Launching the Shuttle!

Science Knowledge:

- To understand the forces involved in launching and landing a shuttle;
- To draw a forces diagram;
- To understand the difference between a shuttle and a rocket.

Science Skills:

- Carrying out a simple test;
- Measuring the distance travelled;
- Recording results in a table;
- Using results (evidence) to answer a question.

Maths Skills:

- Measuring angles accurately using a protractor

WHAT YOU SHOULD KNOW BEFORE YOU BEGIN

NASA's shuttle programme researched, built and tested space craft which could be launched into space using rockets but would be able to return to Earth using the gravitational pull of the Earth to glide back down. The shuttles ditched their rockets once they reached altitude and were in orbit around the Earth. In this way, part of the shuttle was reusable.

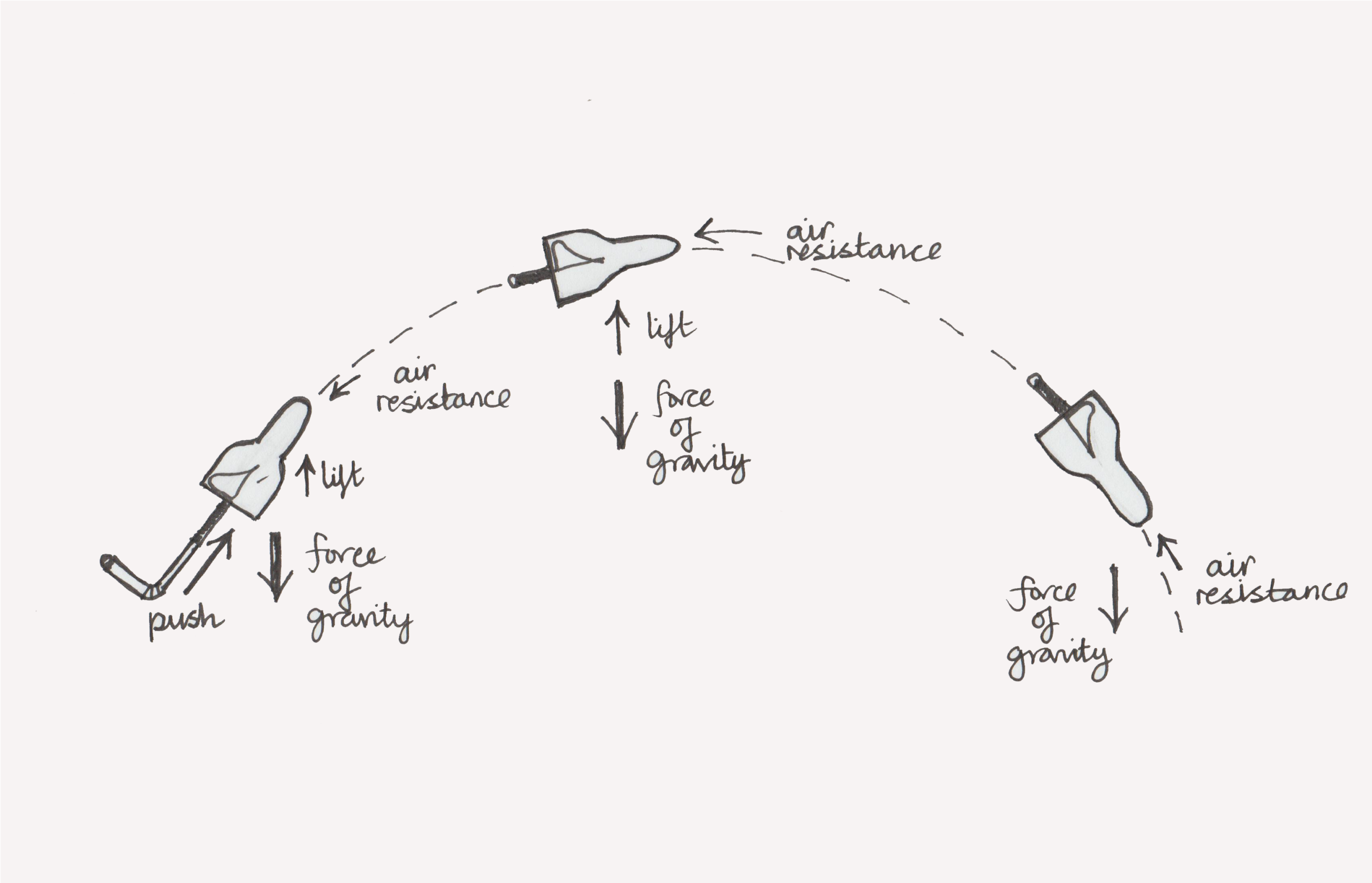
They were quite different to the Saturn V rockets which went to the moon and had several rockets to get them into orbit and from there into space and to the moon. The shuttles were shaped more like planes so they could glide down and land on an airstrip, whereas the only part of the Saturn V rockets which returned to earth were the tiny command modules in the nose of each rocket, which had to freefall through the atmosphere and splashdown in the sea.

