Teacher CPD
Workshop 3

Journey into Space

3

DPSM/ESERO
Framework for Inquiry

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THEME		
CURRICULUM	Strand: Strand Unit: Curriculum Objectives: Skills Development:	

ENGAGE

THE TRIGGER	WONDERING	EXPLORING

INVESTIGATE

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

REFLECTION	

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THEME	Overall theme	
CURRICULUM	**Strand:** **Strand Unit:** **Curriculum Objectives:** **Skills Development:**	**Use the DPSM Planning Guide to identify the strand/strand units and the appropriate curriculum/learning objectives that your pupils should achieve.**

ENGAGE

THE TRIGGER	WONDERING	EXPLORING
• Relating the new experience to the children • Using objects (e.g. torch for simple circuits, sycamore seeds for spinners etc.) • Play with toys, objects (e.g. magnets) • Use DVD clips, digital images of the scientific phenomenon • Story • The mystery box A mystery demonstration	• Discuss everyday experiences • Concept mapping • Concept cartoons • Think and draw • Question and answer session • Free writing • Brainstorming • Manipulation of materials • Newspaper article (fictional/actual) • The science talk ball	• The Invitation to learn • New experience presented to the children • The children discuss this and try to provide explanation • Teacher identifies children's 'alternative ideas' • Children's questions about the exploration • Provides them with opportunities to explore the phenomenon

INVESTIGATE

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• Starter question for investigation • Teacher or children pose the question/scenario/present the problem to be investigated	• Children record predictions and provide reasons for their predictions	• In groups the children design, plan and conduct inquiry • Collect and organise data	• Children interpret and discuss their results • Present their findings: Propose explanations and solutions based on the data • Drawing conclusions

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

- Discuss implications of their findings e.g. bigger spinner falls more slowly than smaller one. Therefore if I was to jump out of a plane I would choose a bigger parachute as it would fall more slowly.
- Debating
- Making connections
- Apply their knowledge to a new learning situation.
- Consider how to extend their new understanding and skills - further exploration, address new questions.

REFLECTION	
REFLECTION	• Did I meet my learning objectives? • Are the children moving on with their science skills? • Are there cross curriculum opportunities here? • What questions worked very well? • What questions didn't work well? • Ask the children would they change anything or do anything differently.

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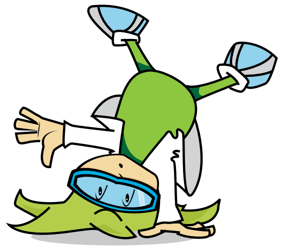
DESIGN & MAKE A FOAM ROCKET



Class level
3rd - 6th Class

Skills
Predicting, experimenting,
observing, recording, analysing.
Designing and Making
(Exploring, Planning,
Making, Evaluating

Content
SCIENCE: Energy and Forces

MATHS: Measures: Length

Shape and Space: Angles

Data: Representing and Interpreting

Cross - curricular links
Geography: Planet Earth in Space

Art: Rocket design

Equipment
For each rocket:

- Foam pipe insulation *(” diameter) – 30 cm length*
- Wide rubber band - *(6 mm. size 64 works well)*
- Duct tape
- Cardboard or styrofoam food tray *(for fins)*
- Scissors
- Long tape measure
- Metre stick




Preparation
3rd/4th may need to have the slits in the pipe insulation cut for them.

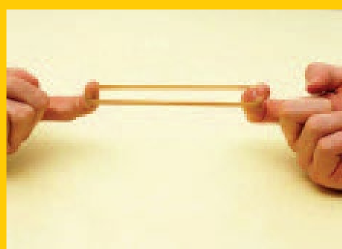
They may also need to be given a template for the fins.

A large room with a high ceiling or the school hall - or, ideally, the playground on a calm day - would be suitable for launching the rockets. Children can send them quite high!

Background information
This rocket is based on stored energy.

When you pull back the elastic band, the elastic band stores this energy.

