of a scene on Windermere, and get children to describe the scenery.

ULLSWATER.—Draw attention to Ullswater, and let children point out the best way to get from Windermere to Ullswater, viz., over Kirkstone Pass and by Brother's Water to Patterdale on Lake Ullswater.

HELVELLYN.—Describe ascent and view from summit. Compare its height with neighbouring church spire, &c.

THIRLMERE.—Descend to this lake, from which Manchester now derives its water-supply, and continue journey to Keswick.

KESWICK.—The chief town in the Lake District. The famous black-lead mines are near here.

SKIDDAW.—The ascent is easy. Compare height with Scawfell, Helvellyn, &c. [See B.B. sketch.]

DERWENTWATER or KESWICK LAKE.—Show pictures of scenery. Continue journey up the Borrowdale Valley, over Honister Pass, and the Scarf Gap and Black Sail Passes, to—

WASTWATER.—The wildest, although not the prettiest, Lake in the district. Show picture.

SCAWFELL PIKE (3210 ft.).—The highest mountain in England. Describe ascent, and get from class what they would imagine might be seen from its summit.

From Wastwater take a long day's walk over crag and fell to—

CONISTON, on Lake Coniston. Note Coniston Old Man.
FIG. 217.
LESSON VIII
LIMESTONE

Apparatus.—Specimens of various limestones, e.g. carboniferous limestone, showing fossils, &c.; Portland stone; Bath stone; any acid; some quicklime.

I. Examination of Limestone.

1. Show specimens of limestone. Note that some are soft, some hard; some have fossils, some no fossils.

2. Pour a little acid (any acid will do) on each. Note that they all effervesce.
   Some of the harder specimens, which do not effervesce easily, can be made to do so by crushing a little to powder and putting the powder into the acid.

3. Draw attention to the fossils, and point out that on account of likeness shown in (2), and for other stronger reasons, we believe that all limestones are wholly or partly derived from the remains of animal and vegetable matter.

4. Examine the Portland and Bath stones. Point out their suitability for building purposes.

5. Let the children name the parts (if any) of the school that are built of limestone.
II. Uses of Limestone.

1. For building purposes.
2. For making lime; hence the term "limestone."

Heat some limestone for some time in the fire till it becomes quicklime. Show how the quicklime effervesces on the addition of water (Fig. 220).

III. Effects of Weather on Limestone.

If the school has been built some time, direct the children to examine the face of the limestone, or direct attention to some building in the locality built wholly or partly of this stone. Infer that limestone does not withstand the weather so well as granite does, but, being harder than chalk, it is not so easily affected by the weather as chalk is.

IV. The Kinds of Hills in which Limestone Rocks are Found.

From the foregoing paragraph get children to reason that limestone will be found in those districts which have hills and mountains intermediate in height between the granite and slate districts (Wales, Cumberland, Devon) and the chalk districts (North and South Downs).

B.B. SUMMARY.

Limestone—the remains of animals.

Uses

1. For building.
2. For lime-making.

The hills in limestone districts are not very high. They have been worn by the weather.
LESSON IX

LIMESTONE DISTRICTS

Apparatus.—Model and Map of England; specimens of limestone; Blue-John; pictures of Derbyshire Dales, Clifton Suspension Bridge, Cheddar Cliffs.

[As the lesson proceeds, the children may fill in particulars on sketch maps.]

1. THE PENNINE CHAIN.—Get position pointed out on map. Compare with backbone of animal, and show appropriateness of appellation "the Backbone of England."

Show positions of Crossfell (2900 feet) and Whernside (2400 feet). Compare heights with Snowdon.

Show from model how the chain forms the watershed of the North of England, and contrast the lengths of the rivers flowing east and west from it (page 205). Explain that the rivers on the eastern slope often form picturesque dales or valleys, but that the higher parts of the chain are mainly barren and desolate moorland (cf. Dartmoor).

Show pictures of some of the Derbyshire dales.

Explain that the rivers in some cases have worn out caves or caverns in the limestone, the most remarkable of these being the Peak Cavern and the Blue John Mines. Show specimen of Blue John, and have the Peak pointed out on map.

2. THE COTSWOLD HILLS.—Have position pointed out on map. Note the sources of the Avon and the Thames.

Excellent building-stone (called Bath stone) is quarried in them. Show specimens. Point out position of Bath on map.

These hills are about half as high as the Pennines, and give pasturage for large numbers of sheep.

The precipitous banks of the Avon at Clifton near Bristol are formed of limestone.

Show picture of Clifton Suspension Bridge. Point out position of Bristol on map; note its position as a port.
FIG. 221.—High Tor: Dovedale in the Peak Country.
(Engraved from a Photo by Frith, by kind permission.)
3. The Mendip Hills.—Show position and picture of the Cheddar Cliffs near Cheddar, where the famous cheese was first made.

4. Portland Bill.—The world-famed Portland stone is found on Portland Bill.

Show position on map and specimen of stone.

The Scenery of the Limestone Districts.—Not so grand as the scenery of Cumberland and Wales, but exceedingly picturesque and interesting.

B.B. Sketch.

LESSON X

CHALK

Apparatus.—Chalk; chalk or limestone with fossils; a few shells; some powdered chalk; glass beaker; water; a microscope; glass slip.

Revision.—Chalk is a white, soft solid, insoluble in water.

I. How the Shells "got into" the Chalk.

Show piece of chalk with fossil shell in it (Fig. 223). Arouse interest by stating that you are going to help the class to
discover how the shells "got into" the chalk. Argue that the presence of shells points to the presence of water. Place a few shells in a glass beaker filled with water. Pour powdered chalk into the water. Observe that the chalk sinks (since it is heavier than water and insoluble in it), and that it covers the shells with a layer of "chalk-mud" (Fig. 226). The class already knows that mud may harden into shale. From this argue that in a similar way this "chalk-mud" might be supposed to harden into chalk.

The shells were once at the bottom of the water; minute particles of chalk fell through the water and covered the shells with chalk-mud; layers of chalk or other rock above hardened the chalk-mud into chalk.

II. Where did the Chalk come from?
With a camel's-hair brush, dust some natural (not prepared) chalk into a beaker of clear water. After some time pour the water off, and place a little of the sediment on a glass slip under a microscope. Let several children describe what they see, viz., small shells and bits of larger shells.

Draw a few shells on B.B. or show picture like Figs. 224, 225.

III. The Formation of Chalk.
(Draw the following theory from class by way of recapitulation.)

I. Shell-fish, great and small, lived in the water.
2. They died, and their shells fell to the bottom of the water and formed beds of "chalk-mud" (chalk-ooze).

![Diagram of minute shells common in the Chalk.](image)

3. The lower layers of chalk became hardened by the pressure of upper layers and formed beds of hard chalk.

4. The chalk was forced upwards out of the water and became dry land.

The presence of chalk tells us that that part of the land was formerly under water.

**B.B. SUMMARY.**

- **Chalk**
  - Formed under water.
  - Composed of large and small shells.
  - Hardened by pressure above.

The presence of chalk tells that the land was formerly under water.
LESSON XI

THE CHALK DISTRICTS

Apparatus. — Map and model of England; pictures of Down scenery. Sketch map may be provided for the class.

Revision. — Question class on Salisbury Plain and the North and South Downs.

I. Salisbury Plain is the Centre of the Chalk Ranges.

Show its position, and show the other ranges radiating from it as depicted in B.B. sketch.

II. Scenery of the Chalk Districts.

Show pictures; get children to observe rounded tops of hills. Recapitulate lesson on chalk (p. 224), and get class to explain the reasons for this appearance.

Tell that these heights are covered with grass which supplies pasturage for many sheep. Hence the famous Down mutton. The valleys are well wooded and fertile. The great thing lacking in the scenery is water.

III. Recapitulation of Mountains of England.

Require class to name the mountain ranges of England, to point out their positions, and to tell the chief kind of rock of which they are composed.
1. Granite and Slate Rocks.
   a. The Cumbrian Mountains.
   b. The Cambrian Mountains.
   c. The Devonian and Cornish Heights.

2. Limestone Rocks.
   a. Pennine Chain.
   b. Cotswold Hills.

   a. Salisbury Plain.
   b. Chiltern Hills.
   c. East Anglian Heights.
   d. North and South Downs.
   e. Dorset Heights.

B.B. SKETCH

Fig. 227.—The Chalk Districts.

LESSON XII

THE PLAINS AND RIVERS OF ENGLAND

Apparatus.—Model of England, with principal mountain ranges only inserted; some pieces of string to represent the rivers; some pins.

Introduction.—Revise the positions of the mountain and hill ranges of England. The children already know that rivers rise in high lands and generally flow through plains to the sea.
Fig. 228.—Thames Valley.

Fig. 229.—Basin of the River Thames.
Get the children to point out the positions of the lowlands of England, and to note that they are most extensive in the eastern and central portions. Infer that the long rivers of England must be in Central and Eastern England.

II. Rivers rising in the Pennine Chain.
Draw attention to the Pennines; get children to notice the difference in the eastern and western slopes. Draw Fig. 203, p. 205.

Fig. 230.—The Severn.
Pin strings on model to represent the rivers rising on the east of the Pennines, have their names found out from the map. Show the reason that a port is often found at the mouth of a river.

[Throughout the lesson, as far as possible, connect a seaport with each river named. The names of the rivers and ports that should be taught are indicated in the B.B. sketch.]

Fig. 231.—Basin of the River Severn.
Point out the peculiar course of the Trent, which rises on the west of the Pennines, skirts to the south of them, and finally flows north.

III. The Thames.

Point out the valley of the Thames on the model. Have its length (215 miles) approximately measured on the map.
IV. The Rivers on the South Coast.

Show how, from the position of the chalk ranges, the rivers flowing south must necessarily be short in course.

Fig. 233.—Basin of the River Trent.
V. The Severn.

Draw attention to the peculiar course of the Severn, have its length (220 miles) approximately measured on the map, and get children to observe that it is the only long river in the west.

VI. Recapitulation.

Direct children to draw rough maps of England, and to insert rivers from B.B. sketch.

[Three maps of river basins are inserted in this Lesson in order to enable those teachers who desire to give lessons on these river basins to make models and draw up appropriate B.B. sketches.]
Fig. 235.—Basin of the River Ouse.
Fig. 236.—England.

B.B. SKETCH.
[To be drawn from the above relief map.]
LESSON XIII

COAL

Apparatus.—A piece of ordinary coal; tobacco-pipe; clay; powdered coal; wood; white plate; sawdust; piece of shale from coal-measures, with imprint of leaves, &c.; specimens of lignite, cannel-coal, and anthracite; fish-glue; a rough Map of England drawn on cartridge-paper.

I. Review of Previous Knowledge.

By questioning, and by reference if necessary to objects, obtain following facts from class:

1. A piece of coal is black in colour.
2. Some sides of a piece of coal are bright black, others dull black; the latter blacken the fingers most.
3. A piece of coal is made up of a number of flat layers.
4. Coal is hard, heavy, and brittle.
5. Coal is a mineral.

II. Coal resembles Wood.

(a) Put both coal and wood on fire. They both burn easily.
(b) i. Put some powdered coal into a tobacco-pipe; cover top with layer of clay; heat; apply clean white plate to issuing smoke; ignite smoke (Fig. 239).

ii. Repeat last experiment, using sawdust instead of coal.

When heated, both coal and wood give off a black sticky substance (tar) and a gas (coal-gas) which ignites.

III. The Origin of Coal.

(a) Pass round a piece of shale which shows impressions of leaves (Fig. 237). Explain that the shale was found near coal.

