PHYSICAL PROCESSES
Age 7-8 (year 3)

A. Forces and motion
B. Light and sound
C. The earth and beyond

15 lessons

A. Forces and motion

4 lessons
How things move: friction
Pushing and pulling
Changing shape
The strength of shapes

1. How things move

Give a wide variety of objects (e.g. dice, book, toy car, marble, five pencils, a round plastic bottler and a square-ish plastic bottle).

Explain that you are going to try to move the objects in a variety of ways, such as rolling and sliding.

First, choose a smooth surface such a table and try to roll each object. Ask questions such as 'did the object roll?' 'Did it roll in a straight line?' Did some objects roll further than others?' Record your results. Discuss how shape and weight and texture seem to affect movement.

Next, take the objects which rolled easily and try rolling them on a rough surface such as a carpet. Do they roll differently? Can you explain why? Talk about **friction** which is caused by **resistance** when two objects rub together – smooth surfaces offer less resistance and so there is less friction. To show the meaning of resistance, hold the child's hand very tight and ask him to try to pull it away...).

Now take the book and try to slide it along the floor. Why doesn't it work? Give him the marbles and ask how these might help the book to move. Then give him the pencils and try those instead – how might they help the books move?

Extension: Try rolling/sliding objects on an angle/slant. What happens? Can you explain why?

Take two quite different objects which cannot be moved by rolling or sliding and discover how they move. For example, you might investigate scissors, discuss pivots and try to think of or find other things with pivots e.g. see-saws. And/or you could take a hand- whisk, discuss cogs and try to think of or find other things which use cogs.

2. Pushing and pulling

The aim here is to show that non-living objects cannot move themselves – they need a force to move them. Explain that when we try to make an object move, the force we usually use is a push or a pull.

You'll need pencils, elastic bands, springs, a toy car, a full drink can, a book and a brick. Try to predict whether it will be easier to move each object across the floor by pushing or pulling it, or whether it would make no difference. We measure the easiness/difficulty by the amount of effort/energy needed to move the object.
List the objects in order from easiest to hardest to move for each approach: push or pull.

Look around the house and find as many objects as you can which need to be pushed or pulled in order to be moved (e.g. fridge door - pull, bathroom light switch- pull, kettle switch – push). Discuss how a push or pull often causes something else to happen.

Extension: You could measure the forces in this experiment more accurately. Use and elastic band to measure pulls – by how much is it stretched when moving each object over the same distance? Use a spring to measure pushes – how far is the spring compressed when moving each object over the same distance? Make a table to show your measurements.

3. How forces change the shapes of objects

For this experiment you'll need clay/plasticene, an elastic band, an old pair of tights, a drink can, a straw, a pipe cleaner, a small cardboard box, a plastic bottle, balsa wood, a sponge ball, sticky tape, wool, paper and pencils.

The idea is to find out which objects will change their shape when various types of force are applied to them: pushing, pulling, stretching, twisting and bending.

Apply each force to each object and record the results (draw them if you like). Ask questions such as: Which objects changed shape easily? Which could be easily changed back to their original shape and which could not? Which objects held their new shape and which did not? Did any of the objects break, collapse or tear? Can you think why? What does this tell you about the materials they are made from? Did any objects change in all 5 ways?

Discuss why it might be good or bad for a material to change shape easily in terms of things we use. What about a pillow, a trampoline, a desk, a chair, a plastic bag? Look around and discuss the things you see in these terms.

Extension: focus on the plasticene. What happens when you push it down? Why? (The downward force of the push from the hand and the upward force of the table are both greater than the internal forces holding the clay in its original shape)

4. The strength of shapes

The aim here is to show the child that changing the shape of a material can alter its strength.

You'll need pencil, scissors, very stiff card or board, ruler, sticky tape, measuring weights or equivalent, plywood 20 x 14cm OR a hardback book in similar dimensions.

Draw templates on the card (or print them off) to make two each of a 3D cube/box shape and a 3D pyramid/tent triangle shape with open ends – not solid (make these before hand if it's easier).

Place one cube and one 'tent' on the table. Holding the base steady, push each one with your fingers on a top edge of the square, then on one of the sides. What happens? Do the same with the tent shape. What happens? Which shape is more rigid? Why?

Take both cubes and both tents. Using the wood/book make two 'bridges'. Place weights on each, recording the amount of weights each can take before collapsing. Which holds more? Can you suggest why? Could the supports be moved to different positions to make them stronger?

This should show the children that different shapes can have different strengths even when they are made from the same material.

Extension: Think about how you could make the cube stronger (try adding two pieces of card in an 'x' shaped support inside the cube). Discuss the application of these findings to building e.g. houses and bridges.

B. Light and sound

8 lessons
Light sources
Straight lines
Transparency
Shadows
Shadow shapes
Reflections
Mirror images

1. Light sources

For this experiment you'll need a few torches of different strengths and a candle.