When you let it go, it releases this energy as it returns to its original length.
(See DPSM activity 'Design and Make a Catapult' – also based on stored energy).



The foam rocket is stabilised by the fins, which keep it pointed in the desired direction.

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Technically the foam rocket is a rocket in appearance only. Real rockets get their energy from burning fuels emitting gases from the back of them, which send them forwards. See DPSM activities 'Rocket Launch' and 'Make a Rocket' which are based more on the principle of real rockets.

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Trigger questions:

What are rockets?

(Cylinders full of materials which produce gases).

How do they work?

(Gases going out the back of the rocket push it forward, like an untied blown-up balloon goes forward when you let it go and the air goes out the back)

What are rockets used for?

(Sending space machines into the air with great force to get outside Earth's gravity)

See DPSM activities 'Design and Make a Catapult' (related to stored energy) and 'Make a Rocket'

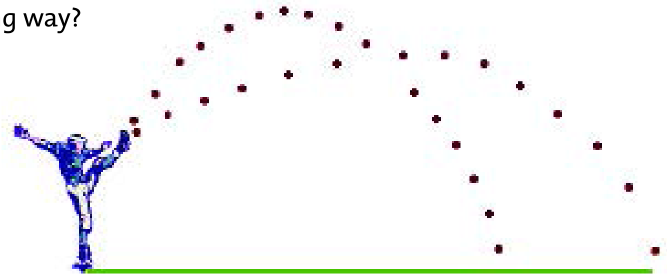
(using a film canister) for more Trigger Questions on the themes of stored energy and rockets.

If you sent your rocket straight up into the air where do you think it would land? (At or near your feet!).

If you want to throw a ball a very long distance how would you throw it? Very hard? Very high?

Or kick a football a very long way?

Does the angle matter?



Activities:

1. Design and Make a Foam Rocket

The following is a suggested way of making a foam rocket, but children should be encouraged to use their own creativity in relation to design: (see diagrams)

- Using scissors, cut one 30-cm. length of pipe insulation for each rocket.
- Cut four equally-spaced slits, each about 8 cm. long, at one end of the tube.

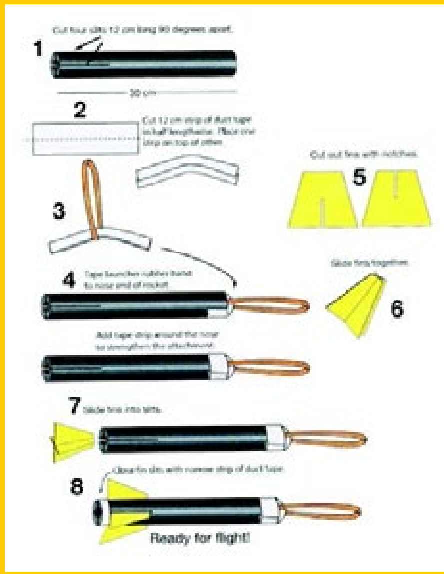
This will be the tail of the rocket. The fins will go into these slits.

Front of rocket:

- Cut a 12 cm. length of duct tape down the middle to make two pieces. Place one piece over the other, sticky to shiny side, to make the tape extra-strong.
- Place a (single strand of a) rubber band across the top of the foam tube. Tape the rubber band down to the tube, using the double strength duct tape at right angles to the rubber band. Press the tape down to the sides of the tube.
- Reinforce this tape with another length of tape wrapped around the top end of the side of the tube.

Fins end of rocket:

- Cut four fins from cardboard (or Styrofoam food tray). A suggested way is as follows:
- Cut a 10 cm. square, draw a diagonal and cut along the diagonal (forming 2 isosceles triangles). Then cut half-way down the height of one triangle and half-way up the other. Now nest the fins together, and place them in the slits.
- Close off the slits with another piece of duct tape wrapped around the foam tube.



