

Teacher Notes

1. Lesson Outline

During their voyages in the oceans around Antarctica both Dame Ellen MacArthur and the crew of *HMS Endurance* frequently encounter albatrosses. These magnificent birds are masters of gliding on the air currents above the oceans and can remain aloft for months on end without having to land.

Of the 22 known albatross species, 19 are now threatened with extinction.

In this lesson pupils are asked to explore how albatrosses fly and investigate the forces that act on them during flight.

2. Learning Objectives

By the end of the lesson, pupils should be able to:

- Work effectively within a small group/team.
- Discuss within a group/team.
- Communicate effectively with others.
- Understand that a force is a push or a pull.
- Appreciate that forces can cause movement.
- Develop an understanding of how the albatross is adapted to its environment.

3. Age Group

Years 4, 5 and 6.

4. Timing

This lesson should take approximately two hours to complete.

5. Curriculum Links

England (National Curriculum)

Key Stage 2 Science

- Sc2: 2e; 5c
- Sc4: 2b - e

England (QCA Schemes of Work)

- Unit 4E: Friction
- Unit 6E: Forces in action
- Unit 6A: Interdependence and adaptation

Scotland (5-14 National Guidelines)

Environmental Studies: Science

- Forces and their effects: Level A,B,C
- Variety and characteristic features: Level A,B,C

Wales

Key Stage 2 Science

- Life Processes and Living Things: 4.1, 4.2
- Physical Processes: 2.1 - 2.3, 2.5, 2.6

Northern Ireland

Key Stage 2 Science and Technology

- Living Things: Animals and Plants a, b
- Physical Processes: Forces and Energy c

6. Keywords

The following is a list of keywords that will be used in this lesson:

- *air resistance* - the force that pushes against anything moving through the air. The faster you go, the greater the air resistance is.
- *drag* - another name for air resistance.
- *force* - a push or a pull.
- *gravity* - the force that pulls things towards the ground and gives matter weight.
- *lift* - the force produced by air passing over a wing, that lifts an aeroplane or bird into the sky.

7. Equipment & Materials

Teacher Resources

- A large globe and/or world map.
- Pictures of Dame Ellen MacArthur *HMS Endurance* from the Resource Gallery either printed out or displaying on the class whiteboard.
- Albatross pictures from the Resource Gallery either printed out or for displaying on the class whiteboard.

Practical Activity Resources

This lesson is supported with resource sheets which provide a template for building a flying model albatross and instructions for how to test the effect of adding more weight and changing the size and form of the wings.

Each pupil will need the following materials and resources:

- A copy of *Resource Sheet 11.1 - Forces and flying*.
- A copy of *Resource Sheet 11.2 - Build your own flying albatross*.
- A copy of *Resource Sheet 11.3 - Flight test your albatross*.
- A paper craft straw about 30 cm long.
- Scissors and sticky tape.
- Six 1 gram balls of modelling clay. If you do not have access to scales accurate enough to weigh these out, this equates to a ball of modelling clay about the size of a large pea.
- A stop watch.
- Access to a long tape measure (around 10 m) or measuring wheel.
- Something with a mass of approximately 11 kg - 11 bags of sugar in a basket for example.

