# Science Enhancement Experience (SEE)

## Teacher Resource Pack – STEM Challenges

Science Enhancement Experience (SEE) was created and developed by See Science. Its activities are designed to provide primary (year 5 & 6) and secondary (KS3) pupils with a series of challenges. The activities have been designed so that they can be used as transition day activities.

The challenges are designed to facilitate learning, team working and encourage pupils' curiosity to find out how and why things work. During each challenge pupils will develop their problem solving, communication and innovation skills.

All secondary pupils who complete the challenge can register for a Discovery CREST Award. Primary pupils who complete the additional extension activities can also register for a Discovery CREST Award.

Science Enhancement Experience (SEE) resources were produced thanks to the generous support from the Welsh Government's National Science Academy.

The resource pack includes:

- Teachers notes
- Student worksheets
- PowerPoint to complement some of the challenges

To find out more about Science Enhancement Experience (SEE) please visit the See Science website: www.see-science.co.uk.

## Brief description of the challenges

- **Primary Electricity Challenge**. Through this activity, pupils will investigate the uses of electricity and its control in simple circuits, investigate the flow of electricity, and recognise that forces can affect movement and measure speed. The pupils will construct an electric powered Alien. The groups test their Alien and refine their designs so that it travels quickly over the track. The activity allows the pupils to develop their teamwork and communication skills.
- **Primary Space Challenge**. In this activity, pupils will learn how forces can affect movement and how friction and gravity affects objects in motion. They will construct a space craft (International Space Station) with a door or doors which can be opened and closed remotely. The activity allows pupils to develop their teamwork and communication skills.
- **Primary Marble Roller Coaster**. This activity will help pupils to learn how friction and gravity affects objects in motion. The pupils will build a marble run and experiment where to place bends and slopes in their roller coaster to meet the challenge. The activity allows them to develop their teamwork and communication skills by designing the slowest marble run.
- **Secondary Emergency Communication Challenge**. The students act as the engineer rescue team based in a town that is relatively unaffected by the extreme weather. Their challenge is to design and build a prototype device that will send a coded message across the mountains for decoding in the affected town. The students will also create the code to use to send a message. The activity allows them to develop their teamwork and communication skills.
- **Secondary Space Challenge**. In this activity, students will learn how forces can affect movement and how friction and gravity affects objects in motion. They will construct a space craft with a door or doors which can be opened and closed remotely. In a second challenge students design and build a vehicle (Mars Rover) that will travel across a surface in the fastest time possible. The students investigate how the wheels and propellers have a direct effect on the speed of their vehicles. The activity allows students to develop their teamwork communication and scientific recording skills by designing the fastest Rover for a race.
- **Secondary Marble Roller Coaster Challenge**. This activity will help students to learn how friction and gravity affects objects in motion. The students will build a marble run and experiment where to place bends and slopes in their roller coaster to meet the challenge. The activity allows them to develop their teamwork and communication skills. In a second challenge students construct a loop the loop marble roller coaster and develop scientific recording skills.



Noddir gan Lywodraeth Cymru Sponsored by Welsh Government

STEM AMBASSADOR HUB STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

## Pupils' roles in each team

For each of the challenges the student can be given roles. For example, each team can be made up of:

- **Project manager**
  - Manages time
  - Ensures there is an even distribution of workload – re-assigns team members where necessary
  - Maintains the high standard of work produced by the team
  - Takes the opinions of all team members into consideration
- **Design management**
  - Liaises with all other management roles within team
  - Discusses with the team their design ideas
  - Takes the opinions of all team members into consideration
  - Produces final design on paper for the team
- **Construction management**
  - Liaises with all other management roles within team
  - Discusses with the team their construction ideas
  - Takes the opinions of all team members into consideration
  - Ensures there is an even distribution of workload – re-assigns team members where necessary to ensure work is completed to time
- **Communication management**
  - Discusses with the team their ideas e.g. what works well and what could be improved
  - Takes the opinions of all team members into consideration
  - Reports back to the class on the project when asked
- **Equipment management**
  - Discusses with the team the use of the materials and tools
  - Ensures that the equipment is used efficiently
  - Ensures that all tools such as scissors are present at the end of the project
- **Trialling management**
  - Ensures that the project is tested at appropriate times to ensure that the challenge meets the brief
  - Organises the final testing so that there is sufficient time to make amendments and improvements

## CREST Discovery Passport

Following the challenge, pupils registered for the CREST Award will fill in the CREST Discovery Passport. This asks the pupils to reflect on their performance in the team during the challenge. The pupils will be asked to comment on how they performed and where they need more practice to improve the following skills:

- Self-management
- Team-working
- Problem-solving
- Research
- Knowledge
- Skills
- Communication

## Detailed notes for each challenge

The following pages contain detailed notes for each challenges:

- Primary Electricity Challenge
- Primary Space Challenge
- Primary Marble Roller Coaster Challenge
- Secondary Emergency Communications Challenge
- Secondary Space Challenge
- Secondary Marble Roller Coaster Challenge



Noddir gan Lywodraeth Cymru
Sponsored by Welsh Government

STEM AMBASSADOR HUB
STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

# Primary Electricity Challenge

## Time

- 2 hours

## Learning objectives

- To recognise that forces can affect movement
- To investigate the uses of electricity and its control in simple circuits
- To explain the meaning of speed and how it is calculated
- To be given opportunities to listen, plan and design
- To develop team working and communication skills

## Resources

- Per class for human circuit:
  - T-Shirts or PE bibs and names /pictures of parts of the circuit to attached to T-Shirts or PE bibs
  - Cosmic ball
  - 2 x clear hosepipes (5m and 10m) joined at end with wood dowel inserted into the pipe to form a loop
  - Approximately 100 beads to fit inside hosepipe
- Per group: See details on pupil activity sheets.

Most resources can be sourced from Mindsets Ltd www.mindsetsonline.co.uk/ or high street DIY shops.

## Advance preparation

- Prepare labels marked with the names of the parts of the circuit.
- Prepare human circuit.

## Introduction

Introduce the activity by revising how to build circuits. Ask pupils if they can remember how to build a circuit followed by a brief discussion on how electricity flows. Build a human circuit and explore how to complete or break a circuit.

## Activities

- **Challenge 1 – Can you build a circuit?** Pupils working in small groups of approximately 6 pupils build a simple circuit with one light bulb. The pupils repeat this with 2 bulbs and observer any changes in the brightness of the bulbs. The pupils then repeat by moving the bulbs different distances from the battery holder and make further observations.
- **Challenge 2 – Design an electric powered Alien**. Pupils work in small groups of approximately 6 pupils to design and construct an Electric Powered Alien. The groups test their Alien and refine their designs so that it travels quickly over the track. The winning team will build the best designed Alien that travels from the starting line to finishing line in the shortest time.

## Plenary

- Compare the designs of the Aliens with the speed they travelled. How does the position of the motor and battery holder affect the performance? Why do you think this may have made a difference?
- How could you improve your design?
- Discuss how the pupils can now can calculate the speed of the Aliens e.g. in meters per second.

## Information for teachers

Teachers can extend the activity to enable pupils to register for a Discovery CREST Award www.britishscienceassociation.org/crest-awards – Ideas for extension activity can be found at DIY Faraday Challenge Day – Emergency Communication http://faraday.theiet.org/stem-activity-days/diy-challenge/

To register for CREST Awards contact the local CREST Coordinators crest@see-science.co.uk.



Noddir gan Lywodraeth Cymru Sponsored by Welsh Government

STEM AMBASSADOR HUB STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

# Primary Space Challenge

## Time

- 2 hours

## Learning objectives

- To recognise that forces can affect movement
- To investigate different kinds of forces, e.g. gravity and friction
- To be given opportunities to listen, plan and design
- To develop team working and communication skills

## Resources

- Per group: see details on pupil activity sheets

Most resources can be sourced from Mindsets Ltd www.mindsetsonline.co.uk or high street DIY shops.

## Advance preparation

Source photos of the international space station www.nasa.gov/mission_pages/station/images/index.html?id=378104

## Introduction

Introduce the activity by talking about Commander Tim Peaks' space walk in January 2016 and showing them pictures of the International Space Station ISS. Ask the children if they can name different types of forces and give examples. Discuss what is meant by moving equipment by 'remote control'. Now introduce the Space Challenge.

## Activities

- **Space Challenge – Design and build a remotely operated door to the ISS**. Pupils working in small groups of approximately 6 pupils design and construct a space craft with a door or doors which can be opened and closed remotely to allow the astronaut to enter.
- **Extension challenge – Challenge: Design and construct a Mars Rover**. Pupils design and construct a Mars Rover so that it travels most efficiently over the track. The winning team will build the best designed Mars Rover that travels from the starting line to finishing line in the shortest time.

## Plenary

- Compare the designs of the remote controlled doors. Ask the pupils: Which door performed best? How does the design affect the performance? Why do you think this may have made a difference?
- How could you improve your design?
- Why do you think the European Space Agency and NASA carry out experiments and explore Space from the ISS?