Launching the Rocket:

- Loop the rubber band over the end of the metre stick.
  Pull on the fins end of the rocket, holding it below the fins, as you point it up into the air.
- Now let the rocket go.
- What happened to the rocket?

Questions

a. What is the shape of the path of the rocket? Draw it. (An arc of a circle).

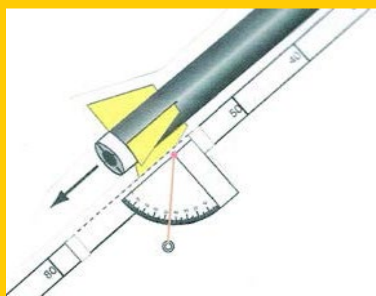
b. What force sends the rocket up? (The thrust from releasing the stretched elastic band).

c. What force brings the rocket down? (Gravity).

Measure the distance the rocket travels.

2. Children can compare the launch angle to the distance the rocket travels, as follows:

- Print the quadrant pattern on card.
- Cut out the pattern and fold it on the dashed line.
- Tape the quadrant to the metre stick so that the black dot lies directly over the 60cm. mark on the stick.
- Press a drawing pin into the black dot.
- Tie a string to the drawing pin and hang a small weight to the string. Make sure the string hangs freely.
  (If you are using a plastic metre stick attach the string to the black dot with a blob of blu-tack).



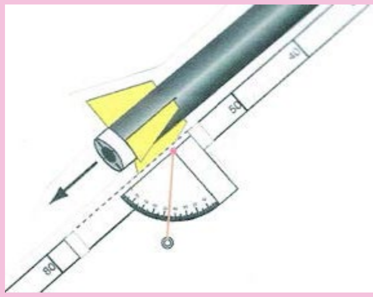
How will you make this a fair test?

What will you keep the same?
(Stretch the rubber band the same amount each time – e.g. the nose is aligned with the 30 cm. mark on the metre stick each time).

What will you change?
(The angle of the rocket).

Maths

Using the Launcher



- Loop the rubber band over the end of the metre stick. Pull on the fin end of the rocket until the nose is aligned with the 30 cm mark. Tilt the launcher up at the chosen angle as indicated with the string and weight on the quadrant.

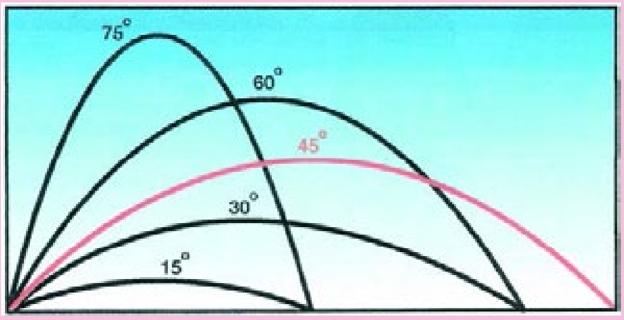
(Launching from the ground or a chair is not essential, but helps to make the launching more stable).

You can watch a video at the following website to see how the launcher is used:
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Rockets.html

To help measure long distances the children can measure, and place markers at, 1 metre intervals, starting at 5 metres and going up to 20 metres. They should repeat this and then take an average. Younger children could place cones where their rocket lands.

They can then tilt the rocket to a different angle and record the distance travelled for different angles. They can then draw a graph of distance travelled versus angle of launch.

Launch Angle (º)	Distance (Metres) 1	Distance (Metres) 2	Distance (Metres) Average
30			
45			
60			
75			



Question:

From your data, what launch angle gave the longest flight path?

They may find that this is approximately 45º

Follow-up Activity

Experiment with different sizes and shapes of fins, different lengths of rubber bands, etc. and see if this affects the movement of their rockets.

Children Can:

Play the game 'Angry Birds' if they have access to a Smartphone.

It is very relevant to the angle for launching things.