8. Lesson Structure

Introduction

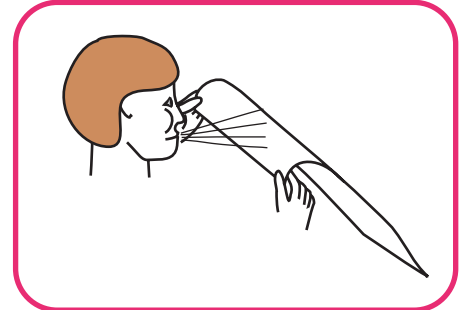
- I. Explain the role of *HMS Endurance*. Show children the images included in the Resource Gallery on this website to help illustrate this part of the lesson. You may also want to use a globe or map to show pupils where Antarctica is in relation to the UK. Explain also who Dame Ellen MacArthur is and that she has spent a lot of time in the southern oceans during her racing. Explain that her racing yachts are very different in design and purpose to *HMS Endurance*.
- II. Ask pupils to spend one minute in pairs writing down as many different animals as possible that they think that Dame Ellen MacArthur and the crew of *HMS Endurance* might see during a trip to the Antarctic.
- III. Show pupils an image of an albatross from the Resource Gallery and ask them if they know what it is.
 - Explain that albatrosses are among the world's largest flying birds. An adult wandering albatross can have a wingspan of over 3 metres and live for more than 60 years. You could ask pupils to measure out a length of 3 metres on the floor so that pupils can then compare this to their own height. You may also wish to show pupils pictures of other birds and animals to compare.
 - Explain that an adult albatross can weigh up to 11 kg. Allow pupils to get a feel for this weight by either passing round the 11 kg mass you have chosen or ask a few volunteers to come to the front of the class to try to lift it.
 - Explain that albatrosses are incredible fliers. They can lock their wing bones in position and glide on ocean wind currents for days on end.
- IV. Give pupils a copy of *Resource Sheet 11.1 - Forces and flying*. Ask them if they can label the forces shown on the diagram. If necessary write the following choices on the white board:
 - gravity
 - lift
 - air resistance (drag)

Pupils will then simply have to choose where the correct labels go.

Notice that there is no force arrow pointing forwards. The forward movement of the bird when it is gliding is due to the combined effect of gravity pulling it downwards and lift pushing it upwards. You could point out that an aeroplane would have another force arrow pointing forwards, this would be the thrust from the engines.

- V. Lift can be demonstrated very easily. Ask pupils to hold a single sheet of A4 paper up to their faces so that the short edge is stretched between their hands, horizontally just below the level of their mouths as in the diagram opposite.

Ask pupils to blow over the paper and they should see the sheet rise upwards.



- V. Explain that pupils are going to make their own model albatross and carry out some experiments to see how changing different things can affect the way in which it flies.

Main Activities

- I. Pupils now build their flying albatrosses. This work can be carried out either individually or in pairs.
- II. Once pupils have built their model albatrosses they will need access to an area such as the school hall for flying them. Flying can take place outside on a calm, dry day but gusts of wind will make assessing the effects of changes made to their albatross more difficult to see.
 - Making the model albatross is quite simple. Pupils should be discouraged from colouring in the wings and tails as this will weaken them and the albatross won't perform as well.
 - If pupils are going to carry out all of the 'flight tests' they may need to make more than one albatross as repeated flying does tend to damage them.
 - At the end of the lesson pupils can feedback to the rest of the class about what they have discovered.

Conclusion

Summarise key points ie;

- A force is a push or a pull.
- Gravity is the force which pulls things towards the Earth.
- Lift is the force produced by air flowing over a wing.
- Drag or air resistance is the force that acts to slow down objects when they move through the air (or any other gas).
- Albatrosses are well adapted to their environments their wings and ability to glide allows them to fly over the huge stretches of ocean that they live on.

9. Differentiation

- Adapt discussion sessions to suit ability and age group.
- Provide extra support during group activities for those pupils who require it.
- When completing *Resource Sheet 11.1 - Forces and flying* write the correct labels on the class whiteboard so that pupils can simply choose which label goes where

10. Extension Work

- More able/older pupils might be able to plan further investigations into how flight is affected by the shape of the wing etc.

11. Risk assessment

Some safety advice is included in this lesson plan, however, it is the responsibility of the supervising teacher to carry out all risk assessments with regard to this activity and to make sure that any such risk assessment complies with the requirements of the particular institution in which it is being conducted.