(b) Show picture of tree-root standing in under-clay (Fig. 238).

Coal is partly made up of the remains of trees and plants.

IV. Kinds of Coal.

Let children examine the various specimens of coal on the table. Have the specimens divided into those coals that are black and those that are not black.

(a) Direct the further examination of the NOT-BLACK COAL. It is dirty brown in colour (hence sometimes termed BROWN COAL), and
Fig. 237.—Tree Fern from Coal Measures.

Fig. 238.—Section showing Coal Seam.

a, coal seam; d, under-clay with roots; b, c, shale and sandstone forming roof, containing fossil stems, leaves, &c.
shows distinct traces of woody fibre. It is termed lignite, and is found in South Devonshire.

Glue a piece of lignite on South Devon in the map.

(b) Direct the further examination of the BLACK COALS. Divide them into:
(i) Those that soil the hands a good deal;
(ii) Those that soil the hands only a little.
Hold a specimen from (i) by tongs in Bunsen flame.
Note that it takes fire easily, and burns with a bright clear flame. This is cannel-coal, which is used for household purposes, and is obtained largely from Northumberland.

Glue a piece to the map.

Hold a specimen from (ii) by tongs in Bunsen flame.
It does not take fire, hence cannot be used for ordinary fires, but it can be burnt in kitchens and furnaces where there is a good draught. Strike specimen (ii) with hammer. It is hard and stony, hence called stone-coal. Its proper name is Anthracite, and it is found largely in South Wales.

Glue specimen to map.

B.B. SUMMARY.

Coal.
Origin.—The remains of trees and plants.
Kinds.—Brown coal (lignite), South Devon.
Ordinary coal (cannel-coal), Northumberland.
Stone-coal (anthracite), South Wales.
LESSON XIV

COALFIELDS

Apparatus.—A Map of England drawn on cardboard or cartridge-paper; some pieces of coal; fish-glue; an ordinary wall Map of England; a Map of England for each child; a blank map for class-test.

I. Revision.

From previous lessons class has learnt that coal is found in South Devon, Northumberland, and South Wales.

Explain that the brown coal is interesting but unimportant.

Explain, further, that a place where coal is found in large quantities is termed a coalfield.

II. The Chief Coalfields of England.

1. Northumberland and Durham.
2. South Wales.
3. Cumberland.
4. South Lancashire.
5. York, Derby, and Nottingham.
7. Bristol.

Deal with each coalfield in a manner somewhat as follows:—
   a. Let a child point out the district on the large map.
   b. Let each child find the district on his small map.
   c. Let a child point out the corresponding spot on the sketch map.
   d. Glue a piece of coal to that spot; write name of coalfield on B.B., and insert reference marks.

III. General Distribution of the Coalfields.

Ask children to name parts of England where coal is found and parts where it is not found, and summarise somewhat as follows: Coal is found in the North and West of England, but not in the East, South, or South-West.

[Note.—Coal exists in Kent, but is not yet worked.]

IV. Map-Drawing by Class.

Let class draw rough maps of England, and shade in the coalfields.
LESSON XV

KINDS OF IRON

Apparatus.—Pieces of paling, water-pipe, gas-pipe; an old iron saucepan; iron wire, chain, nails, screws, poker, hammer; knives, saw, steel spring, watch spring.

1. Have the above articles placed indiscriminately on the table. Get class to note that they are all made of iron, and that they are all hard. Show the suitability of the term *hardware* for such iron goods.
2. Get a child to separate the articles into—
   a. Those that are bright—knives, saw, springs.
   b. Those that are not bright—the remaining articles.

3. Get children to endeavour to bend the articles, and thus separate them into—
   a. Those that are elastic—knives, saw, springs.
   b. Those that are not elastic—the remaining articles.

4. Ask what the knives, saw, and springs are made of. Infer that steel is hard, bright, and flexible.

5. Strike each of the articles which are not made of steel smartly with a hammer. Again separate them into—
   a. Those that break or crack (i.e. are more or less brittle)—paling, pipes, saucepan.
   b. Those that do not break or crack (i.e. are not brittle)—wire, chain, nails, &c.

6. Infer that the kind of iron of which things in Class (a) are composed must be different from that of which things in Class (b) are composed.

7. Give the name cast iron for Class (a), and wrought iron for Class (b).

8. Proceed with steel articles as in No. 5, and infer that steel is not very brittle.

9. Examine the structure of each kind of iron, observing carefully the broken edges of the cast iron articles.
   Note that the broken edges of the cast iron seem to sparkle, that the wrought iron seems more or less stringy or fibrous, whilst the steel has no very distinctive features of this kind.

10. Show the necessity of having such articles as hammers, pokers, &c., made of wrought iron, because they have to withstand much force in the shape of blows. Also show that it is not necessary to have such articles as palings, pipes, &c., made of wrought iron.

11. Elicit why the poker (wrought iron) often breaks the back of the stove (cast iron).
B.B. SUMMARY.

Iron.

<table>
<thead>
<tr>
<th>Cast Iron</th>
<th>Wrought Iron</th>
<th>Steel</th>
</tr>
</thead>
</table>

I. Iron Ore.

Have specimens displayed on the table. Tell that each of them contains iron, but that the iron is "mixed" with other substances. Teach the term Iron Ore.

II. Kinds.

Get children to classify the iron ores somewhat as follows:

a. Those iron ores which are yellow or dirty brown seem more or less mixed with clay, and hence are called clay ironstone or brown iron ore.

b. Those iron ores which are more or less red—red iron ore (haematite).

c. Those iron ores which are made up of rounded lumps or nodules, and which when broken show a radiating fibrous structure of a brass or golden colour—yellow iron ore (iron pyrites).

[Note.—All specimens of iron ore will not answer these descriptions. The names haematite, iron pyrites, are inserted for the teacher’s guidance, and should not be taught to the children.]
III. Distribution.

Explain that clay ironstone is found near coal. Revise the positions of the chief coalfields; have them pointed out on the map of England. Place a specimen of clay ironstone on each of the important coalfields.

Explain that iron is found in some places where no coal is found; e.g.:

a. *North Yorkshire*, chiefly iron pyrites and clay ironstone; chief town, Middlesborough.

b. *Furness*, chiefly red iron ore; chief town, Barrow-in-Furness.
c. Northamptonshire, chiefly clay ironstone.
[d. North and South Downs, yellow iron ore; not now worked (see pp. 259, 260).]
  Have appropriate pieces of ore wired in positions on cardboard map.
  [Outline maps can be distributed to the class and the chief iron districts can be inserted either during the course of the lesson or at its conclusion.]

B.B. SKETCH.
(Fig. 241, on opposite page.)

LESSON XVII
IRON—EXTRACTION FROM ORE AND MANUFACTURE

Apparatus.—Long test tube (or better still, combustion tube); Bunsen burner; powdered iron pyrites; slag; pictures of blast-furnace.

I. Recapitulation.
Recapitulate lesson on iron ores.

II. To obtain Iron from Yellow Iron Ore.
  1. Heat powdered iron pyrites in combustion tube. Note the sulphur deposited in the cool part of the tube (Fig. 242). Infer that the sulphur can be obtained from this form of iron ore by heating, and argue that if sufficient heat could be applied, all the sulphur would be driven off and the iron would be left.
  [Iron pyrites is iron sulphide, i.e. iron and sulphur in chemical combination.]
  The way to obtain iron from yellow iron ore is to heat the iron ore very strongly.

III. Description of Method of obtaining Iron from Brown Iron Ore (Clay Ironstone).
  1. Roasting.—The clay ironstone is broken into small lumps mixed with coal, and heated in the open air.
  2. Smelting.
     a. The roasted ore is taken to a blast-furnace to be smelted.
b. Show picture of the external appearance of a blast-furnace; draw attention to the broad brick towers (the furnaces) and the tall chimney (for making the draught).

c. Draw section of blast-furnace on B.B. (Fig. 243).

d. Explain that layers of coal, iron ore, and limestone are put in one above the other.

e. The coal is ignited and the blast is turned on (cf. bellows). In the course of time some of the other things "mixed" with the iron in the iron ore combine with the limestone and form slag. Show a specimen. The iron now begins to melt.
In some sand near the furnace a long channel (called the sow) is made. Smaller channels (called the pigs) branch from it.

The molten iron is allowed to flow from the furnace into the “sow and her pigs.” The iron is now known as pig iron or cast iron.

IV. Brief Description of Method of obtaining Wrought Iron from Cast Iron.

a. The cast iron is heated in a special kind of furnace different from the blast-furnace.

b. When the iron is quite soft, it is taken from the furnace and hammered. Hence its name, wrought or worked iron.

B.B. SUMMARY.

Cast iron from clay ironstone.
1. Roasted in open air.
2. Smelted in blast-furnace.
3. Allowed to run into channels in sand.

Wrought iron from cast iron.
1. Softened in furnace.
2. Hammered.

LESSON XVIII

THE IRON INDUSTRIES

Apparatus.—Map of England; knife; poker; shovel; tinplate; needles; pins; nails; screws; Coventry bicycle; pictures of ship-building; machinery; plough or any other agricultural implement; gum labels with names of “iron towns” upon them.

INTRODUCTION.—Lessons have already been given on iron, iron ores, and the kinds of iron. This lesson is to show where iron goods are made.

I. Iron Smelting.

Class has already learnt Barrow-in-Furness and Middlesborough as two iron-smelting towns. Now add Dowlais on South Wales coalfield.
II. Where Iron Goods are made.
Get class to reason that the iron goods are likely to be made in districts where iron and coal are found. Revise positions of coal and iron fields (Lessons XIV. and XVI.).

III. Hardware.
Remind children that such small iron goods as pokers, shovels, &c. are known as hardware. Name Birmingham; find out position on map; insert in B.B. sketch; stick label with Birmingham upon it on the shovel, and thus endeavour to set up a connection between the manufactured article and the name and position of the place of its manufacture.

Knives (typical of cutlery generally) at Sheffield.
Needles and Pins—Redditch.
Nails and Screws—Dudley and Birmingham.
Machinery—London, Birmingham.
Agricultural Implements—Lincoln, Ipswich.
Cycles—Coventry, &c. (see Lesson XXXVIII. p. 299).
Teach the above in a similar manner to "Hardware."

IV. Tinplate.
Scratch tinplate and show the iron underneath, or show a rusty tinplate. Hence teach that tinplate, so called, is merely iron coated with tin. Chief town, Newport.

V. Shipbuilding.
Show picture of ship building. Tell class that ships are now built nearly or wholly of iron. Get class to reason that ships would be likely to be built—
a. Near ironfields, because iron will there be cheap.
b. Near the sea, especially at river mouths, because of facilities for launching.
Get children to look at map and mention spots where they would imagine shipbuilding would be carried on.
Select:

Newcastle, at mouth of Tyne, } on Northumberland and
Sunderland, " " Wear, } Durham iron and coal
Birkenhead, " " Mersey, on South Lancashire
coal and iron field.
Barrow, on Furness iron field.
Add that England is the great shipbuilding country of the world.

[Distribute blank maps, and let children insert names given during the lesson.]

**B.B. SKETCH.**

![Map of Iron Industries](image)

Fig. 244.—The Iron Industries.

**LESSON XIX**

**THE CULTIVATION OF THE SOIL**

**Apparatus.**—A shallow box or tray filled with clay; another filled with dry mould; a knife or chisel; a young plant with rootlets; a piece of iron; piece of rusty iron; Bunsen burner or spirit lamp; knitting-needle; a leaf; a comb.