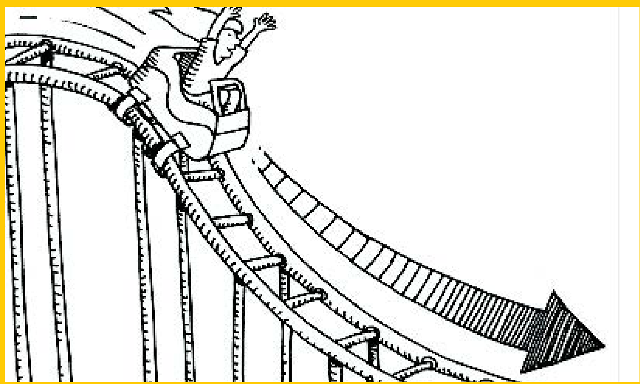
Add various shaped soft items to the nose of the rocket.

Do they make any difference to the flight?

Did You Know?

Things that are sent into the air, and that have no power of their own (e.g. a ball, but not an aeroplane) are called PROJECTILES. Gravity gradually brings them down.

In sport the speed and angle of projectiles are very important e.g. football, golf, table tennis ....



Isaac Newton was a famous scientist who was very interested in activities related to movement and there are famous laws named after him, called Newton's Laws of Motion.

Useful Websites:

This activity is based on one from the American Space Agency (NASA website):

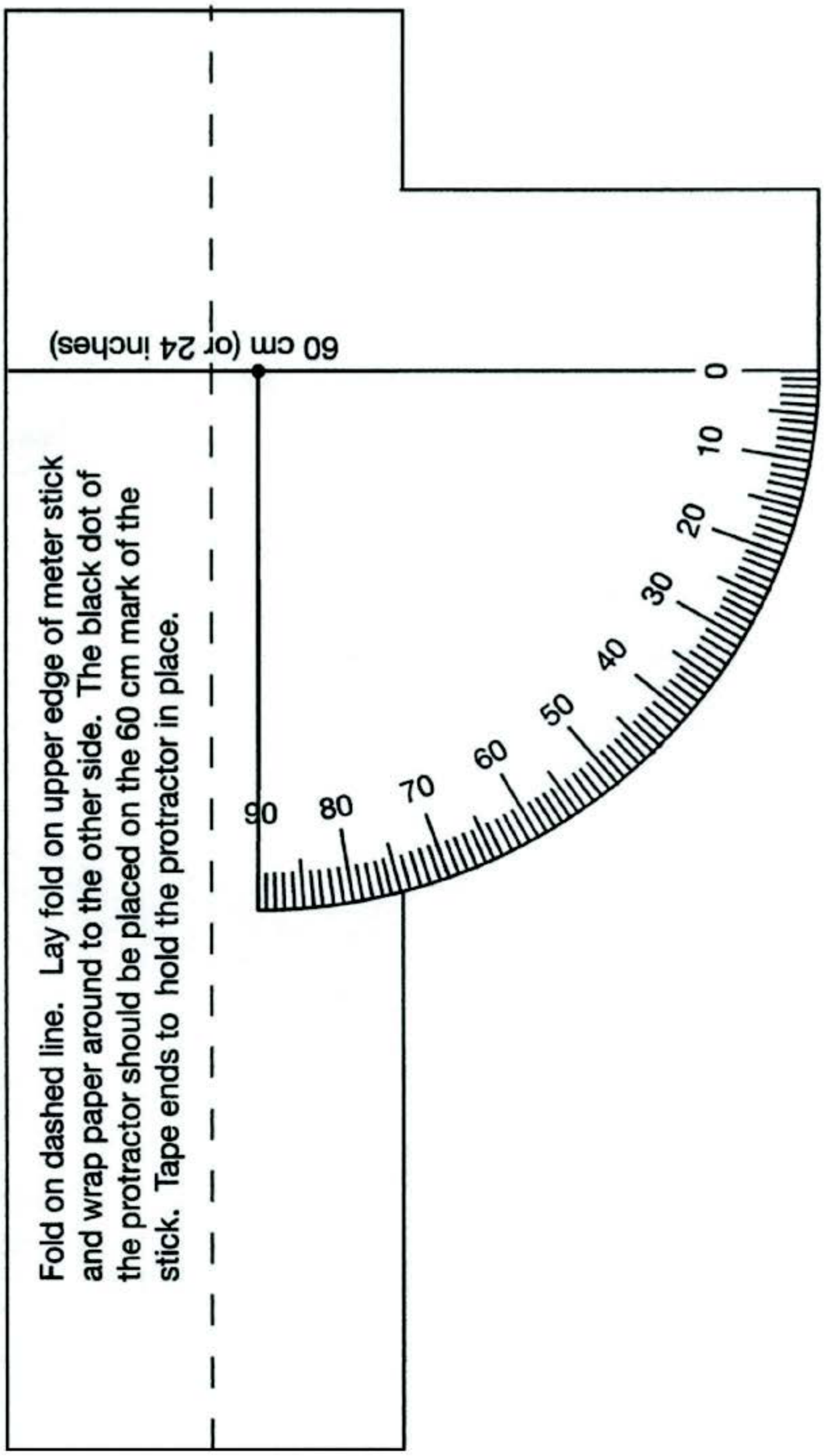
www.nasa.gov/audience/foreducators/topnav/.../Foam_Rocket.html