## Information for teachers

Information about the ISS is available at www.nasa.gov/mission_pages/station/main/index.html.

Teachers can extend the activity to enable pupils to register for a Discovery CREST Award http://www.britishscienceassociation.org/crest-awards – Extension activity included in pack.

To register for CREST Awards contact the local CREST Coordinators at crest@see-science.co.uk.



Noddir gan Lywodraeth Cymru Sponsored by Welsh Government

STEM AMBASSADOR HUB STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

# Primary Marble Roller Coaster Challenge

## Time

- 2 hours

## Learning objectives

- To recognise that forces can affect movement
- To investigate different kinds of forces, e.g. gravity and friction
- To be given opportunities to listen, plan and design
- To develop team working and communication skills

## Resources

- Per group: see details on pupil activity sheets

Most resources can be sourced from Mindsets Ltd www.mindsetsonline.co.uk or stationery stores.

## Advance preparation

Source photos/You Tube footage of roller coasters in action at www.oakwoodthemepark.co.uk.

## Introduction

Introduce the activity by talking about roller coaster and showing them pictures/video of roller coasters in action. Ask the children if they can name different types of forces. What do they understand by gravity? Relate these forces to roller coasters. Now introduce the activities and challenges.

## Activities

- **Challenge 1 – How high can you build a tower?** Pupils work in small groups of approximately 6 pupils to construct the highest tower they can use 1 pack of playing cards. The tower must remain free standing after the 10 minutes construction time has ended.
- **G- Force activity**. In teams the pupils are given a set of items that experience G-Force. The pupils rank the items in order from highest to lowest G-Force.
- **Challenge 2 – Design a marble run**. Pupils design and construct a slow marble run so that the marble travel as slowly as possible and for as long as possible. The marble must be deposited, and stay in a container at the end of its run.

## Extension challenge – How much height to loop the loop?

Pupils design and construct a loop the loop marble roller coaster. The pupils experiment to find out how much height is needed in order for the marble to run through a loop. The pupils then repeat with different size/number of loops.

## Plenary

- Compare the designs of the marble run (roller coaster). Ask the pupils: Which roller coaster performed best? How does the design affect the performance? Why do you think this may have made a difference?
- How could you improve your design?

## Information for teachers

Teachers can extend the activity to enable pupils to register for a Discovery CREST Award www.britishscienceassociation.org/crest-awards – extension activity included in pack.

To register for CREST Awards contact the local CREST Coordinators at crest@see-science.co.uk.



Noddir gan Lywodraeth Cymru Sponsored by Welsh Government

STEM AMBASSADOR HUB STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

# Secondary Emergency Communications Challenge

## Time

- 5 hours

## Learning objectives

- To investigate the uses of electricity and its control in simple circuits
- To design and build a devise which uses electricity, sound and light
- To be given opportunities to listen, plan and design
- To develop team working and communication skills

## Resources

- Per group: see details on pupil activity sheets

Most resources can be sourced from Mindsets Ltd www.mindsetsonline.co.uk or high street DIY shops.

## Advance preparation

Download videos and sound effects form the IET Faraday Challenge. Find out more details at http://faraday.theiet.org/resources/overview/emergency-comms.cfm

## Introduction

Ease of communication is part of our life, we pick up the phone, turn on the radio, TV or internet to get news and information. Wifi networks work by radio signals. Your phone, TV and radio signals are transmitted by masts we hardly notice. But when all of these are knocked out by natural events how do we communicate?

Further introduce the activity by revising how to build circuits. Ask the pupils if they can remember how to build a circuit followed by a brief discussion on how electricity flows. Now introduce the activities and challenges.

## Activity

**Challenge – Emergency Communication**. The students act as the engineer rescue team based in a town that is relatively unaffected by the extreme weather. Their challenge is to design and build a prototype device that will send a coded message across the mountains for decoding in the affected town. The students will also create a code to use to send a message.

## Plenary

- Compare the designs of the prototype devices. Ask the pupils: Which performed best? How does their design affect the performance? Why do they think this may have made a difference? How could you improve your design?
- Compare the codes used by the teams. Which were the most effective?
- How could you improve your designs?

## Information for teachers

Teachers can register their pupils for a Discovery CREST Award at www.britishscienceassociation.org/crest-awards.

To register for CREST Awards contact the local CREST Coordinators at crest@see-science.co.uk.