**I. Out-door Work.**

Where possible, the class should be taken to see the different processes of cultivation practised in the neighbourhood, and these observations should extend to both field and garden work. Many children will probably come from homes with gardens, and this home experience and knowledge should be utilised.
II. Ploughing.
1. Take a shallow box or tray filled with clay and another filled with dry mould somewhat compressed. Plough up the mould and clay with a knife or chisel. Then contrast the thick lumps of clay with the finely-divided and dry mould.
2. Show the rootlets of some young plants. Ask into which soil the tender rootlets would force their way with the greatest ease.

Inference.—The rootlets would grow farther and easier into the dry soil, and so would get more food from it.

3. Show a piece of iron. Rub it with the fingers; nothing comes off. Treat similarly a piece of iron which has become rusty by exposure to the air; something (the rust) can be rubbed off.

Inferences.
1. The air caused the iron to rust.
2. Cultivation, by turning up the soil and by exposing it to the air, causes it to be powdered like the rusty iron. Hence the soil gets more air and becomes more fertile.

III. Draining.
Burn some clay on an iron plate over a Bunsen burner or spirit lamp. Then crumble it up. Contrast with another piece—unburned.

Observation.—The burnt clay is lighter, drier, warmer, and more exposed to the air.

Inferences.
1. That the heat of the sun is largely wasted in drying up the water on undrained lands.
2. That drained land is easier to work.
3. That drained lands are best for manure.
4. Hence draining makes the land more fertile.

IV. Harrowing or Raking.
Show the box or tray of "ploughed" soil again. Make some holes in it with a knitting-needle. Drop some small seeds into the holes. Tear up a leaf or a piece of paper into bits to represent upturned weeds. Spread these over the ploughed mould. Then draw a comb along the soil.
LESSONS IN GEOGRAPHY

Observations.

a. The seed-holes are covered up.
b. The seeds are gathered up.
c. The soil is broken up into smaller particles.

Inference.—Raking makes the soil more fertile.

LESSON XX

THE FARMING INDUSTRY

Apparatus.—Blank Map of England showing counties; sketch maps showing counties, for children; Map of the World; specimens of grain, preferably in the ear.

I. Preparation.

Take a blank map showing the counties; supply each of the scholars with a similar blank sketch map prepared previously by them.

II. Method of Teaching.

The teacher should mark in the places on the blank map as they are named, and the scholars should then copy on to their sketch maps. Specimens of the chief products should be shown.

1. Wheat.

b. Tell that we do not grow nearly enough wheat for our own use, and so have to buy large quantities from abroad.
c. Point out on a map of the world the chief places from which wheat is brought—United States, British India, Russia, Australia, Canada.

2. Garden Produce.

a. Market-gardens fringe most of the big towns, i.e. they lie near to their customers.
b. Early garden produce comes from Cornwall, the Channel Islands, the Scilly Isles, and from Southern France.

3. Crops.—These are practically grown everywhere for cattle food. Such crops include hay, clover, tares, turnips, mangolds, beans.
4. BARLEY, OATS, RYE.
   a. A dry and warm climate is best for barley—Norfolk, Suffolk, the Midlands.
   b. Oats are grown in the N. and in the Fens.
   c. Rye in the N. and E.

5. ORCHARDS.—Chief counties are—Devon, Somerset, Gloucester, Hereford, Worcester, and Kent.

   Note.—These places lie principally in the W. and S.W.

6. HOPS.—Kent, Surrey, Worcester.

7. SUMMARY.—From observation of the map get children to infer that

   The chief farming counties lie east of a line drawn from Whitby to Torquay.

B.B. SKETCH.

![The Farming Districts](image-url)
LESSON XXI

EASTERN COUNTIES

(First Lesson.)

Apparatus.—Relief model of eastern counties; blank map of eastern counties; outline maps of the eastern counties previously prepared by the scholars; Map of England; enlarged map of Broads; any pictures bearing on the subject of the lesson; coloured chalks; Map of Europe; pins, with bits of differently coloured paper; piece of worsted.

I. Teaching.

As in previous lessons. By blank map for teacher and similar sketch blank maps for boys. Names, &c., to be inserted when mentioned.

II. Surface and Position.

1. Call attention to relief model. Class to note—
   a. The counties are flat.
   b. Tell or infer, with the aid of previous lessons on coal and iron, that they contain no coal or iron.
   Inference.—There will be few or no large manufacturing towns.

2. Note position—east. Far from the west and the wet west winds. Point this out on map.
   Inference.—Climate is dry.

3. Elicit that the sun rises in the east. These counties are sometimes called “Sunrise” land. Associate 2 and 3, and let class make inference.
   Inference.—These counties have more sunny skies than most other parts of England.

4. Note the many rivers, broads, meres, cuts, dykes, from sketch map.

5. Associate 2, 3, and 4.
   Inference.—
   a. The soil is fertile.
   b. Agriculture will be the chief industry.
FIG. 246.
OBJECT LESSONS IN GEOGRAPHY

REFERENCE.
Towns above 100,000 inl. NORWICH
Towns above 25,000 inl. Lincoln
Towns below 25,000 inl. Cromer

Limit of Navigation thus: $

FIG. 247.
III. Fens.

1. Take a piece of chalk and mark out the Fen district on the relief model.
   Draw a line from Lincoln to Deeping; thence to Peterborough; thence to St. Ives, and on to Ely. Ely once an island in Fen marshes. Compare Angle-see, Lund-y, &c.

2. Briefly describe the former state of the Fens, and contrast it with the present. We now have—
   a. Farm-land instead of marsh-land.
   b. Means to support a larger number of people.
   c. Improved climate and health.

3. If time permit, briefly tell the tale of Hereward. It will add interest to the lesson. Show a picture in illustration (if possible).

4. Mark Fen district on blank map, and let class copy on to sketch maps.

IV. Broads.

1. Take a piece of coloured chalk and mark out the basin of the Broads on the model.

2. Enter on blank and sketch maps.

3. Show the enlarged map of the Broads, and briefly describe them.

4. Note that they are principally associated with three rivers—the Yare, Bure, Waveney.

5. Explain difference between “BROADS” and “MERES.”
   Meres are hollows in surface, supplied by springs and connected with no rivers.

   a. Pleasure district.
   b. Great home of gulls. Why?
      1. Plenty of food there for them.
      2. Difficult of access on account of marshes.
LESSON XXII

EASTERN COUNTIES

(SECOND LESSON.)

V. Occupations.

1. Farming.—Chief industry. Most of the towns depend more or less on the farming industry. CORN—Grantham, Stamford.

2. The Making of Machinery.—Largely used in farming. Hence some towns engaged in its manufacture, e.g. Lincoln, Ipswich.

3. Fishing.—Note that four out of the five counties are coast counties, hence the fishing industry is important.—Grimsby, Yarmouth, and Lowestoft (herrings); Colchester (oysters for London market).

4. Woollen and Silk Manufactures.—Norwich, crape, silk; woollen goods (worsted at Worstead); Ipswich, silk. Show a piece of worsted.

   a. Explain origin of these trades. Towns near to Flanders. Flemish exiles, driven from their own country by religious persecution, settled there and established these trades.

   b. Trades have deteriorated. Why?

      1. Moved north where coal and iron are found.
      2. Machinery has displaced hand-work.

5. Poultry Rearing.—In Fenland, geese, turkeys, &c., fattened principally for the London market.

6. Shipping.—Turn to relief model. Note the unbroken coast-lines of Lincoln, Norfolk, and part of Suffolk.

   INFERENCE.—No really great ports.

   Chief ports are Grimsby, Boston, Lynn, Yarmouth, Lowestoft, Ipswich, Harwich.

   Harwich.—A packet-station; one of the ways out of England. Boats run to Rotterdam, Hamburg, Ostend, Antwerp.

   Point out these places on the Map of Europe.

7. "Seaside" Places.—These find occupation for many people during the season. The chief are:
Hunstanton, Cromer (Poppyland), Yarmouth, Lowestoft, Felixstowe, Walton-on-the-Naze, Clacton, Southend.

**Reasons for this number—**

a. Proximity to London.
b. Bracing air.
c. Small rainfall.

8. **Railways.**—Great Eastern principally. Mark out the lines on the relief model with coloured chalk.

**Note.**—
1. All the towns named should be pinned out on the relief model.
2. They should then be marked on the blank map.
3. The children should then copy them on to their sketch maps.
4. The rivers on which they stand (if any) should be noted and traced from source to mouth on the model, and then entered on the maps as in the other cases.

**LESSON XXIII**

**THE SOUTH-EAST OF ENGLAND**

**Apparatus.**—Model of district; Map of England; picture of Stonehenge, Salisbury Cathedral, Canterbury Cathedral, view of Dorking; some hops.

**INTRODUCTION.**—Revise lesson on chalk, especially that part dealing with the parts of England where chalk is found.

**SALISBURY PLAIN.**—Commence at west of model. Draw attention to the tableland or plateau. Describe it as a district containing a number of round-topped chalk hills; explain that the title Salisbury Plain is somewhat misleading.

Show a picture of Stonehenge, and refer to its remarkable structure and antiquity. [Its connection with the Druids is doubtful.]

Have Salisbury pointed out on map. Show picture of Salisbury Cathedral with its spire over 400 feet high, the loftiest in the kingdom. Compare with height of neighbouring church spire.

**NORTH DOWNS.**—Get children to note their position, also that they are broken by rivers. Have these rivers pointed out on the model, named from the map, and inserted in B.B. sketch.
Show position of the *Hog's Back*; connect with *Guildford*, the county town of Surrey, and *Farnham*, the centre of the hop-growing district. Show some hops; have them tasted; ask for uses.

Show positions of *Inkpen Beacon* (over 1000 feet) and *Leith Hill* (over 900 feet), the highest points of the range. Compare heights as shown in B.B. sketch. Connect the latter with *Dorking*, the finest spot perhaps in the North Downs.

Show picture of scenery.

![Map of the South Downs](Fig. 249)

Note *Maidstone* on the *Medway*, and show from the model and the map how the North Downs continue to the *South Foreland*, broken only by the valley of the *Stour*, with *Canterbury*, the ecclesiastical capital of England, on its banks.

Show a picture of Canterbury Cathedral.

**SOUTH DOWNS.**—From model, get children to observe that they too originate from Salisbury Plain, but that they are less broken and not so high as the
North Downs. Note their termination in *Beachy Head*.

**The Weald.**

Get the children to imagine that they are standing on Leith Hill, and with the help of the model get them to describe what they would see.

To the north would be seen the North Downs stretching east and west, consisting of round-topped hills covered with grass, which gives pasturage to many sheep. Farther north they would see the smoke of London. Looking south, they would see a range of low hills—well wooded, very fertile, with villages nestling in the valleys. This district is called *The Weald*.

Iron pyrites (show specimen) is plentiful, and the wood of the Wealden Forest was used formerly for smelting the iron. The discovery of coal, however, caused the iron industry to be carried northwards.

The Weald is very fertile, producing wheat, hops, and fruit, and is sometimes known as the English Eden. Point out *Tunbridge Wells*. Note that the *Wealden Heights* (sometimes called the *Forest Ridge*) terminate at Hastings.

**The Coast Scenery.**

Show pictures of the chalk cliffs of Dover or elsewhere. Explain appropriateness of the term *Albion* (Latin *albus*, white).

Connect *Dover* and *Folkestone* with the North Downs and South Foreland, *Hastings* with the Forest Ridge of the Weald, *Eastbourne* with the South Downs and Beachy Head.

Show position of *Brighton*, and get children to measure on model its distance from London.

**Review.**—Show how the principal places in the district are situated either on rivers in the valleys or on the coast, and deduce reasons for this.