For lots of activities and information about rockets, astronauts, space exploration, space shuttles, solar system, and galaxies, have a look at the American Space Agency's Kids Club:

www.nasa.gov/audience/forkids/kidsclub/flash/index.html

Launcher Quadrant Pattern

(Actual Size)



Can you live on Mars?

63

Journey to Mars

Time

65 minutes

Learning outcomes

To:

- know that you would have to take lots of water with you to survive on Mars
- know that when you purify water some of it is lost
- know there are many ways to purify water
- know that the different methods of water purification remove different substances from the water

Materials Needed

- 36 clear plastic cups
- 24 activated carbon tablets
- 12 teaspoons
- 12 half-litre bottles
- 12 1.5-litre thin plastic bottles
- 12 containers to catch water
- 12 cone coffee filter holders
- 12 cone coffee filters
- electric hotplate
- small saucepan
- sand
- small stones
- fountain pen ink
- cotton wool
- scissors
- felt-tip pens

Preparation

The day before you start this lesson, ask the children to complete the activity **Water on Earth and on Mars** as homework.
For the activity **Water purification**, fill 12 bottles with dirty water. Add sand, stones, and ink to the water for this.

Water on Earth and on Mars 20 minutes

The children find out how much water they use at home in a single day and write this down in **Task 1** of the worksheet.

Discuss the table. Do they use more or less than they thought?

Ask what people need to survive. Encourage the children to name as many conditions as they can think of. To survive, people need food and oxygen, but water is also very important. Explain that people cannot survive without water. Also explain that this is one of the reasons why people cannot live on Mars at the moment. The differences in temperature are also very large; Mars has a very thin atmosphere and the air pressure is very low. There is frozen water underground on Mars. This water is not clean. So you would have to take water with you if you wanted to live on Mars. And you would need to be able to purify this water if you wanted to keep using it.

Can you live on Mars?

The children investigate how you can purify water and if this would enable you to survive on Mars.

Purify the water 30 minutes

Organise the children into pairs and hand out the materials for the experiment. Explain that the surface of Mars is covered in stones and sand. The ink in the water represents the invisible impurities. The children are going to purify the water in three stages, by completing **Task 2** on the worksheet. The water will become cleaner at each step. Emphasise that each of the three steps removes different substances from the water. Ask the children if they think the water is completely clean at the end. Do not allow them to drink the purified water! Because it has not been professionally cleaned, it may still contain pollutants.

Can you live on Mars? 10 minutes

Discuss the three stages of water purification. Explain that the first stage is to remove the solid particles. Explain that activated carbon has a sponge-like structure that enables it to absorb all kinds of substances. Because the activated carbon does not pass through the filter, the pollutants it has absorbed remain in the filter with it. This happens in stage 2.