Noddir gan Lywodraeth Cymru
Sponsored by Welsh Government

STEM AMBASSADOR HUB
STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

# Secondary Space Challenge

## Time

- 5 hours

## Learning objectives

- To recognise that forces can affect movement
- To investigate different kinds of forces, e.G. Gravity and friction
- To investigate the uses of electricity and its control in simple circuits
- Explain the meaning of speed and how it is calculated
- To be given opportunities to listen, plan and design
- To develop team working and communication skills

## Resources

- Per group: see details on pupil activity sheets

Most resources can be sourced from Mindsets Ltd www.mindsetsonline.co.uk or high street DIY shops.

## Advance preparation

Source photos of the international space station (ISS) and Soyuz Space Rocket can be downloaded from www.nasa.gov/mission_pages/station/images/index.html?id=378104

## Introduction

Introduce the activity by talking about Commander Tim Peaks' space walk in January 2016 and showing them pictures of the International Space Station ISS. Ask the children if they can name different types of forces and give examples. Discuss what is meant by moving equipment by 'remote control'. Now introduce their Space Challenge.

## Activities

- **Space Challenge 1 – Design and build a remotely operated door to the ISS**. Pupils working in small groups of approximately 6 pupils design and construct a space craft with a door or doors which can be opened and closed remotely to allow the astronaut to enter.
- **Space Challenge 2 – Design and build a Mars Rover**. Pupils design and construct a Mars Rover so that it travels most efficiently over the track. The winning team will build the best designed Mars Rover that travels from the starting line to finishing line in the shortest time.

## Plenary

- Compare the designs of the remote controlled doors. Ask the pupils: Which door(s) performed best? How does their design affect the performance? Why do they think this may have made a difference? How could you improve your design?
- Compare the designs of the Mars Rover. Ask pupils: How does their design affect the performance? Why do they think this may have made a difference? How could you improve your design?
- Why do you think the European Space Agency and NASA carry out experiments and explore Space from the ISS?

## Information for teachers

Information about the ISS is available at www.nasa.gov/mission_pages/station/main/index.html. Teachers can register their pupils for a Discovery CREST Award at www.britishscienceassociation.org/crest-awards

To register for CREST Awards contact the local CREST Coordinators at crest@see-science.co.uk.



Noddir gan Lywodraeth Cymru Sponsored by Welsh Government

STEM AMBASSADOR HUB STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk

# Secondary Marble Roller Coaster Challenge

## Time

- 5 hours

## Learning objectives

- To recognise that forces can affect movement
- To investigate different kinds of forces, e.g. gravity and friction
- To investigate the uses of electricity and its control in simple circuits
- To be given opportunities to listen, plan and design
- To develop team working and communication skills

## Resources

- Per group: see details on pupil activity sheets

Most resources can be sourced from Mindsets Ltd www.mindsetsonline.co.uk and stationery stores.

## Advance preparation

Source photos/You Tube footage of roller coasters in action at www.oakwoodthemepark.co.uk.

## Introduction

Introduce the activity by talking about roller coasters and showing them pictures/videos of roller coasters in action. Ask the pupils if they can name different types of forces in action on a roller coaster. What do they understand by gravity? Relate these forces to roller coasters. Now introduce the activities and challenges.

## Activities

- **Challenge 1 – How high can you build a tower?** Pupils work in small groups of approximately 6 pupils to construct the highest tower they can using 1 pack of playing cards. The tower must remain free standing after the 10 minutes construction time has ended.
- **G- Force activity**. In teams the pupils are given a set of items that experience G-Force. The pupils rank the items in order from highest to lowest G-Force.
- **Challenge 2 – Design a marble run**. Pupils design and construct a slow marble run so that three marble travel as slowly as possible and for as long as possible. The marbles must be deposited, and stay in a container at the end of its run. A bulb is lit when 3 marbles are in the container.
- **Challenge 3 – How much height to loop the loop?** Pupils design and construct a loop the loop marble roller coaster. The pupils experiment to find out how much height is needed in order for the marble to run through a loop. The pupils then repeat with different size and number of loops.

## Plenary

- Compare the designs of the marble run (roller coaster). Ask the pupils: Which roller coaster performed best? How does the design affect the performance? Why do you think this may have made a difference?
- How could you improve your design?

## Information for teachers

Teachers can register their pupils for a Discovery CREST Award at www.britishscienceassociation.org/crest-awards

To register for CREST Awards contact the local CREST Coordinators at crest@see-science.co.uk.



Noddir gan Lywodraeth Cymru Sponsored by Welsh Government

STEM AMBASSADOR HUB STEM Ambassador Hub Wales

See Science is the Regional STEM Club Contract Holder in Wales
www.see-science.co.uk enquiries@see-science.co.uk