Let children copy the map on their slates.
LESSON XXIV

DEVONSHIRE

Apparatus.—Map of England, model of Devonshire, outline Map of Devonshire on B.B.; coloured chalks for filling in details as lesson proceeds; cream, apples, granite; pictures of Devon Coombes, Ilfracombe, Plymouth Hoe, parts of Dart and Rhine; Exeter Cathedral; view of Dartmoor.

I. Position.

Get child to point out position on Map of England.
II. Bird's-Eye View of County.

Draw attention to model, and from observation deduce that interior is a Tableland, and that the parts near the coast are Lowlands. Compare with inverted pie-dish. Draw attention to the cream, the apples, and the granite; say that they are Devonshire products, and ask which they imagine come from the uplands and lowlands of Devon respectively.

III. The Lowlands of Devonshire.

Show pictures of Devonshire Coombes. Note the streams, the meadows, the grazing cattle, the orchards. Explain: "The Land of Junket and Cream."

Ilfracombe.—Draw attention to the termination combe. Show picture and get children to briefly describe it.
Barnstaple, Bideford.—Show positions of these at end of river valleys.

River Tamar.—Note that it forms the western boundary; also its estuary—Plymouth Sound.

Plymouth.—Show picture of the Hoe. Connect tale of Drake and the game of bowls with the fact that it is a great naval port.

River Dart.—Show pictures of Dart and Rhine scenery; let children point out similarities. Infer appropriateness of the epithet—the “English Rhine.”

Connect River Dart, Dart-moor, Dart-mouth.

Exeter.—The county town. Show picture of cathedral.

Connect Exeter, River Exe, Ex-moor, Ex-mouth.

IV. The Uplands of Devonshire.

1. Exmoor.—Have position pointed out on map.

2. Dartmoor.—Connect with piece of granite. Revise lesson on granite, especially that part dealing with effect of granite rocks on scenery (p. 210). Have the Tors of Dartmoor pointed out on model. Show position of Yes-Tor.

Compare height of Snowdon and Yes-Tor somewhat as follows:

```
<table>
<thead>
<tr>
<th>Snowdon</th>
<th>3500 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000 ft.</td>
</tr>
<tr>
<td></td>
<td>1000 ft.</td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>Yes Tor</th>
<th>2000 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000 ft.</td>
</tr>
</tbody>
</table>
```

Fig. 253.

Show picture of a part of Dartmoor, and thus deduce chief physical features.

Describe the bogs and fogs, and the consequent dangers incurred at times in crossing it.
Fig. 254.

Lowlands.—Fertile. Milk, cream, apples.
Highlands.—Unfertile. Granite.

LESSON XXV

BARLEY, ASSOCIATED WITH THE "LIQUOR" TRADE

Apparatus.—Complete barley and some grass plant; any leaf with a stalk; some barley soaked in water two or three days; dry grains of barley; some germinating barley; blank Map of England showing counties; similar sketch maps for boys; Map of the World; some yeast, sugar, hops.

Method of Teaching.—As in previous lessons.
3. Sketch maps for boys, previously prepared.
   The maps to be used as directed in previous lessons.
I. The Barley Plant Examined.

1. Show a complete specimen, and also any grass plant.
   a. Stalks.—Examine the stalks of both plants. They are
      1. Hollow.
      2. Knotted (have internodes).
   b. Leaves.—Examine the leaves of both. Note that they have
      1. Sheaths (Figs. 256, 257) split in front.
      2. Blades (leaves).
      3. No stalks.
         Show a stalked leaf and contrast.
   c. Roots.—All the roots are fibrous (Fig. 255).

Inference.—From these facts infer that barley is a grass.

II. Malt.

1. Two or three days before the lesson some barley grains should have been put in water. These should now be produced and compared with some dry grains. Class to note—
   a. The grain placed in water has swollen.
   b. Some of the husks have dissolved.
   c. If equal quantities of soaked and dry grains are weighed, the soaked will be found the heavier.

2. Germinate some barley in the dark. Start several weeks before the lesson. Now produce these, and let class note that each grain is a growing plant.
Note.—The grains must be kept upright, with the embryo end downwards. A thin piece of cork might be perforated for this purpose, and the grains placed in the perforations. See that the grains touch the water. Cover over and put in a dark place.

3. The place in which the growing barley is kept is made very hot (104° F.), and the heat kills the little plant.

A great change has meantime taken place in the grain. The starch in it has been changed into sugar.

4. Add a little yeast to a solution of sugar and water, and leave in a warm place for some time before the lesson. *The liquid will be found to have the smell of alcohol.*

**Inference.**—*Alcohol is obtained from sugar.*

5. Tell that beer, spirits, and wine all contain alcohol. Alcohol, if taken in excess, is intoxicating.

III. The "Liquor" Trade.

1. Its Size.—The size of the trade, judged by the amount of money spent in it, is enormous.

Convey an idea of the size of the trade by means of the following facts:

- a. Its value is greater than that of the cotton trade.
- b. It equals all the money spent on bread, butter, cheese.
- c. It equals about three times the amount spent on woollen and worsted goods.

2. Places where the Trade is carried on.—All over the country.

- a. The biggest **breweries** are in London and Burton-on-Trent.
- b. **Gin** is especially made in London, Plymouth, and Bristol.
- c. **Whisky**, Scotland and Ireland.

3. Imports.—We buy wine and spirits from abroad.

- a. **Wine**.—France, Spain, Portugal, Italy, Hungary, California, Australia.
- b. **Gin**.—Holland.
- c. **Brandy**.—France principally.
- d. **Rum**.—British Guiana, West Indies.
- e. **Sugar**.—An immense amount of sugar is used in the trade. Recapitulate from *Lesson on Sugar* for places for sugar.
4. Things of which Beer, &c., is made.
   a. Malt.—Best made from barley. Chief barley districts are the Midland, Eastern, and Southern Counties.

**B.B. Sketch.**

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**LESSON XXVI**

**Milk, Associated with the Dairy Industry**

**Apparatus.**—A glass of milk; small bottle; some water; oil; some rennet, lemon-juice, or vinegar; Bunsen burner or spirit-lamp; porcelain crucible; blank Map of England showing counties; sketch maps for boys like blank map.

**Method of Teaching.**—
Use a blank Map of England showing the counties; a Map of the World, and sketch-maps for the boys as directed in previous lessons.
I. The Uses of Food.
Question out the following facts:—(Tell where necessary).
1. A person who is starving or underfed looks thin. A person who is well fed looks fat and well.
   **Inference.**—**Food is a flesh-former.**
   Tell that flesh-formers contain nitrogen.
2. Before dinner, or on a chilly day, we sometimes feel cold; after dinner we feel warmer.
   **Inference.**—**Food is a heat-producer.**
3. Some children who are badly fed suffer from "rickets" (explain), and do not grow well.
   **Inference.**—**Food is a bone-former.**
4. From common experience infer that water is a food.

II. The Composition of Milk.
1. Show a glass of milk. It is a liquid (tell class about four-fifths are water).
   **Inference.**—**Milk supplies us with water.**

2. a. Take a small bottle half filled with water. Add a little oil, so as to form a layer on top of the water.
The oil and water do not mix. Shake the bottle well. They mix and have a milky appearance.

**Inference.** — The white colour of the milk is due to oil or fat globules.

b. A drop of milk magnified under a microscope would show the tiny bits of fat floating about in water (Fig. 259).

Put a sketch on B.B. in illustration.

3. Elicit that butter is—
   a. Fatty food.  
   b. Made of milk.  

   **Inference.** — Milk warms the body.

4. a. Take a glass of milk and pour into it some rennet, lime-juice, or vinegar.

   **Note.** — The appearance of the milk changes. White solid lumps (curds) are seen floating in a watery liquid (whey) (Fig. 260).

   b. Tell that cheese is made of these white lumps or curds. Cheese contains nitrogen.

   **Inference.** — Milk forms flesh.

5. Boil a little milk over a Bunsen burner or spirit-lamp till all the water is evaporated and dried up (Fig. 262). Burn the solid part left. The ash that remains behind is mineral matter (Fig. 261).

   **Inference.** — Milk is a mineral food.

   **Inference from II. 1, 3, 4b and 5.** — Milk is a perfect or complete food.
III. The Dairy Industry.

1. The Milk Trade.—Around London and the large towns.
   We import cows from Jersey and Guernsey, because our own cows are beef-producers rather than milk-producers.

2. The Cheese Trade.—Cheshire, Shropshire, Gloucestershire, Leicestershire (Stilton), Wiltshire, Somersetshire (Cheddar).

3. The Butter Trade.—Dorsetshire, Devonshire, Cambridgeshire.

IV. Dairy Imports.

As we do not make enough butter and cheese at home, we have to buy a great deal from abroad and from Ireland.

1. Butter and Margarine.—Holland, Denmark, France, Sweden, Germany.
   Margarine, a preparation of milk with butter or fat. Show a piece, and let the class compare it with a piece of butter.

2. Cheese.—Mainly from United States, Canada, Holland.

V. Dairy Ports.

1. Newcastle receives more butter than any other English port. It receives more than twice as much as London.
   Reason—London draws enormous supplies from the great agricultural districts of Southern England and the Channel Islands.


3. Cheese to most of these ports.
LESSON XXVII

THE HORSE AND ITS USES, ASSOCIATED WITH THE LIVE- STOCK INDUSTRY

Apparatus.—Pictures of horses; model of a horse; specimens of horse's teeth; a horseshoe; a piece of sole leather; blank Map of England showing counties; Map of Europe; blank sketch map for children.

I. Adaptability of Structure to Habit.

1. Show models and pictures of horses.

Observation.

a. The head is long.
b. The jaws are very long.
c. The neck is long.

Inference.—The head and neck are an aid to grazing.
2. Show specimens of the horse's teeth.
   There are six sharp cutting-teeth in front of each jaw, and the rest are broad and flat.
   **Inference.**—The teeth fit the mouth for eating grass.

   ![Fig. 264](image1)
   ![Fig. 265](image2)

3. Show model and pictures again. Note tail.

   **Observation.**
   a. The tail is thick, short, and pointed, and covered with long hair, which starts quite from the base of the tail.

   ![Fig. 266](image3)

   b. From common observation, and from the pictures, elicit that the body of the horse is covered with short hair, which is fine in summer and thicker in winter.

   c. A little questioning should bring out the practice of "clipping" horses.
Inference from the above observations—

a. The short hair causes the horse to be troubled with flies, and the long tail is wanted to drive them away.

b. The tail should never be cropped.

II. Adaptability of Structure to Use.

1. From the observation of the model and the pictures let the class note—

   a. The large, heavy body, with its broad chest and round hips.

   Inferences.
   
   1. The heavy body denotes strength.
   2. The broad chest denotes lung power.
   3. It is therefore well fitted for a beast of burden.

   b. Its broad back sinking slightly towards the middle.

   Inference.—It is well fitted for riding.

   c. The slender but strong legs.

   Inference.—The legs are suitable for speed.

2. Show the horse’s teeth again, and note from B.B. sketch (Fig. 265)—

   a. The tusk on either side of the jaw.
   b. The gap between the tusks and the grinders. This gap is called the “bar.”

   Explain that the horse’s mouth is tender, and that this bar is used for the bit.

   The bit is used for guiding the horse.

3. Uses.—Elicit by questioning—

   a. For carriages and carts.
   b. For hunting and riding.
   c. For racing.
   d. For the army.

III. The Live-Stock Trade.

1. Our moist climate gives us splendid pasture-lands.

   Inference.—Our country is fitted by Nature for the rearing of cattle.