The shuttle was designed to hold cargo. It had a payload bay from where items could be launched into space or serviced such as the Hubble telescope. It could also carry large pieces of equipment including Spacelab – a self-contained laboratory which could be used for carrying out experiments in space.

Four shuttles were built originally: Columbia, Challenger, Discovery and Atlantis. Challenger and Columbia were lost in tragic accidents. Endeavour, the shuttle on which Mae Jemison travelled, was built in 1991 to replace Challenger.

In this activity, the children can make their own shuttle, using the templates on the worksheet, attached to a straw, which is launched by a child blowing.

The forces involved in launching a rocket or shuttle include: a push force (usually the thrust of the rockets but here the push is provided by the blower), air resistance as the rocket flies through the air, and gravity. The shuttle itself would have a push force for as long as the rockets are firing. However, with these model shuttles, the push force stops as the shuttle leaves the 'launcher straw'. There is some lift force acting on the rocket, holding it up in the air and the shuttle will begin to slow down as there is air resistance acting against the movement of the shuttle and gravity will pull the shuttle down. It will travel in an arc. See the diagram below.



WARM UP – Gliding

Ask the children to construct a paper aeroplane. Watch to see if the children are making different designs.

Ask:

- How do you make it go further?
- Which designs go furthest?

Elicit that some planes glide well and that the angle and speed at which the plane is thrown, affects how far it will glide.

Draw a forces diagram to show which forces are at play (see the diagram above for guidance).

INTRODUCTION

Tell the children:
Mae Jemison's shuttle was designed more like an aeroplane than a rocket. It used rocket thrusters to get into space, but it jettisoned the rockets once the fuel was used up. When the shuttle returned from its orbit, it glided to Earth and landed on a runway, using parachutes to help it slow down.

We are going to create shuttles on based on a straw rocket design.
Watch this 10 minute video:

DK Stay Home Science Lab – Making Straw Rockets
https://www.facebook.com/dkbooks.uk/videos/2606870396193272/

MAIN ACTIVITY

Give out equipment:

- Straws
- Scissors
- Paper
- Tape
- Shuttles Worksheet
- Measuring tapes (or masking tape marked up on the floor)
- Protractors

Tell the children:

Make a straw rocket, following the instructions on the video. Cut out the shuttle designs on the sheet (you will need two of each) and stick to the straw rocket to make a shuttle. Test each shape to find the 'best' one.

You may need to spend some time discussing what 'best' means in this context and come to the agreement that the 'best' shuttle will glide the furthest.

Once the children have found the shuttle design that glides the furthest, ask them how they controlled all the other variables, so they could tell was only the shuttle design that made the difference. Elicit that it is hard to control how hard you blow but you could control the angle at which you launch the shuttle.

Tell the children:

You are going to investigate the angle of launch of your chosen shuttle. Use the protractor to try launching your shuttle at different angles. Record your results in a table like this:

Angle of launch (degrees)	Distance travelled by the shuttle
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	

After the children have tested their rockets at different angles, ask:

- What did you find out?
- Do we all agree on which is the best shuttle design and best launch angle? Why might we get different results?
- Did you have to solve any problems?
- What forces do you think are at work here?

EXTENSION

Measure the angles in increments of 5 degrees and try out their own designs for a shuttle shape.

FINALE

Watch a real launch of the shuttle.

https://www.youtube.com/watch?v=-iCwc99mQWg

REVIEW

ALL: Children are able to carry out a simple test comparing the angle of launch and be able to say which launch angle made the shuttle travel the furthest.
MOST: Children are able to measure distances and angles accurately and identify the forces at work.
SOME: Children make their own designs to test and measure with more accuracy.