In stage 3, the water is boiled to kill all the remaining germs and bacteria that can cause illness.

Ask whether the children think it would be possible to survive on Mars using this kind of water treatment. What would they have to take with them? And what would they do when it was all used up? On Earth we use water treatment works to purify the water that we use.

The children complete **Task 3** on the worksheet.

Conditions for life 5 minutes

Review the conditions for life with the children. We have already investigated one of these conditions: water. But what about the other conditions for life? Are these present on Mars? Could you take them with you? How could you make sure you don't run out?

Can you live on Mars?

You are going to investigate how you can purify water and if this would enable you to survive on Mars.

1 Water on Earth and on Mars

A. Keep a record for one day of all the water that you use that day. Record the information in the table.

Activity	Litres water each time	Number of Times	Total
Taking a shower	60 litres		
Brushing teeth	2 litres		
Washing face	2.5 litres		
Flushing the toilet	6 litres		
Washing hands	1 litres		
Washing the dishes by hand	8 litres		
Using the dishwasher	10 litres		
Cooking	1.5 litres		
Drinking water, tea, soft drinks	0.2 litres		

write your amounts **HERE**

ADD UP the figures in this column

B. How much water did you use in total in a day?

C. Do you think this is a little or a lot?

write your answer **HERE**

2 Purify the water

What do you need?

- 1.5 litre plastic water bottle
- scissors
- small cup of stones
- cup of sand
- cotton wool
- felt-tip pen
- 0.5 litre bottle with dirty water

What do you need to do?
You are going to purify the water using three different methods.
Use the water you treated in one method for the next.

Examine the bottle of dirty water.

A. What colour is the water? ______________________

____

B. What kinds of dirt can you see? ______________________

____

Solid dirt.

First of all you are going to remove the solid, undissolved dirt that you can see in the water. You are going to make a filter for this.

1 Use a felt pen to draw lines dividing the bottle into three equal parts.

2 Cut off the bottom third of the bottle.

3 Turn the top part of the bottle upside down and push it into the bottom part.

4 Fill the top part of the bottle with cotton wool, sand and stones, as shown in the drawing. Now you have made your filter.

5 Pour the dirty water into the filter. Pour carefully so that you do not disturb the layers.

CIRCLE the correct answer

C. Does your filter work? **YES / NO**

____

D. What colour is the water now?

____

write your answer **HERE**

E. What has the filter removed from the water?

____

F. Is the water clean enough to drink? yes / no, because

____

Invisible substances

Now you are going to remove the invisible substances from the water. Use the filtered water from the first stage. You do not need the filter.

What do you need?

- 2 clear plastic cups
- 2 tablets of activated carbon
- teaspoon
- coffee filter
- coffee filter holder

What do you need to do?

1. Take the filtered water.
2. Pour this water into a plastic cup.
3. Add two tablets of activated carbon to the water and stir well.
4. Put the filter holder on the other plastic cup, as shown in the drawing.
5. Pour the mixture into the filter.

The travelling space buggy

40

Space technology

Time

60 minutes

Learning outcomes

To:

- find out what is needed for a vehicle to travel along
- know what specifications a space buggy must meet to be able to travel on a bumpy surface

End Product

• A space buggy

Materials Needed

- photograph of Mars Lander (Appendix)
- 12 1-litre drink cartons
- 12 containers
- coloured card
- wooden skewers
- scissors
- glue
- paint
- toilet paper rolls
- large and small buttons
- container with sand and stones

Preparation

For the activity **Move it** you will need a block trolley and a doll's pram or buggy. You will need the photograph of the Mars Lander from the Appendix. For the activity **Your space buggy** you will need 12 containers with scissors, glue, paint, toilet roll tubes, large and small buttons, wooden skewers, coloured card, and a milk carton. You will also need a large container with sand and stones for the children to test their space buggies in.