2. Horse-breeding is an important industry with us. No other nation has such fine breeds of horses. Our thoroughbreds are in some points even superior to the Arabian horses.


4. Sheep.—See lesson on Woollen Trade.
LESSON XXVIII

THE MEAT TRADE

Apparatus.—Meat trade catalogues, labels, tickets; shop lists; store lists; tins (of tinned meats); blank Map of England showing counties; similar sketch maps for class; Map of the World.

Method of Teaching.

1. Paper labels should be prepared and pinned on to each foreign country as it is named, e.g. [LIVE MEAT] should be pinned on to Holland, Denmark, &c.
2. Places in England should be entered on the blank map, and suitable labels should be pinned under them. The labels should be prepared on differently coloured papers.
3. The boys should copy names of places on to their sketch maps.

I. Introduction.

1. Show some catalogues, lists, &c., and elicit from an examination of them such trade facts as—
   1. Welsh and South Down mutton.
   2. Yorkshire hams.
   3. Wiltshire bacon.
   4. Ostend rabbits.
   5. New Zealand mutton, &c.

2. From an examination of these and similar facts get the class to infer—
   a. Part of our meat supply is raised at home.
   b. Part comes from abroad.

   Utilise any local knowledge of shops also.

Enter the facts on the B.B. as named, and let the class copy on to their slates or note-books.

II. The Meat Trade.

By the aid of the following facts proceed to elaborate the trade still further:

1. Home Supply.—Everywhere (see lessons on wool, milk, &c.). Lincoln, Leicester, Northampton, Hereford, Somerset, Devon, Eastern Counties, Sussex, Wales. This applies to beef and mutton, veal and lamb.

   Pigs.—Everywhere, principally Wiltshire (bacon), Yorkshire (ham), Hampshire, Berkshire, Essex.
2. Foreign Trade.—Large and increasing.

a. Live Meat.—Bullocks and sheep from Holland, Denmark, North Germany, United States, Canada. Pigs from Holland and Denmark.

b. Dead Meat (frozen carcases). Why frozen?
   1. Beef.—United States principally.
   2. Mutton.—New Zealand, Australia, Argentine Republic.

c. Tinned Meats.—Show a tin. Tins made air-tight. Why?
   New Zealand, Australia, Argentine Republic, United States.

The meat is tinned because these countries are too distant for the live cattle trade.
   1. Big grazing countries, hence huge sheep-farms, &c.
   2. Farmers used to rear sheep for wool. The meat was thrown away.
   3. Now the carcases are boiled in big coppers, to get the fat for tallow-making.
   4. The fat being removed, the meat is tinned.

d. Hams and Bacon.—United States and Canada.

e. Poultry and Eggs.—France and Holland.

f. Rabbits.—Belgium (Ostend).


a. Live Animals.—Deptford (cattle market), Liverpool (beef especially), Newcastle.

b. Sheep Ports.—Hull, Grimsby, Harwich.
LESSON XXIX
A HERRING AND THE FISHING INDUSTRIES

Apparatus.—A glass vessel filled with water and containing several live fish; a fresh herring and a sharp knife; fresh egg; salt water; a small elastic bladder; a spindle or tip-cat; blank Map of England; pictures of different kinds of fish.

I. Swimming.
A. Weight.
1. Call attention to the bowl of fish. They are swimming. Why can fish swim?
2. Take a fresh egg and place it in salt water (Fig. 269). If it sinks, add salt until it floats anywhere in the water. Compare with fish.

Inference.—Bulk for bulk most fish, like the egg, weigh the same as an equal bulk of water.
3. (a) Get a small elastic bladder, and partly blow it out. Tie the neck.
   Class to note that it does not rise at all, or does not rise easily in the air.

(b) Heat the bladder before a fire or gas jet.
   The bladder becomes larger and rises more easily.
   Note. — The quantity of air was the same in each case.

4. Now carefully open the herring and show the air bladder.
   Call attention to the fish swimming in the glass vessel. They rise and sink.

5. Explain that the fish can make this bladder larger or smaller by the aid of some muscles. When larger, the air in it is lighter, bulk for bulk.
   Inference. — The fish then rises in the water.
   When smaller, the air within the bladder is pressed closer together and weighs heavier, bulk for bulk.
   Inference. — The fish then sinks in the water.

B. Shape.
1. Point to the shape of the fish (Fig. 270).

2. Sketch the outline of a torpedo on the B.B. (Fig. 272). Compare the two.
   Both are spindle-shaped. Show a spindle or tip-cat.
3. Sketch the outline of a "best" boat (Fig. 271). (Those used by scullers for racing.) Tell that this boat is fashioned thus for speed.

![Fig. 271.]

4. Compare again with the torpedo, which also is shaped for speed.

**Inference.** — The spindle-shaped body of the fish is the best shape for motion in the water.

![Fig. 272.]

**C. COVERING.**

1. Let the children run their hands along the fish from head to tail. It is smooth and somewhat slimy.

**Inference.** — The smooth scales and the slimy skin make it easier for the fish to go through the water.

**D. TEMPERATURE.**

1. Take a fish out of the bowl and let a child handle it. *It is cold.*

2. Now let several feel each other's hands. They are warm.

**Inference.** — Our blood is warm, but the blood of the fish is cold, so that it can withstand cold water.

*Note.* — A further lesson might be given, if desired, upon *Movements, Food, and Breathing.*
II. The Fishing Industry.

1. An Important Industry.
   
   a. Over 50,000 men and boys employed in it. One fisherman for every 600 people.
   
   b. Account for this importance as follows:
      1. We live on an island.
      2. Point to the long coast-line.
      3. Quick transit by railways.
      4. In some cases steam vessels collect the fish and bring it into port.

2. Fishing Centres.

   (Enter on blank map.)

   a. East Coast. — Whitby, Hull, Grimsby, Yarmouth, Lowestoft, Ramsgate, Deal.

   b. South Coast. — Hastings, Brixham, Plymouth, Penzance.
3. **Chief Fish Caught.**

Show pictures of as many as possible.
(Show each picture as the fish is named.)

*Herring, Cod, Mackerel, Pilchard, Plaice, Sole, Oyster, Lobster, Haddock, Sprats, Eels.*

*Salmon, Trout,* are caught in some of our rivers.


**B.B. Sketch.**

(See Fig. 273, on opposite page.)

**LESSON XXX**

**SALT**

**Apparatus.** — Saturated solution of salt brought under notice of class during previous day, placed in large watch-glass and left in a place where slow evaporation will take place; Bunsen burner; platinum wire; sugar-candy; copper sulphate (blue vitriol).

**Revision.** — By questioning on previous object lessons obtain from class that salt—

1. Is white.  2. Has a peculiar taste.  3. Is easily soluble in water.  4. Is obtained (a) from rock-salt, (b) by evaporation of sea-water.

**I. Salt is Crystalline.**

1. Let class examine the salt in the watch-glass and note the tiny cubes of salt—all the same shape, but not the same size. Draw shape on B.B. (Fig. 274). Teach the terms *crystal* and *crystalline.*

![Fig. 274](image)

![Fig. 275](image)

2. Show crystals of sugar (in sugar-candy), of alum (Fig. 275), and of copper sulphate (blue vitriol). Note that they sparkle,
Crush the crystals. The "sparkling" disappears. 
The sparkling of salt, sugar, &c., is due to the crystals they contain.

II. Where Salt is Found in Small Quantities.
1. Sprinkle salt in Bunsen burner or spirit-lamp flame. 
The flame turns yellow. Tell class that this is a test for salt.
2. Thoroughly clean platinum wire by allowing it to remain in Bunsen flame till no yellow coloration is visible. 
Touch a book, clothing, clean drinking water—anything—with the platinum wire. Place in flame. A yellow coloration is produced.
Salt is found everywhere in small quantities.

III. Where Salt is Found in Large Quantities.
Explain that the salt we use at table is not obtained from sea-water, but from—
1. Rock-Salt.—Show specimens to class and ask for description.
2. Brine.—Very salt water obtained from springs.
Tell that salt is obtained chiefly from Cheshire and Worcestershire.
Draw a rough map of England on B.B.; let a child find out positions of Cheshire and Worcestershire on wall map and indicate corresponding positions on map on B.B. Insert the names Nantwich in Cheshire, Droitwich and Stoke in Worcestershire, and explain that these are the towns most concerned in the salt industry.

B.B. SUMMARY.

Salt.

\[
\text{(1)} \text{ In small quantities everywhere.} \\
\text{Found } \text{(2) In large quantities in Cheshire and Worcestershire.} \\
\text{Rock-salt} \} \text{ contain salt.} \\
\text{Brine} \} \\
\]
LESSON XXXI

SALT-MINING

Apparatus.—Map of England; specimen of rock-salt; evaporating basin; Bunsen burner; picture of street showing effects of subsidence.

Revision. — Previous lesson on salt.

I. Salt-Mining and the Preparation of Salt.

A shaft is dug and galleries are made in much the same way as in mining for coal.

1. A bed of rock-salt is reached, and large slabs are cut out and sent to the surface.

Show a piece of rock-salt, and ask how the salt could be obtained from it. Break some rock-salt into a coarse powder; cover it with water; let it stand some time to allow the salt to dissolve; pour off some of the water; evaporate the remainder (Fig. 276), and draw attention to the residue of salt.

Explain that in a very similar manner the salt is obtained from the rock-salt.

2. Or a brine spring may be reached.

The brine is then pumped into reservoirs, and afterwards into shallow pans, from which the water is evaporated.

II. Some Effects of Salt-Mining.

Show photograph or picture of street showing effects of subsidence, and ask class to try to explain how the houses have become tilted in this peculiar manner (Fig. 277).
B.B. SKETCH.

Salt is found as—

1. Rock-salt. 
   (a) Dissolved in water. 
   (b) Water evaporated. 
   (c) Salt left.

2. Brine 
   (a) Water evaporated. 
   (b) Salt left.

FIG. 277.

LESSON XXXII

COTTON

Apparatus.—*A piece of calico; a thread of sewing-cotton and a piece of cotton-wool for each child; a thistle-head; cotton pod; Map of World; picture of cotton plant; picture of field showing cotton culture.*

I. Examination of a Piece of Calico.

*a. Get children to fray out a piece of calico, and to observe that it is made up of “threads” running along and across the material.*
b. Let child take up one of the threads produced by fraying, gently untwist one end, and then pull thread longitudinally into smaller threads. Repeat until a small heap of "fluffy" material is obtained.

II. Examination of a Thread of Sewing-Cotton.
   a. Have the thread of cotton untwisted into smaller threads. Compare the smaller threads with the threads obtained from the calico.
   b. Pull the smaller threads longitudinally as in 1b. Compare the results with the results of 1b.

III. Examination of a Piece of Cotton-Wool.
   Have the threads of cotton-wool pulled apart, and compare the results with those obtained in 1b and 2b.
   RESULT.—The "threads" of calico, the "threads" of cotton, and the "threads" of cotton-wool are much alike. Infer that they probably were all quite alike once, but have become somewhat changed in manufacture.

IV. Comparison of Cotton-Wool with Down in a Thistle-Head.
   Get class to notice that both are white, soft, and fine. Note that a seed is attached to the thistledown. Show some cotton-wool containing cotton seeds. Ask for origin of thistledown (Fig. 278), and infer that—
   Cotton-wool must be obtained from plants.
   Show the unsuitability of the term "wool" in cotton-wool.

V. Country in which Cotton is Grown.
   Show cotton pod. Country children will name the thistle and the dandelion head as containing "down" something like cotton-wool, but will know of nothing so large as the cotton pod. Proceed to explain that the cotton plant requires a hot climate, and tell that the cotton plant is cultivated chiefly in the United States. Show position on Map of World.
VI. Description of Cotton Plant.