12. Find Out More

Teachers

www.visitandlearn.co.uk and www.royalnavy.mod.uk

Lots of information about HMS Endurance and its work in Antarctica.

www.ellenmacarthur.com/

Find out what Dame Ellen MacArthur has been up to recently.

www.earthlife.net/birds/feathers.html

Lots of information about the technicalities of feathers.

www.antarctica.ac.uk/about_antarctica/wildlife/birds/albatross.php

An outline of the problems facing the albatross.

www.savethealbatross.net/

Lots of information about albatrosses and the problems that human activities are causing them.

<http://en.wikipedia.org/wiki/Albatross>

Detailed information about the albatross lifecycle and taxonomy.

www.rspb.org.uk/supporting/campaigns/albatross/support.asp

Details of how to support the RSPB *Save the Albatross* campaign

www.grc.nasa.gov/WWW/K-12/airplane/

Lots of interactive information about flight. A bit advanced for KS2, but useful teacher reference.

Pupils

www.ellenmacarthur.com/

Find out what Dame Ellen MacArthur has been up to recently.

www.antarctica.ac.uk/about_antarctica/wildlife/birds/albatross.php

An outline of the problems facing the albatross.

www.savethealbatross.net/

Lots of information about albatrosses and the problems that human activities are causing them.

www.kcc.org.nz/birds/albatross.asp

Interesting albatross factsheet on a childrens' conservation website.

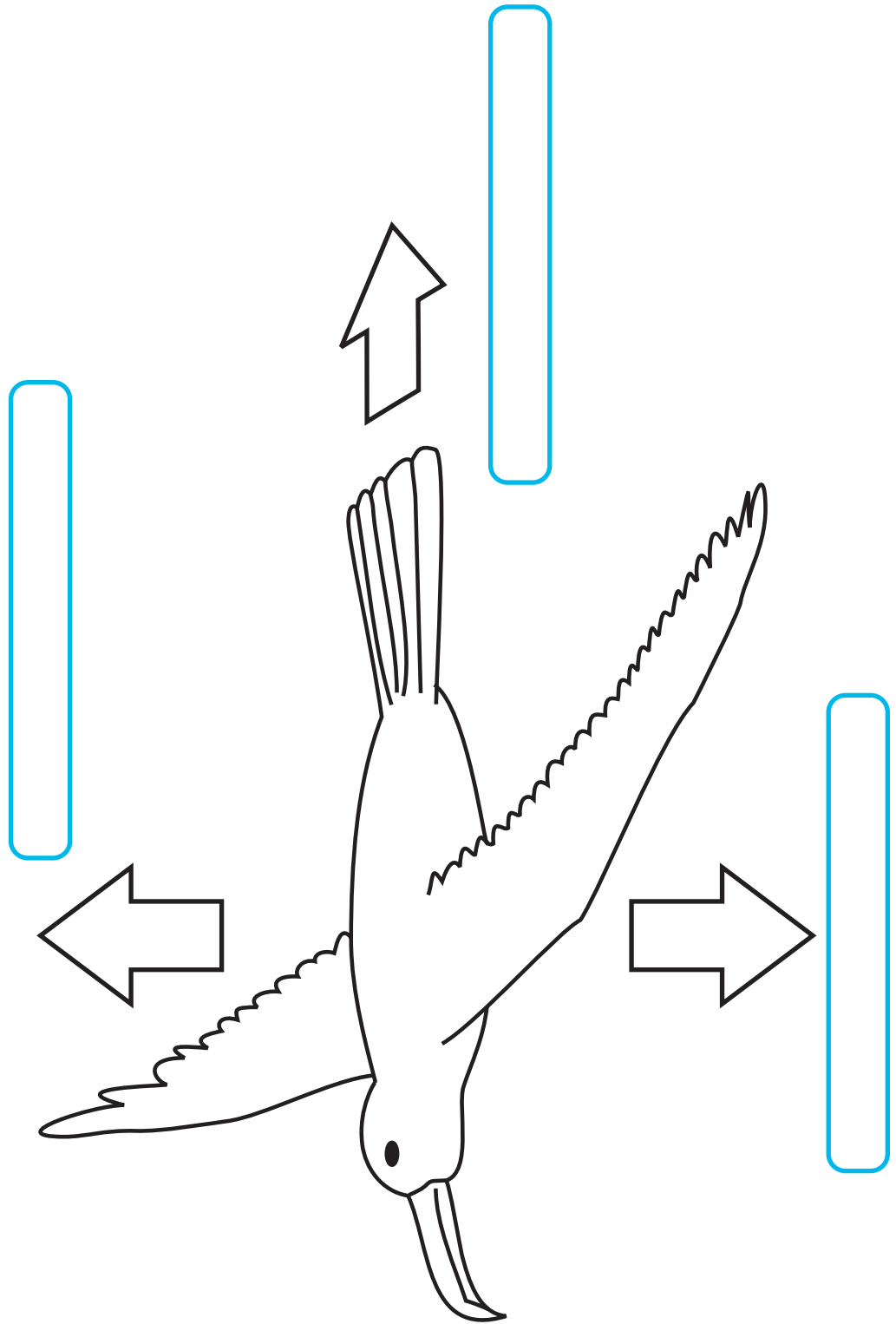
www.grc.nasa.gov/WWW/K-12/airplane/foilsime.html