Move it 30 min.

Take the children outside. Show the block trolley and the doll's pram or buggy. Where will the trolley and the pram or buggy be able to move best, on the playground or in the sandpit? Encourage several children to have a go moving the trolley and the pram or buggy. Now take a few blocks out of the trolley and put them on the ground. Ask the children to try pushing the doll's pram or buggy and block trolley over the blocks on the ground. Is this easy or difficult?

The children make a space buggy that can move across a bumpy surface, like the sandpit and over the blocks in the playground.

Your space buggy 30 min.

Take the children back to the classroom. Show the children the photograph of the Mars Lander. Explain that they are going to make a space buggy for **Task 1** on the worksheet. Explain that the buggy:

- has to be stable and not easy to blow over;
- has to be able to move forwards;
- has to be able to move over obstacles;
- must be made using the items in the container.

Organise the children into pairs. Give each pair of children a container. Examine together the items that they can use. Explain that their space buggy should look as much like their design as possible. They can choose whether to use large or small buttons as wheels for their space buggy.

The children make a space buggy. Give assistance where needed.

Once again, sit in a circle with the children. Ask them to bring their space buggy. What do the buggies look like? Does each buggy look like its design?

Encourage the children to test their space buggy.

- Is it strong? Encourage the children to blow against their buggy to see if it falls over.
- Can it move over obstacles? Challenge the children to move their buggy through the container with sand and stones.

Discuss which was the best space buggy. What do they notice about this buggy that makes it better than the other space buggies?

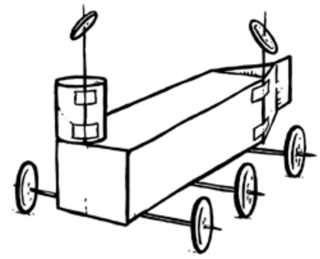
Encourage the children to adapt their space buggies so that they are better able to meet the requirements. For example, they could make them heavier; they could change the position of the wheels, or use larger or smaller wheels.

40 Worksheet

The travelling space buggy

Make a design for your space buggy.
You can see an example in this drawing.

draw **HERE** the design
for your space buggy



DPSM/ESERO
Framework for Inquiry

THEME	A Journey into Space	
CURRICULUM	**Strand:**	Energy & Forces; Materials
	Strand Unit:	Forces, Mixing and other changes, Properties and characteristics of materials
	Curriculum Objectives:	- Identify and explore how objects and materials may be moved - Come to appreciate that gravity is a force - Explore some simple ways in which materials may be separated - Describe and compare materials - Group material according to their properties - Investigate how materials may be used in construction - Observe and investigate the movement of objects such as toys on various materials and surfaces
	Skills Development:	Working Scientifically: Questioning; Investigating & Experimenting; Analysing. Designing and Making: Exploring; Planning; Making; Evaluating.

ENGAGE

THE TRIGGER	WONDERING	EXPLORING
Photograph of outer space or the far side of the moon. Purifying water on the ISS Launch of Vega (first minute of video) Beagle Lander found on Mars (link)	I wonder what life is like in outer space? How would I get there? How do we explore other planets? How would I survive? How do the astronauts 'recycle' their water? How do I get around when I am there? What are my constraints? How can we design a vehicle to cross difficult terrain? Can we make models of rockets / space buggies to find out how they work?	Explore a selection of pre-made rockets (Make a rocket, Design and make a paper rocket, Rocket launch, Design and make a foam rocket). Explore how each one is launched. Discuss all the different ways we use water in the home and at school? Do you know how much water the average person uses a day? Explore how a moving vehicle can move when it has a full load compared to when it is empty. Explore how it moves over different surfaces

INVESTIGATION 1 – DESIGN AND MAKE A FOAM ROCKET (DPSM)

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
How does the force at launch affect how far the rocket goes? or How does angle of launch affect how far the rocket goes?	What do you think about how the objects fell?	Examine a pre-made foam rocket and use it to carry out the investigation. Outdoors can be used if the wind is calm. A large indoor space is an alternative.	Did anything unexpected happen? Discuss: did any of the objects go up in the air? Did any of the objects stay up in the air? Or did they all fall to the ground?