Show picture of cotton plant; get children to observe as many of the following points as possible from the picture (Fig. 279):

General Description.—Rather a bush than a plant.

Height.—About 4 feet. Have this height measured on school wall.

Leaves.—Large, dark green. Sketch shape on B.B.

Flowers.—Yellow spotted with purple. As the flower fades, the base gets larger and forms a pod. Compare with thistle, pea, &c.

Pods.—Show cotton pod; get children to observe that it is about the size of a walnut, and that the cotton-wool has broken through the pod. Note the cotton seeds; compare with pea as regards size.
VI. What is done to Cotton in the United States.
   a. Gathered.
      Show picture, and get children to observe that the cotton is gathered by black women. Teach the terms "negro" and "negress."
   b. Dried in sun.
   c. Freed from seeds. This operation is called "ginning," because performed by a machine called a "gin." Compare engine.
   d. Packed into large bales.
   e. Conveyed to coast and put upon steamer for England.

B.B. SUMMARY.

Cotton.
Grown in the United States.
   { Four feet high.
     Cotton
     Large green leaves.
     Plant.
     Yellow flowers.
     Pod contains the cotton.
Cotton is—
   1. Gathered.
   2. Dried.
   3. Freed from seed.
   4. Packed into bales.
   5. Sent to England.

LESSON XXXIII
THE COTTON TOWNS

Apparatus.—Map of World; Map of England; pictures of Liverpool docks, the Manchester Ship Canal.

Blank maps may be distributed and names may be inserted either during or after the lesson.

I. Transit of Cotton to England.
   Let child trace course of ship from south of the United States across the Atlantic to England.

II. Where Cotton is Landed in England.
   1. Get class to reason as follows:—
      a. The cotton-wool has to be manufactured into cotton goods.
      b. Machinery must be used in this manufacture.
      c. Coal will be required to help to make the steam to drive this machinery.
      d. Hence it would be well to land the cotton-wool near a coalfield.
2. (a) Let class enumerate and show on map the chief coalfields of England (p. 235).
(b) Argue that if the ship stopped near one of the coalfields near the west coast, it would not have so far to go as if it stopped near a coalfield on the east coast.
(c) Tell children that the great centre of the cotton industry is situated on the South Lancashire coalfield.

Draw a sketch map of South Lancashire on B B. (Fig. 280).

III. The Cotton Ports.
Ask children to look at map of England, and point out the chief ports on the South Lancashire coalfield. Show picture of docks of Liverpool and Manchester.

IV. The Cotton Towns.
Manchester, the centre of the industry. Show the position. Oldham, Preston, Bolton, Wigan, Bury.
Have these found out on the map; insert on sketch map. Get children to copy sketch map, and to learn the towns from their positions.

V. The Manchester Ship Canal.
Indicate position on map; show picture; dwell on its commercial importance to Manchester.
WHERE COTTON IS SENT TO.—India, China, Cape Colony, West Indies.

B.B. SKETCH.
LESSON XXXIV

CLOTHING, ASSOCIATED WITH THE WOOLLEN TRADE.

(First Lesson.)

Apparatus.—Two small glass bottles; kettle of hot water; corks for bottles; a piece of flannel and a pocket-handkerchief of equal size; two pieces of ice of equal size; another piece of flannel and one of cotton of equal size; couple of slates; a teaspoon; two smaller bits of flannel and cotton respectively of equal size; specimens of fine (Australian, &c.) and coarse (English) wool; blank Map of England showing counties; similar sketch maps for boys; Map of the World.

Method of Teaching.—As in previous lessons.
2. Similar sketch maps for class.

I. Clothing and Warmth.

1. Previous to the lesson, take two small glass bottles; fill each with hot water from the same kettle. Cork tightly. Wrap one thoroughly in flannel, the other in a pocket-handkerchief.

   Flannel to be the same size as the handkerchief.

   Draw attention to this preliminary part of the experiment, and let class uncover and test for warmth.

RESULT.—The bottle wrapped in flannel is the warmer.

Inference.—Flannel does not allow heat to escape as quickly as linen or cotton.

2. Compare our bodies with the warm bottles, and further infer—

   That woollen clothing does not let the heat of the body escape so quickly as cotton clothing.

3. Wrap two pieces of ice of equal size in flannel and cotton respectively. Allow them to remain some time on the table, and after a suitable interval observe that—
a. The piece wrapped in flannel has not melted so much as the piece wrapped in cotton.

b. The flannel kept the hot bottle warm and the ice cold.

The ice should be wrapped up before the lesson begins.

Inferences.

a. The flannel prevented the heat escaping from the hot bottle, and it also prevented the heat getting to the ice.

b. Woollen goods are not warm in themselves, but since they prevent the heat escaping quickly from our bodies, we call them warm.

II. Moisture and Clothing.

1. Take a couple of small slates. Pour one or two teaspoonsfuls of water on each. Take a piece of cotton and a piece of good flannel of equal size. Use one on each slate to soak up the water.

Result.—The flannel soaks up most.

2. Call attention to our changeable climate, and the risk of having cold, damp clothing next to the skin (perspiration), and infer that—

It is always safest to wear woollen goods next to the skin.

III. The Chief Wool Districts.

1. Explain that our sheep are reared for mutton rather than for wool. Hence, as a rule, English wool is long and coarse. Whereas, in Australia, New Zealand, and Saxony, sheep are reared rather for their wool. The result is that these wools are much finer than ours.

2. Show specimens of these wools and compare with some English wool, and let class distinguish the difference in quality.

3. Sheep districts. (See map in lesson on Meat Trade.)

<table>
<thead>
<tr>
<th>North of England</th>
<th>Cheviot Hills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wales.</td>
<td>Lincolnshire</td>
</tr>
<tr>
<td>Suffolk.</td>
<td>Herefordshire</td>
</tr>
<tr>
<td>Shropshire.</td>
<td>Leicestershire</td>
</tr>
<tr>
<td>Cotswold Hills.</td>
<td>Oxfordshire.</td>
</tr>
<tr>
<td>South Downs.</td>
<td>Hampshire.</td>
</tr>
<tr>
<td>Dorsetshire.</td>
<td>Devonshire.</td>
</tr>
</tbody>
</table>
LESSON XXXV

THE WOOLLEN TRADE

(SECOND LESSON.)

Apparatus.—Specimens of broadcloth, coarse cloth, coarse and fine wool; flannel, blanket, carpet (Brussels, Wilton, Kidderminster); alpaca; blank Map of England, showing coalfields and rivers near coalfields; similar sketch maps for boys, previously prepared; Map of World; a piece of shoddy goods.

Method of Teaching.—As in previous lessons, by means of—

2. Sketch maps for class, previously prepared.

I. The Wool Towns.

Connect position with coalfields and pure water-supply.

1. Broadcloth.
   a. Show a piece of broadcloth and a piece of any kind of coarser cloth. Let class examine them. Note the close, matted appearance of the broadcloth.
   b. Show specimens of fine (Saxony or Australian) and coarse wool. Have them examined, and associate the broadcloth with the finer wool.
   c. Towns.
      Leeds is the centre of the wholesale clothing trade.

2. Flannel and Blankets.
   a. Show specimen pieces of flannel and blanket goods. Flannel light, blanket heavy. Question for the reason of this difference.
   b. Towns.
      Rochdale, Halifax, Newton, Welshpool, Dolgelly, for flannel.
      Dewsbury, Batley, Witney, Welshpool, Dolgelly, Newton, for blankets.
3. CARPETS.
   a. Show specimen pieces of carpets. Let class examine them.
      1. Brussels.—Note linen web or foundation on which is worked a worsted pattern. Show specimens of worsted and linen. Explain name.
      2. Wilton.—Called Wilton pile. The surface is a pile of cut ends of worsted which has been sheared to make a level smooth nap.
      3. Kidderminster.—Really two separate carpets linked together. They are woven together. Made of worsted and wool. Note that, being double, both surfaces have the same pattern, only with the colours reversed.
   b. Towns.
      London, Kidderminster, and Wilton (for Brussels), Rochdale, Halifax. Kidderminster carpets are now made in the West Riding of Yorkshire. Not many carpets made at Wilton now.

4. SHODDY GOODS.
   Show a piece of shoddy and examine it.
   a. Explain "shoddy." Old woollen rags torn to pieces by machinery until they look like fibres of wool (show some fibres). A little new wool is mixed with them, and the mixture is then spun into cloth again. This will explain the cheapness of some clothing.
   b. Towns.
      Dewsbury, Batley.

5. OTHER BRANCHES OF THE TRADE.
   a. ALPACA.
      Show a piece of alpaca. Made of a beautiful wool, silky and elastic. Straighter and stronger than that of sheep's and lamb's wool. Used, not for woollens, but for stuffs (unfelted or unmilled).
      Made at Saltaire (near Keighley, in Yorkshire), Bradford, Halifax.
   b. SHAWLS.—London.
   c. WORSTEDS.—Bradford.
   d. WOOLLEN HOSIERY.—Leicester. Reasons: (1) Near coalfields; (2) Leicestershire sheep have excellent wool.

II. IMPORTS and EXPORTS.
   1. IMPORTS.—We buy wool from Australia, New Zealand, Cape Colony, Argentine Republic, British India, Natal, Russia, Spain (merino), East Indies (alpaca).
   2. EXPORTS.—We sell woollen goods to (principally) United States, Germany, France, Belgium, Holland, Australia, Canada.
III. Wool Ports.

1. **Exports.** — *Liverpool* (\(\frac{1}{2}\)), a great port near the chief centre of the trade; *London* (\(\frac{1}{4}\)), *Hull* (\(\frac{1}{15}\)), *Goole, Folkestone, Harwich, Grimsby*.

2. **Imports.** — *London* (nearly eight times *Liverpool*, which is next in order), *Southampton, Hull*.

IV. **Importance of the Trade.**

*a.* High reputation. Beats all other nations.

*b.* Special reasons for this —

1. The abundance of coal and iron found in the country.
2. The universal use of steam machinery.
3. No checks on the trade, as is often the case abroad.
4. A plentiful water-supply.
5. The existence of two great seaports, Hull and Liverpool, within easy reach. Good and easy communication.
6. Highly-trained workmen.
7. An extensive colonial empire.
8. Large and enterprising capitalists (explain).

**B.B. SKETCH.**

*Fig. 281.—The Woollen Districts.*
LESSON XXXVI

LEATHER AND THE LEATHER INDUSTRY

Apparatus.—Pieces of leather of different kinds (upper leather, sole leather, glove leather, &c.); leather purse; glass of water; piece of cow-skin (pieces of the skins of any animals will be useful); kid glove; dog-skin glove; blank Map of England showing counties; sketch maps for boys; Map of the World.

Method of Teaching.—As in previous lessons.
2. Sketch maps of England for class.

I. Uses of Leather.

By questioning elicit a few of the chief uses of leather, e.g.—
1. Boots and shoes.
2. Harness.
3. Travelling articles (bags, hat-boxes, cases for brushes, &c.).

II. The Suitability of Leather for its Uses.

1. Take a piece of soft leather ("upper" leather or glove leather). Form a rough kind of cup and pour water into it.

Note.—Water does not run through.

Inference.—Leather is waterproof.

Hence useful for the making of boots, shoes, bags, &c. Question out the wisdom and necessity of keeping our feet dry. Repeat experiment with sole leather.