Discuss the fact that our natural source of light is the sun (what makes the sun light?). Explain that objects which produce light are called **luminous**. Think of various sources of light (fire, candle, electric lights, torches, some small animals such as glow worms). The purpose of the experiment is to show that various light sources provide varying degrees of light.

Make the room completely dark. Light the candle. What can be seen? How far does the light from the candle extend? Can you see all the objects in the room clearly? Blow out the candle and switch on the weakest torch. If you hold it straight up just where the candle was, does its light extend further than the candle's? Is the same/less? If you direct the beam straight ahead of you, keeping it still, can you see further than you could with the candle? Can you see objects more clearly? Try the same with the other torches. With the most powerful torch, can you see all the objects in the room?

Extension: Can you measure the lengths of the various beams? Can the brightness of the torch or the size of the beam be altered? How does the torch actually work?

2. Straight lines

This experiment answers the question, 'Why can't we see around corners?'

You'll need a torch, two A5 pieces of cardboard, scissors, a shoe box with lid, pencils, white paper, rulers and two dusters.

Make a small hole in the centre of each piece of card. Support the two cards upright about 5cm apart, with the holes aligned (you may need sticky tape or 'blu tak'). Place a torch (you may need to support it on a book) about 3cm behind the second piece of card, so that it shines through the holes. Now move one of the pieces of card so that the holes are no longer aligned. Why do you think can the light no longer be seen?

Next, cut a slit in one end of the shoe box, about 3cm long and 3mm wide. Place a piece of white paper jutting out from the end of the box with the slit. Position the torch in the box and switch it on. What do you notice about the beam of light showing on the paper? Draw a pencil line alongside the beam. Next, place an object on the paper. What happens to the beam? What happens where it hits the object and what happens behind the object?

Use this information to answer the question 'Why can't we see around corners?' (because light travels in straight lines).

Extension: shine the torch in a darkened room and shake a duster or cloth in the beam. What do you see? What do you notice about the edges of the beam? Research the 'Tyndall effect'.

3. Transparent, translucent or opaque?

You'll need a shoe box, torch, scissors, card, cling film, clear plastic, paper, tissue paper, glass, tin lid, plastic lid, wood, fabric, foil.

Explain that light can pass through certain materials but not others. Materials which allow light through so that you can actually see through them are called **transparent**; materials which allow some light through to give a blurred image are called **translucent**; materials which allow no light through are called **opaque.**

Cut out one end of the box and place the torch so that it is shining into the box, onto the uncut end. Test each material to discover whether it is transparent, translucent or opaque. Sort the materials into these three groups. Do the materials in each group have anything in common? (e.g. hard, soft, thick, thin).

Extension: Look around the room and find a few objects to place into each category. Test with a torch if possible to see if your predications are correct.

4. Shadows

Explain that you are going to investigate what happens when light shins on an opaque object.

Place some objects in small envelopes, such a 50p, a paper clip, a small pencil, a feather – anything which has a distinctive outline.

In a darkened room, shine a torch onto each envelope and ask the child to identify the object contained in it. Discuss why the light shows the outline of the shape but cannot shine through it (the object is opaque).

Choose a few more objects and ask the child to draw what he thinks the shadow will look like. See if he is right.

Extension: Place an object which is a mixture of opaque and transparent (e.g. a toy car with windows). Predict whether or not a shadow will be produced where the windows are (perhaps drawing a prediction of the shadow to be produced).

5. Shadow shapes

You'll need three torches of different strengths and some everyday objects such as cup, toy etc.
In a darkened room, give the child the torches and objects.

First, ask him whether he thinks the shadow will be the same for each object using each torch, or if there will be some differences in the shape or size of the shadows produced (if so, what? Write down the predictions). Let him carry out the tests (keeping the torch at the same distance each time) and see if he was correct in his predictions.

Next, ask him how he thinks he might be able to affect the shape of the shadows formed by using the torches differently. Again, have him make suggestions and make predictions. You might suggest that he holds the torch at a different angle, or a different height, from above and from the side. What happens if he uses more than one torch at the same time?

Extension: You could measure the height and angle of the torch from the object, record these measurements and discuss the effect these have on the shape of the shadow.

6. Shadow sizes

This experiment is about finding out what affects the size of a shadow.

You'll need an empty matchbox, a torch, a metre ruler and a small ruler.

Place the matchbox on the edge of a table with a blank wall behind it. Place the metre ruler on the table, and position the torch about 70 cm from the matchbox. Switch on the torch so that a shadow is produced on the wall. Make a note of both measurements (perhaps in a table): the distance between the torch and the matchbox, and the height of the shadow. Ask the child what he thinks will happen to the shadow if the torch is placed at 60cm from the matchbox? Write his prediction then carry out the test. Do the same for 40cm and 30cm. Ask him to predict what the height of the shadow will be at 20cm then at 10cm.
Were his predictions accurate? Does this show there is a pattern to the results? What does the experiment show? (distance from light source affects shadow size).