Good wing simulation, but requires a download and installation.

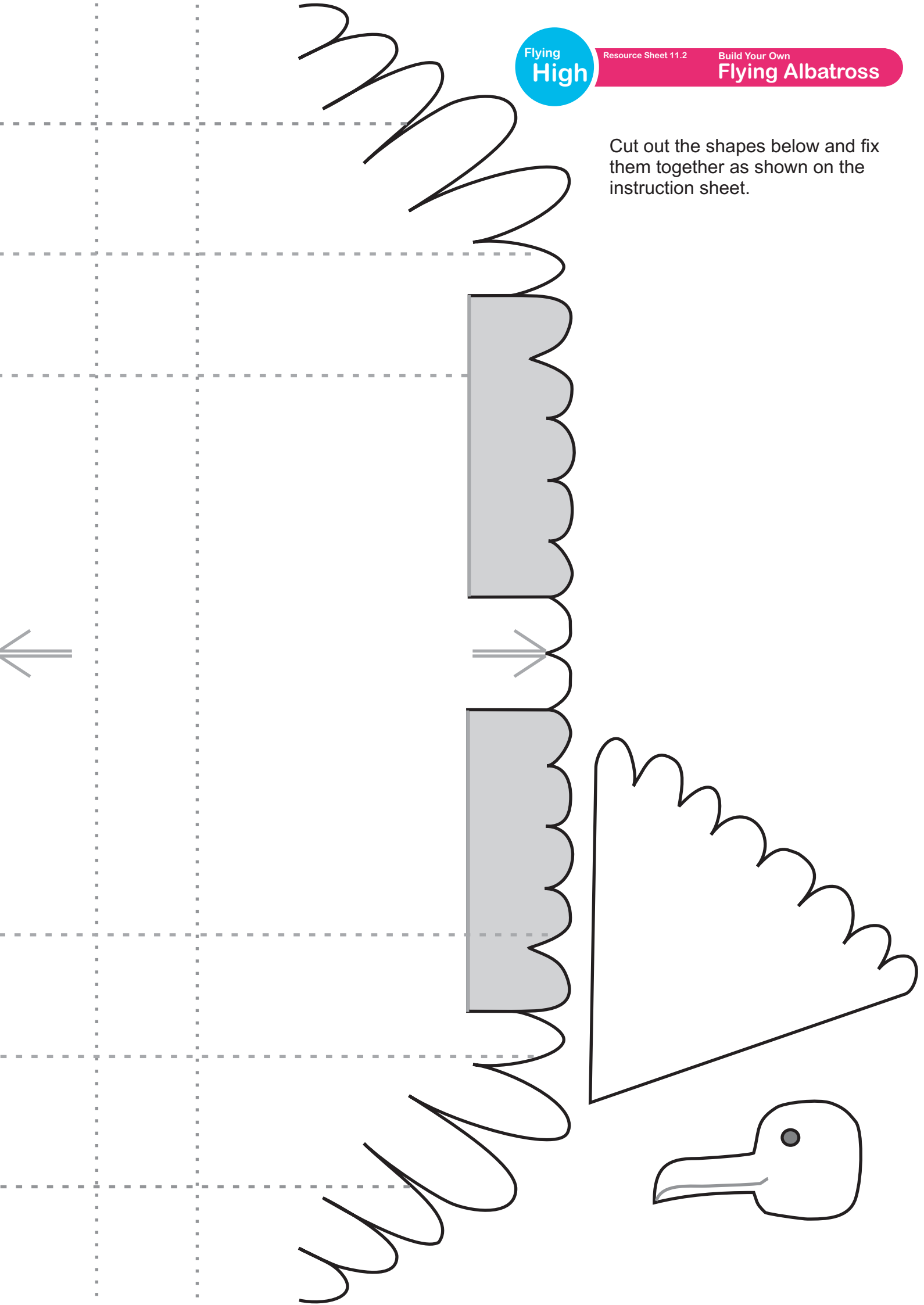
The picture below shows an albatross gliding far out to sea.