2. Hand round specimens of soft leather. Class to discover from their own experimenting—
   a. That the leather is soft.
   b. It bends about easily.
   c. It is very tough.
Now compare with the "uppers" of their own boots. Show a leather glove (kid, dog-skin, &c.). Compare again. Show a leather purse. Bend it about. From these facts let the class infer the suitability of leather for these purposes.

III. Hides and their Special Uses.

1. Show piece of sole or harness leather. Made from bull or cow hide. Show a piece of cow-skin. Note that it is thick and strong.
2. Show a piece of "upper" leather. Made from calf-skin. Show a piece of calf-skin (if possible), and compare with the leather.
3. Show a kid glove. It is made from the skin of the kid.
4. Refer to a horse's collar. Made of horse's skin, which is very thin. A saddle is made from pig-skin.
5. All have heard of seal-skin jackets.
6. Show a dog-skin glove to illustrate the use of the dog's skin.

IV. The Leather Industry.

1. TANNING.—Bermondsey, Ashford, Northampton, Stafford, Cheshire, Lancashire, Lincolnshire.
2. LEATHER MARKETS.—Southwark, Bristol, Leeds (chief).
4. SADDLERY AND HARNESS.—London, Birmingham (very good).
6. FANCY LEATHER GOODS.—London (celebrated).

V. Imports.

Raw material nearly all imported. We buy HIDES from South America, United States, South Africa, Australia, Russia. We buy GLOVES from France.

VI. Exports.

Goods sent to France, United States, Germany, Holland, Belgium, Brazil.
LESSON XXXVII

SUGAR AND THE SUGAR INDUSTRY

Apparatus.—Some moist sugar; evaporating dish; spirit-lamp or Bunsen burner; wire gauze; picture of sugar plant; piece of sugar-cane; stem of some soft herbaceous plant; hammer; water; beetroot; some boiled beetroot; blank Map of England; blank sketch maps for boys; Map of the World.

Method of Teaching.

1. The names of the foreign countries should be pointed out on the Map of the World, and a slip of paper with the word "Sugar" printed on it should be pinned on to each country as it is named.

2. The English towns should be entered on the blank map as they are named, and then copied by the boys on to their sketch maps.
I. Properties.
1. Its sweetening properties are well known.
2. Put some moist sugar in a thin metal dish and heat over a Bunsen burner or spirit-lamp. Place dish on wire gauze (Fig. 283). The sugar melts.
3. Let the sugar cool. It becomes "Toffee."
4. Associate the heating of the sugar with the making of jam, sweetmeats, &c.

II. The Principles of Manufacture.
1. Brown Sugar.
   a. Show a picture of the sugar plant (Fig. 284). If possible, show also a specimen of the stem from the school museum.
   b. Take a piece of the stem of some soft herbaceous plant and pound it with a hammer. Call attention to the sap or juice in it. Use this to illustrate the presence of the sap in the sugar-cane.
      Show the pith of any wood. Pith is the valuable part of the cane. The ripe canes are cut down, cut into short portions, tied in bundles, and crushed between rollers to extract the juice.
   c. Take some warm water and dissolve brown sugar in it. Get a thick solution. Tell class that this is something like the juice or sap.
**d.** Pour a small quantity of the solution into an evaporating dish. Boil over gas, spirit-lamp, or Bunsen burner. The water evaporates and the sugar is left.

This will partly explain the process of extraction.

e. Explain that the sugar is then put into casks to cool for several weeks.

The casks have holes in their bottoms and stand over cisterns. Some cool and form into solid grains (Brown Sugar). That which will not solidify runs through the holes into the cisterns (Treacle). Loaf Sugar is made from Brown Sugar.

### III. The Sugar Industry.

1. **Its Importance.** — The quantity of sugar used is enormous.

   a. On an average 1 lb. per week for each person.

   b. Only four other classes of imported goods are of greater value, viz., Grain and Flour, Raw Cotton, Wool, and Metals.

---

**Fig. 285.** — The Sugar Districts.

2. **Kinds of Sugar.**

   From observation of specimens get class to note that cane-sugar is more crystalline and sweeter than beetroot sugar. Show a beetroot. Let several boys taste a bit of boiled beetroot and note its sweetness.
3. COUNTRIES FROM WHICH WE BUY SUGAR.
   a. Cane Sugar.—From tropical countries; the chief are—Java, Brasil, British Guiana, British West Indies, and British India.
   b. Beetroot Sugar.—From Germany, Holland, Austria, France, and Belgium. More beetroot sugar is used than cane-sugar.

4. SUGAR TOWNS.
   a. Unrefined Sugar.—Liverpool, London, most important. Then a long way below comes Bristol.
   b. Refined Sugar.—London, the most important. More than three times any other port. Hull and Goole next.

B.B. SKETCH.
(See Fig. 285, on opposite page.)

LESSON XXXVIII

INDIA-RUBBER, ASSOCIATED WITH THE CYCLE TRADE

Apparatus.—Specimens of different kinds of india-rubber; india-rubber ball; sponge; silk handkerchief; a bicycle (one wheel will do); cycle pump; a mackintosh or piece of mackintosh cloth; a glass of water; some boiling water (got ready before lesson); sharp knife; some naphtha, benzoline, or paraffin; blank Map of England; blank sketch maps for class; Map of the World.

METHOD OF TEACHING.—As in previous lessons.

2. Blank sketch maps for class.

In England.—Places as named to be entered on the blank map by the teacher, and then copied on to the sketch maps by the class.

Abroad.—Places as named to be pointed out on Map of the World.

I. Its Suitability for Tyres.

1. Let class experiment with pieces of india-rubber. They bend and stretch. Compare with sponge and silk handkerchief. Both elastic, but not to same extent. Throw an india-rubber ball on the ground. It bounces back.
2. (a) Now show bicycle (or bicycle wheel); deflate tyre a little; blow up again.

Inference.—The tyre can be blown hard because it is elastic.

(b) Deflate again, and detach tyre on one side. Call attention to the rim, and the way the tyre fits under it.

Inference.—The bending property of the rubber makes it fit more easily under the rim.

(c) Speak of the noise and jolting of an iron-tyred cart. Contrast with the smooth, quiet, easy running of the rubber tyre.

Inference from (1) and (2).—The elastic and bending properties reduce vibration.

3. Take a mackintosh. Let two boys hold up one end hollowed in the centre. Pour in water.

Note.—The water does not go through.

Inference.—India-rubber is waterproof, and water therefore cannot soak through the tyres.

4. Before the lesson begins, (a) put a piece of india-rubber in a vessel containing cold water, (b) and two pieces in a vessel containing boiling water. Use pure rubber.

Note.—a. Rubber does not dissolve.

b. Rubber swells and softens, but does not dissolve.

Inference.—It is not dissolved by water, hence wet roads and wet weather do not hurt tyres.

5. Take the two pieces out of the boiling water; put their edges together and press. They stick.

If the rubber has got too cold, then cut a piece of rubber in two. Place both in a spoon. Heat over Bunsen burner or spirit-lamp. Place the fresh edges together; press.

Result.—The edges stick together.

Inference.—The fact that rubber melts with heat enables the edges of tyres to be joined, and so made into a circle.

6. Put a piece in naphtha, benzoline, or paraffin.

Result.—It dissolves.

Inference.—We must protect the tyres from such oils, as they would damage them.

II. The Cycle Trade.

Has grown marvellously, and has practically invaded the whole world.

Nearly every town in the country now has its cycle makers, repairers, and agents.
1. **Chief Centres of Cycle Trade.**—Coventry, London, Birmingham, Nottingham, Wolverhampton, Beeston, Newcastle, and many other towns.

Associate these centres with the coal and iron districts.

2. **Imports.**—From *United States* principally.

3. **Exports.**—Large numbers are exported.

Chief countries: *Australia, India, Cape, Natal, New Zealand*, all forming parts of our own Empire.

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**Fig. 286.**—India-rubber Tree, and Method of Extracting Sap.

5. **India-rubber: Where Obtained.**—*South America* (Brazil; Para rubber the best), *Mexico, Borneo, Central Africa*. Note that rubber is a tropical product (Fig. 286).
LESSON XXXIX

PAPER AND THE PAPER INDUSTRY

Apparatus.—Cotton and linen rags; esparto; straw; old waste paper; piece of millboard; specimens of paper (from notepaper to brown paper); some caustic soda; woollen rags; some fraying pins; retort stand; flask; Bunsen burner or spirit-lamp; a pair of millboard bookcovers; a millboard box; Map of England; Map of World.

TEACHING.—Map of England and one of the World required.

I. What Paper is made of.

1. RAGS.

a. Show some cotton and linen rags. Compare with woollen rags. Let class feel them and note differences. Have a few cotton, linen, and woollen rags frayed out, and get class to note difference of fibres:
Cotton and linen fibres are vegetable fibres. Wool is an animal product.

b. On the previous day a tumbler should receive a strong solution of caustic soda. Into it should have been placed some bits of paper (Fig. 288). This should now be produced, and the class should be told what it contains. Class then to note:

The paper has been reduced to a pulp.

2. ESPARTO and STRAW.

Show some esparto and some straw.

Class to note—

a. Both are vegetable products.

b. Both have to be reduced to a pulp.

Show some white writing or printing paper. Contrast colour with the esparto and straw.

Inference.—They both have to be bleached.

c. Show some straw. Call attention to the nodes or joints. Tell that these nodes are a difficulty, as the paper varies in strength in consequence.

d. Show some writing paper, stout and transparent—probably made from esparto.

Show some millboard and coarse brown paper—made from straw probably. Clean white papers are made from oat and barley straw.

3. WOOD-PULP.

A large amount of paper is now made from wood-pulp.

4. OLD PAPER.

a. Show the tumbler with caustic soda solution containing paper. It is in a pulp.

Inference.—Paper easily reduces to a pulp.

b. Take a piece of writing paper with writing in ink upon it.

1. Pour some caustic soda on the paper. It partly removes the ink at once.

2. Boil a solution of caustic soda containing bits of printed paper. The ink is removed.

Inference.—Since the ink can be removed from old paper, and it easily reduces to pulp, old paper is suitable for making fresh paper.

The class can now understand the superiority of rags.

1. They are easily reduced to pulp.

2. They only require cleansing.
3. Whereas vegetable fibres contain gums, resins, nodes, &c., which have to be got rid of.

**EXPERIMENT.**—The quality of the paper can be roughly estimated by sight and touch, but better still by burning. Burn several pieces (fairly large) of different kinds of paper. The smaller the amount of ash the better the paper.

**II. The Paper Industry.**

1. **THE RAG TRADE.**—Rags collected for paper trade. Associate with rag-and-bone man and the rag-shop. Woollen rags are no good.

2. **MILLBOARD TRADE.**—For bookbinding, boxmaking, packing, and other purposes. Show an old pair of millboard book-covers and a millboard box.

3. **PAPER TRADE.**—Over 300 paper-mills.
   We make nearly twice as much paper as France, and more than twice as much as Germany.

4. **PAPER TOWNS.**—London, Dartford, St. Mary's Cray (S.E. of London), Canterbury, Manchester, Bath, Bristol.

5. **IMPORTS.**

   **Wood-pulp.**—Norway, Sweden.
Esparto.—Spain, Algeria. Newcastle, the port for esparto.
Rags.—Belgium, France, Germany.
Straw and Woodboard.—Germany, Holland, Belgium.

6. EXPORTS.—Both rags and paper exported. Paper exports growing. English paper superior to others. Exported to Asia, South America, and the Colonies.

B.B. SKETCH.
(See Fig. 289, on opposite page.)