DPSM/ESERO
Framework for Inquiry

INVESTIGATION 2 – CAN YOU LIVE ON MARS? (ESERO) / CLEANING DIRTY WATER (DPSM)

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
How do the astronauts purify their water in space? Look at the Chris Hadfield clip.	Allow the children to discuss and predict different methods they think the astronauts use to purify and recycle their water.	Working in groups the children will begin the purifying process. Initially they will remove the solid dirt from their mixture. After this they will remove the invisible substances and finally they will remove limescale and germs.	Record the volume of water remaining after the 'purifying process'. Present your findings on a chart.

INVESTIGATION 3 – THE TRAVELLING SPACE BUGGY (ESERO)

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
How can a space buggy be designed to be stable and travel easily over bumpy ground?	Predict by drawing the design of a buggy that students think will be stable / travel easily using the equipment provided. Wheel size and location are likely variables.	Make the buggy as designed. Test for stability / ease of travel. Re-design as needed.	How are the buggies the same? How are they different? What makes the best buggy? What do we mean by 'best'?

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

- Discuss student findings.
- Consider how to extend student knowledge/findings into further learning situations or investigations
  - Examples: Where does the water in your home come from? How was this rocket like/unlike other/real rockets? Is this vehicle suitable for all terrains? Do all vehicles have 4 wheels?
- Apply learning into other subjects - see back page of this booklet for some cross-curricular ideas.

REFLECTION

- Did I meet my learning objectives?
- What went well, what would I change?
- Were the cross curriculum opportunities used?
- Are the children progressing with their science skills?
- Have you recorded and reviewed any new vocabulary?
- What questions worked very well?
- What questions didn't work well?
- Ask the children would they change anything or do anything differently.

JOURNEY INTO SPACE:
Some Cross-curricular Ideas*

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ENGLISH

- Letter to ESA asking information
- Application for a job as an astronaut
- Keep a diary of your time in space
- Instructions – Write instructions for a rocket launch
- Description of an alien
- Newspaper report of a UFO sighting
- Interviews
- Lists of equipment

MATHS

- Length: Scale drawing of planets in our solar system and distance to and between each
- Capacity: Calculate amount of water needed in space for a week on the basis that 20% is lost in each purifying process
- Weight: Calculate space weight
- Shape and Space: Design a rocket; calculate the perimeter / area
- Data: Conduct research within the class and present results
- Number: Calculate orbit times of planets
- Time: ISS Astronaut timetable **http://esamultimedia.esa.int/docs/primedukit/en/PrimEduKit_ch4_en.pdf**

PE

- Zero gravity training / high intensity training
- Mission X Train Like an Astronaut **http://trainlikeanastronaut.org/**

SESE

- Geography: Study the planets, the solar system, investigate sunlight and its importance
- Science: Other rocket activities, purifying water, space buggy
- History: Neil Armstrong, Time Lines, relationship between the sun and Newgrange, 1st moon landing and history of space travel, the ISS

ARTS

- Music: Listen to and respond to Gustav Holst. The Planets Suite. How does the music reflect each planet; John Adams – Short Ride in a Fast Machine
- Drama: Act out moon walking
- Art: Shadow portraits, space windows, 3D rockets, Design and Make rockets, space suit, space buggy

EXTRA

- Display: Use rockets flying to the moon for individual curriculum targets
- Make a human sun dial
- ICT: Create an animation movie, graphs, news broadcast, internet, comic strip, movies

*These are examples of ***some*** cross-curricular activities suitable for 3rd/4th classes

Science Foundation Ireland, Wilton Park House, Wilton Place, Dublin 2, Ireland
t: +353 1 6073184 e: primaryscience@sfi.ie