The arrows on the diagram are forces that are acting on the albatross.

Can you label them correctly?



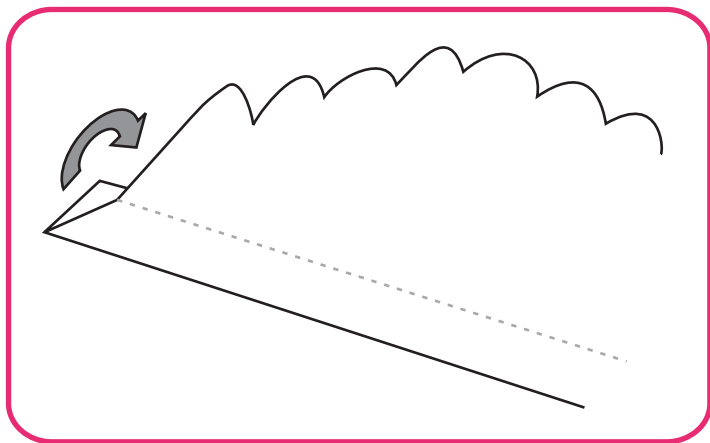
Cut out the shapes below and fix them together as shown on the instruction sheet.



Once you have cut out the parts of your albatross follow the instructions below to build your very own Flying Albatross.

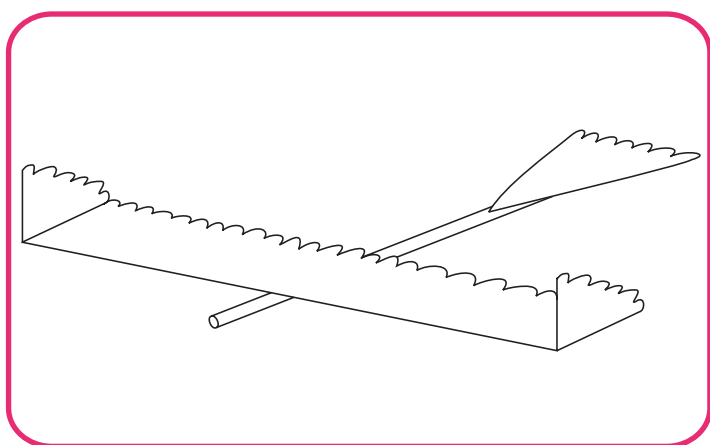
Step 1

Fold up the front of the wing.