LESSONS XL AND XLI

STEAM, ASSOCIATED WITH OUR RAILWAYS

Apparatus.—Evaporating dish; water; flask for boiling water; retort stand; spirit-lamp or Bunsen burner; cork for flask; kettle of boiling water; slate; piece of slate; physical and political Map of England; railway Map of England; sketch railway maps for the class.

I. Some Properties of Steam.
1. Place a few drops of water in an evaporating dish; heat.
2. Boil a flask of water.
   Draw attention to the great "cloud" issuing from the flask (Fig. 290).
   Note.—Water is changed into steam.
   Inference.—Water when heated becomes steam, which takes up much more room than water.
3. Insert a cork lightly into the neck of a flask of water that is about to boil.
   Speak about the great power of steam.
   Note.—The cork is driven out of the flask.
   Inference.—Steam has great force.

Fig. 290.
4. a. Ask if anything can be seen between the boiling water and the "cloud" issuing from the top of the flask.

b. Draw attention to the apparently empty space between the spout of the kettle and the "cloud of steam."

*Note.*—Nothing can be seen.

**Inference.**—Real steam is invisible.

c. Argue from 3 and 4a that it was just in that apparently empty space that the work of driving out the cork was done.

5. a. Insert cold slate into the apparently empty space between the spout of the kettle and the cloud of "steam" (Fig. 291).

b. Lower a small piece of slate into the neck of the flask containing boiling water, taking care to keep the slate out of the water.

*Note.*—The slate becomes covered with water.

**Inference.**—Steam when cooled becomes water.

6. Associate steam with the steam-engine, which will be a familiar memory to all the boys. Briefly explain that the engine is driven by steam. Avoid technicalities and particulars. The general principle only is required.
II. Our Railways.

Deal only with the chief systems.

1. Trace the course of each railway on the railway map, and so deduce its name.
2. Enter the approximate lengths on the B.B.
3. Describe the nature of the country traversed in each case.
4. Then try to deduce the nature of the traffic for each line. (Do not spend too much time over this, but make the children think, if possible.)
5. Mention a few of the chief towns on each line, and insert in map.

<table>
<thead>
<tr>
<th>Name of Company</th>
<th>Length</th>
<th>Nature of Country Traversed</th>
<th>Character of Traffic</th>
<th>Chief Towns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Western</td>
<td>2500</td>
<td>Undulating corn and pasture land; hilly in Devon, Cornwall, and Wales.</td>
<td>Mining and agricultural produce; fish from Cornwall, &amp;c.</td>
<td>London, Bristol, Exeter, Plymouth, Penzance, Oxford, Birmingham, &amp;c.</td>
</tr>
<tr>
<td>Midland</td>
<td>1400</td>
<td>Undulating farm country to Derby. Very hilly north of this.</td>
<td>Coal, iron, cotton, woollen, and other manufactures.</td>
<td>London, Leicester, Nottingham, Sheffield, Leeds, Manchester, Liverpool, Bristol, Birmingham.</td>
</tr>
</tbody>
</table>

(From Messrs. Longmans' "British Empire.")
Fig. 292.—Railway Map of England.
III. Suggestions.

1. The teaching should proceed through—
   b. A railway map.
   c. Sketch railway maps for the class.

2. Another lesson should be given on the smaller railway systems, e.g.—
   a. London & South-Western.
   b. Great Northern.
   c. Lancashire & Yorkshire.
   d. London, Brighton & South Coast.
   e. South-Eastern.
   f. Great Central Railway.
   g. London, Chatham, & Dover.

These railway systems are given in the order of their length.

B.B. SKETCH.
(See Fig. 292, on opposite page.)

LESSON XLII

CANALS

Apparatus.—Clay model of a canal; some light porous soil; blank Map of England; blank sketch map for class.

Method of Teaching.—As in previous lessons.

2. Blank sketch maps of England for class, prepared previous to the lesson. Class to copy in canals, &c., from the teacher's blank map as they are inserted.

I. Navigation Canals.

1. The children should be advised to visit the local canal (if any), and reference should be made to it during the lesson by way of illustration.
2. Show the model. Note—
   a. Its bed or channel has no slope or fall; the water is still.
   b. It has a towing-path.
3. Contrast the canal with the highroads and railroads. Unlike them, it cannot adapt itself so easily to the variations of soil and surface. 

RESULT.—*Cuttings, embankments, bridges, and tunnels sometimes required.*

4. Point to the **Leeds and Liverpool Canal** on the map. Class to note that—
   a. It joins the **Ouse** and the **Mersey**.
   b. It crosses the **Pennines**.

5. Elicit by questioning how it gets over the Pennines. By *locks* (Fig. 293). Tell this, if necessary.

6. By the aid of a B.B. sketch, briefly describe the action of a lock (Fig. 295).

7. Turn to the map showing canals. Class to note that most of these canals join one river with another.

**Inference.**—They increase the value of our waterways.
Fig. 294.—The Manchester Ship Canal.
8. By a further use of the map, elicit that for the passage of boats or barges—
   a. Some rivers may be too shallow.
   b. Some may be too rapid.
   c. Some may be too winding.
   d. Some may be profitably connected.

Hence the necessity for canals, which—
   a. Have no currents or tides.
   b. Are the same depth throughout.
   c. Are straighter and more direct than rivers.

II. Some of our Chief Navigation Canals.
   1. Enter each on the blank map as it is named.
   2. Let class copy on to their sketch maps.
      a. Leeds and Liverpool Canal.
      b. Huddersfield and Manchester Canal.
      c. Grand Trunk Canal (Trent and Mersey).
      d. Shropshire Canal.
      e. Oxford Canal.
      f. Thames and Severn Canal.
      g. Kennet and Avon Canal.
      h. Bude and Launceston Canal.
      i. Grand Junction Canal.
      j. Manchester Ship Canal.

      Note.—They are cheaper but slower than railways, which have acted as a check to their growth.

III. Other Uses of Canals.
   1. Irrigation.
      a. Show some light, porous soil. Let class handle it. It is dry.

      (A sandy soil with a little admixture of clay and mud is best.)
b. Argue that such soil wants water, and that it can be taken to the land by canals.

c. Explain that dry porous land in England, principally in the south and west, is changed into what are called "Water Meadows" by means of such canals. About 100,000 acres of barren land are thus made fertile.

2. DRAINAGE.
Illustrate by a reference to—

a. Sewers and gutters.
b. Ditches.
c. The changes wrought in the Fen District by such drainage.
d. By local drained land (if any).

B.B. SKETCH.

![Canals Map]

Fig. 296.—Canals.
LESSON XLIII

RAIN—THE RAIN-GAUGE

Apparatus.—Glass jam-jar; funnel of same diameter, or tin canister and funnel of same diameter; school ruler; strip of paper; compasses. If possible a real rain-gauge.

I. Revision.
Recapitulate lesson on Rain (Lesson III. Standard II.), dwelling especially on the reasons that more rain falls—

a. On the west than on the east coast of England.
b. On the sea-coast than inland.
c. In hilly than in flat country.

II. How the Rainfall is Measured.

THE RAIN-GAUGE.

1. On some previous occasion stand empty glass jam-jar or tin in school playground during a very wet day (Fig. 297).
2. Measure with ruler the depth of rain-water in the jam-pot or tin.
3. Allow the water to remain in the jar, and get class to note that the water begins to disappear on the succeeding fine days.

4. Infer that we want something that will let the water in, but will not let it escape readily.
5. Introduce funnel, which is of the same diameter as the jar or tin. Show that it offers no impediment to the entrance of the water, but that it checks rapid evaporation (Fig. 298).
6. Stand the jar and funnel out during a slight shower. Note that the rain-water barely covers the bottom of the jar, and that it is impossible to measure with the ruler the quantity of rain that has fallen.

7. Infer that something is evidently wanted to measure a very small quantity of rain.

8. Pour water into jar until there is exactly half-an-inch of water in it (Fig. 299). Introduce long glass (Fig. 300). Pour the half-inch of water into it.

9. Cut out a strip of paper the height of the water, and divide this strip into fifty equal parts. Paste on the long glass, which now becomes the measuring-glass. Show that as we have divided a column measuring half-an-inch of rain into 50 equal parts, we can now measure the 50th part of half-an-inch, i.e. \( \frac{1}{100} \) of an inch of rain.

This home-made rain-gauge may be kept on the roof of the school or building in school playground, and daily observations of its contents may be taken and recorded. The rainfall of the district for a week, month, or year may thus be ascertained.

A more elaborate rain-gauge is shown in Fig. 301.

III. The Rainfall of England.

The annual rainfall at Coniston is about 85 inches; at Liverpool, about 35 inches; at London, about 24 inches; at Lincoln, about 20 inches.

By questioning, get class to tell that if all the rain that fell in London remained just where it fell, if none of it ran off the ground, if none of it sank into the ground, if none of it was evaporated, then the
people of London at the end of a year would be walking about more than knee-deep in water. Apply to other places in a similar way. Compare the rainfalls as shown in Fig. 302. The teacher can easily add another sketch, showing the rainfall of the district in which the school is situated.

Get the children to point out the reasons the rainfall at Coniston is greater than that at Liverpool, &c.

LESSON XLIV

THE CLIMATE OF ENGLAND

Apparatus.—Map of England showing rainfall.

I. Revision.
Recapitulate the chief facts (very briefly) of the lessons on Winds, Clouds, and Rain in Standard II., and the lesson on the Rain-gauge in Standard III.

II. Factors Influencing Climate.

1. Temperature.
Show that temperature depends on—
   a. Distance from the equator (latitude). Speaking generally—
      1. The nearer a country is to the equator the warmer it is.
      2. Conversely, the nearer to the poles the colder it is.
      3. Point out England’s favourable position in the temperate regions of the northern hemisphere.
b. Proximity to the sea (insular climate).

1. Tell that the climate of the sea does not vary so much as that of the land. Water absorbs heat more slowly than land, and parts with it more slowly.

Inferences.

(1) The sea is cooler in summer and warmer in winter than the neighbouring land.
(2) An "insular" climate is thus more temperate than a "continental" climate.

2. Point to the Map of England, and show that its climate must be an "insular" one.

Verification.

The teacher might compare the temperature of England with one or two Continental countries in the same latitude in proof of this.

c. The prevailing winds.—With the aid of a map point out the direction of the prevailing winds.

1. West and South-West Winds.—Show that these come over the ocean, and are therefore wet and warm. These are the commonest, most frequent, or prevailing winds.

2. East and North-East.—Use map again. Come overland (Europe); therefore cold and dry, as a rule.

3. North Winds.—From over the sea and from the Arctic regions; therefore cold, and may bring snow—

"The north wind doth blow,
And we shall have snow."

4. South and South-East Winds.—Come over the warmer parts of the Continent from the tropics: hence warm.


England is a "moist" country.

a. Associate the rainfall with—

1. Its insular position.
2. Its prevailing winds (W. & S.W.).
3. The position and direction of its mountain chains.

b. Illustrate these facts by special reference to the annual rainfall, as illustrated by the Rainfall Map. England especially illustrates the effects of 2a (2) and (3).
Fig. 303.—Rainfall Map.
c. Associate the moist temperate climate with—

1. The energy of our people for work. Excessive heat and excessive cold are both against continued energy for work.
2. Our rich pasture lands and fine breeds of cattle.
3. The healthy nature, on the whole, of our climate.

*Note.*—

1. Storms.—Terrible storms rage in autumn and winter round our coasts. About 360 lighthouses and 50 lightships mark the more dangerous points. There is also an excellent service of lifeboats round the coast.
2. The class should copy the Rainfall Map in a subsequent "Mapping Lesson," and should preserve it for further use.

**B.B. SKETCH.**

(See Fig. 303, on opposite page.)