Extension: graph the results of the experiment.

7. Reflections

Make a collection of shiny objects (wrapping paper, lids, foil, spoons, baubles, mirror, bottle, fabric etc.).

Discuss what we mean by 'shiny'. Discuss the idea of reflections. If you look at yourself in each object, what do you see? How does the image of you differ in the different objects?
List the objects in order as to which gives the clearest reflection and which the least clear. Can you think of reasons for this? (shape, surface?).
Look at your face carefully in the spoon – back and front. Is there any difference? Look very close up and then far away in the front of the spoon. What do you see?

Now shine a torch on each object. What happens? Shine the torch on some non-shiny objects and observe the differences. Does the torch make shiny things look shinier? If so, do you know why? (they are reflecting more light)

Extension: create a hall of mirrors with different reflective objects/materials and invite someone to view himself in the various 'mirrors'.

8. Mirrors

You'll need 2 mirrors, blue tac, and small toys

Have some fun with the mirrors: try to write your name whilst looking in the mirror. Why is it so difficult? How can you look behind you, or at the ceiling, under the table or even around a corner? Explain what mirrors are made from (polished glass with a reflective silver film on the back), and that they show a reverse image of everything.

Using two mirrors together, we can create a true image. Let the child see if he can position the two mirrors on the table in such a way that he can see a true image of his face (to make it easier, first draw a mark on one cheek and show him how this is 'reversed' in a single mirror. He'll know he has a true image when the mark is on the 'real' cheek). He may need to stick the mirrors to the table. Try the same thing with a small toy car.

What happens when you move the mirrors together, or apart? Is the number of images affected? Try using three mirrors – what happens?

Give a sheet with various patterns on and see how these change when a mirror is applied to them (you can find these online).

Extension: design and make a kaleidoscope.

C. The earth and beyond

3 lessons
Earth, sun, moon
Tracking the sun
Changing shadows

1. Earth, sun, moon

You'll need card cut-outs of the earth, moon and sun (make them in the ratio 1mm – 4,880km: sun = 286mm, earth = 2.6 mm, moon = 1mm), a ball, a globe, pictures of the earth and a very large open space such as a park or field.

Discuss the term 'sphere'. Show some spherical objects (e.g. ball). Explain that the earth is a sphere. Examine a globe; find out your own home location. Ask which they think is larger – sun, moon or earth. Display the cards to show the relative sizes.

Look at the pictures of the earth. Explain that it is about 7.923 miles (12,756km) in diameter and is surrounded by an atmosphere about 400km deep.

Find out about the sun, which is a star with a diameter of 865,134 m (1,392,530km), and the moon which has a diameter of 2,171m (3,476km). Note that the moon makes no light of its own but only reflects the sun's light.

Take the card cut outs to a large open space and explain that you are going to try to show the distances between the earth and the sun. Explain that the earth is about 93,000,000m (152,000,000km) from the sun. Using a scale of 1 metre to 1 million km, mark the distance between the two as 150m. If you cannot manage this due to the distances involved, use a scale of 1cm to 1 million km.

Extension: Given that the moon is about 240, 388m (384,622km) from the earth, display the distance between the two in the ratios given above, thus showing the relative distances of all three bodies.

2. Tracking the sun

You'll need a sunny day, a marker cone or flag and a globe.

Place the cone of flag in a fixed position in a south facing area. Early in the day, ask the child to draw the view in front of him (buildings, trees etc.) noting carefully the position of the sun in relation to them. Make a note of the time under the picture. A few hours later, ask him to do the same. Repeat this ever few hours until the sun is not longer visible (try to fit in four observations). What does he notice? Did he expect this to happen? Ask him to note the time at which the sun was highest in the sky, and at its lowest. Does he think that if he repeats the experiment in a month's time, the sun will be in exactly the same place at the same time? Why, or why not?

Why does the sun appear to move across the sky? What direction does it take? (east to west). Using the globe, show how the earth turns, spinning on its axis from west to each each day. Why does the sun seem to move east to west? Have the child turn around from west to east, noting that his surroundings appear to move from east to west.

How many hours does it take the earth to spin once on its axis? What do we call this length of time?

Extension: repeat the experiment at different times of the year and record the results. Explain the movement of the sun.

3. Changing shadows

You'll need a sunny day, a piece of wood, white paper and a nail, a ruler and a torch.

Bang the nail into the wood with the paper on it. Place it in a sunny spot and don't move it all day. Record the shadow cast by the nail by drawing over it on the paper (recall why there is a shadow). Record the length of the shadow and the time it appeared. Ask the child if he thinks the shadow will be different in one hour's time. Test again after one hour. Ask him to predict again. Test again after one more hour. Continue through the day.

When the results are recorded, discuss why the shadow moved and changed length.

Extension: Plot a graph with the test results.
Research sun dials and create your own. How accurate is a sun dial likely to be at different times of the year?