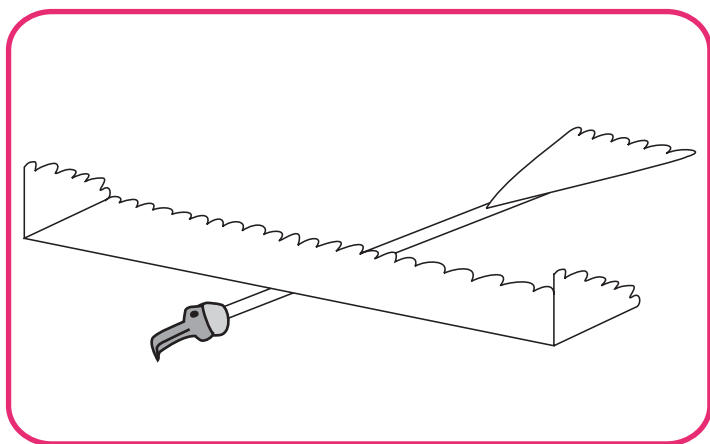
Step 2

Fix the wing and tail onto the paper straw with sticky tape.



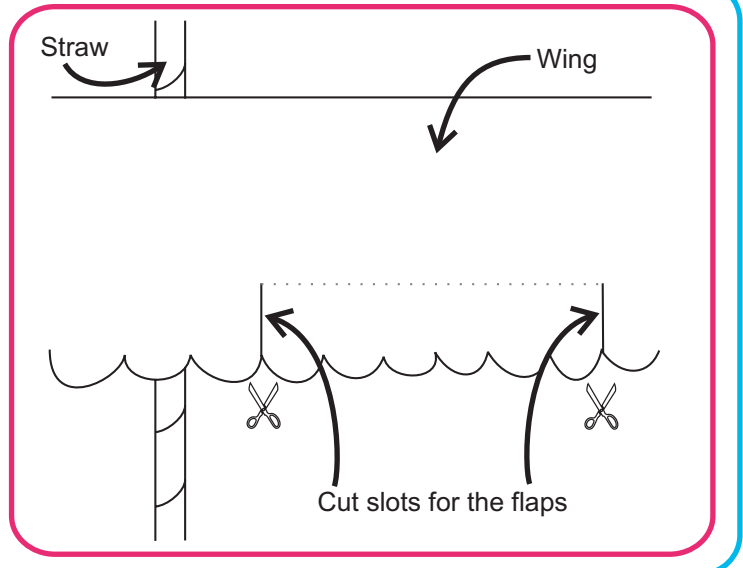
Step 3

Push a ball of modelling clay onto the front end of the paper straw and then push the albatross head into the modelling clay.



Step 4

Cut the flaps.



Now you have built your albatross it is time to do some experiments.

Follow the steps below to find out how changing weight and the shape and size of the albatrosses wings affect how it flies.

Changing Weight

- 1 Practice flying your albatross a few times so that you can see how it flies.
- 2 Try to throw it so that it flies about the same distance each time.
- 3 Once you can do this measure how far it is flying and write down the distance in the first line of the table below.
- 4 Balance your albatross on a pencil or finger as in the diagram below. The point where the albatross balances is called its 'centre of gravity'.
- 5 Fix one ball of modelling clay to the centre of gravity and then throw your albatross. Try to make sure that you throw your albatross with the same amount of force as you did before.
- 6 Write down how far it flew in the table below.
- 7 Add another ball of modelling clay and throw the albatross again.
- 8 Repeat this until you have added all 5 balls of modelling clay.

Number of modelling clay balls or added weight in grams	Distance travelled in metres
0	
1	
2	
3	
4	
5	

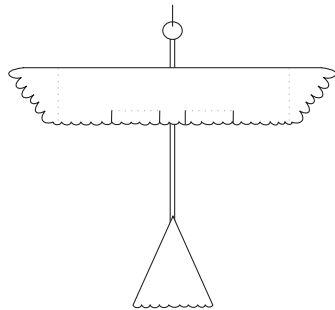
Before you go onto the next stage check that your albatross is still flight worthy. If it is a bit battered you might need to build another one.

Changing Wing Shape

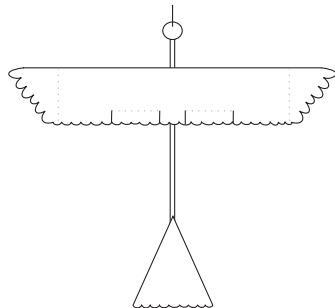
- 1 On the main wing of your albatross there are two 'flaps' which you can bend up or down.
- 2 The tail is a triangle shape and you can also bend the back of this up and down.
- 3 Fly your albatross without moving any of these and in the box below describe how it flew did it go straight ahead, did it go left, did it go right, did it go up or did it go down?

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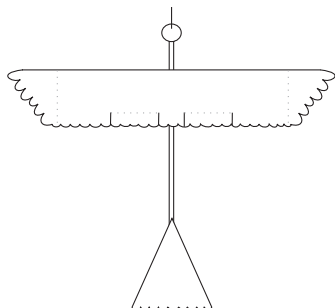
- 4 Now try seeing what difference moving the flaps and tail make to your albatross's flight.
- 5 On the diagrams below colour each flap and the tail according to which direction you bend it in. Red means UP, blue means DOWN and no colour means that you haven't moved it. Then in the box next to the diagram describe how your albatross flew.



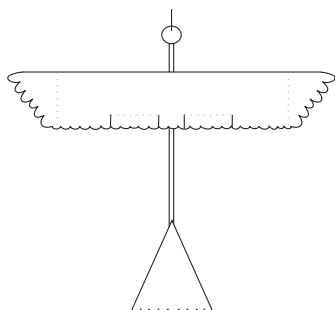
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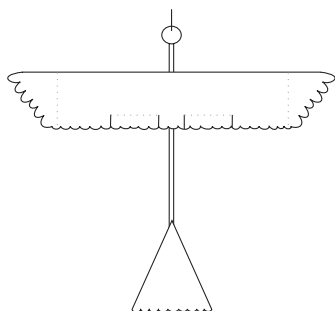
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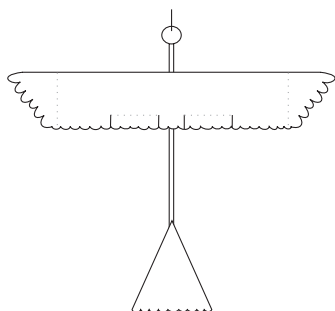
Four horizontal dashed lines for writing.



Four horizontal dashed lines for writing.



Four horizontal dashed lines for writing.



Four horizontal dashed lines for writing.

Before you go onto the next stage check that your albatross is still flight worthy. If it is a bit battered you might need to build another one.

Changing Wing Size

- 1 Throw your albatross and measure how far it flies. Write the distance in the table below.
- 2 On the main wing you will notice that there are three sets of dotted lines. Now trim the tips off of the wings to the first set of lines. Fold the ends of the wings back upwards as this helps your albatross fly in a straight line.
- 3 Do not move the flaps or the tail for this experiment.
- 4 Now fly your albatross and try to make sure that you throw it with the same amount of force as you did before.
- 5 Write down the distance it flew in the table below.
- 6 Now cut the wings down to the second dotted line and fly the albatross again. Write the distance it flew in the table.
- 7 Now cut the wings down to the third dotted line and fly the albatross again. Write the distance it flew in the table.

Wing size in centimetres from tip to tip	Distance travelled in metres

What Have You Found Out?

In the boxes below write down what your experiments have helped you to find out.

What difference did increasing weight make to my albatross?

Four horizontal dashed lines for writing.

What difference did changing the shape of the wing make to my albatross?

Four horizontal dashed lines for writing.

What difference did changing the size of the wing make to my albatross?

Four horizontal dashed lines for writing.