Applicable standards
Next Generation Science Standards

Grade 5 Science and Engineering

Element of the curriculum	Lessons 1	2	3	4	5	6
Matter and its Interactions						
5-PS1-3. Make observations and measurements to identify materials based on their properties.				✓	✓	
Motion and Stability: Forces and Interactions						
5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.	✓	✓	✓	✓		
Engineering Design						
3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	✓	✓	✓	✓	✓	✓
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	✓	✓	✓	✓	✓	✓
3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	✓	✓	✓	✓	✓	

Grade 6-8 Middle School Science and Engineering

Element of the curriculum	Lessons 1	2	3	4	5	6
Matter and its Interactions						
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.					✓	✓
Motion and Stability: Forces and Interactions						
MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	✓	✓	✓			

Applicable standards
Next Generation Science Standards

Grade 6-8 Middle School Science and Engineering (continued)	Lessons					
Element of the curriculum	**1**	**2**	**3**	**4**	**5**	**6**
From Molecules to Organisms: Structures and Processes						
MS-LS1-3. Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.						✓
MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.						✓
Engineering Design						
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	✓	✓	✓	✓	✓	✓
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	✓	✓	✓	✓	✓	✓
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	✓	✓	✓	✓	✓	
Science and Engineering Practices						
• Asking questions	✓	✓	✓	✓	✓	✓
• Developing and using models	✓	✓	✓	✓	✓	
• Planning and carrying out investigations	✓	✓	✓	✓	✓	✓
• Analyzing and interpreting data	✓	✓	✓	✓	✓	✓
• Using mathematics		✓	✓	✓		
• Constructing explanations	✓	✓	✓	✓	✓	✓
• Engaging in argument from evidence	✓	✓	✓	✓	✓	✓
• Obtaining, evaluating and communicating information	✓	✓	✓	✓	✓	✓

Lesson 1: How big and how deep is the ocean?

Overview

This lesson sets the scene for the whole Submarine STEM unit. 71% of our blue planet is covered by the ocean, with an average depth of 2.3 miles. The ocean affects people's food, safety, livelihoods, transport and access to resources, yet we know very little about the deep ocean – we have better maps of the moon! This lesson explores the importance of the ocean and introduces students to some of the strange creatures which inhabit the deep sea.

Learning outcomes

- Discuss prior knowledge of the ocean
- Understand the scale of the ocean
- Describe how the ocean affects our lives
- Compare, observe and ask questions about the features of deep-sea creatures
- Review learning and make suggestions for future learning

Resources

Slideshow 1:
How big and how deep is the ocean?

Student Sheet 1a:
Deep-sea funnies

Student Sheet 1b:
What I would like to know

Gallery:
Deep-sea creatures

Video:
Nekton Mission II: The Indian Ocean

Lesson 2: What lives in the deep sea?

Overview

This lesson explores the depth of the ocean through creating a scale diagram of the different ocean zones and identifying significant points within these zones. Students will consider why deep sea exploration is so challenging for humans and the different issues scientists have to overcome. This lesson allows students to examine submersibles and identify their main differences.

Learning outcomes

- Identify living things, habitats and environments
- Understand the scale and depth of the ocean
- Make accurate measurements
- Explain why ocean exploration is challenging for humans
- Describe how different submersibles make ocean exploration possible
- Identify significant ocean zones

Resources

Slideshow 2:
What lives in the deep sea?

Activity Overview 2a:
Ocean depths

Student Sheet 2a:
Deep-sea funnies

Student Sheet 2b:
Points of interest

Student Sheet 2c:
Ocean zones

Gallery:
Deep ocean poster

360 Gallery:
Submarine science

Video:
Mission Director

Subject Update:
How to: Quick start to 360 VR in the classroom

Subject Update:
How to: Four ways to use 360 VR in the classroom

Lesson 3: What forces affect submarines?

Overview

The context of the lesson is a practical investigation to discover how shape and surface area affect the speed at which a submersible descends. Students develop their understanding of forces, surface area, and fair testing.

Learning outcomes

- Understand gravity as a force
- Consider how forces affect submersibles
- Investigate how shape affects speed
- Predict and test with accuracy
- Describe how forces affect submersibles

Resources

Slideshow 3:
What forces affect submarines?

Activity Overview 3a:
Submersible shape investigation

Student Sheet 3a:
Shape Investigation

360 Gallery:
Diving in a submarine

Subject Update:
How to: Quick start to 360 VR in the classroom

Subject Update:
How to: Four ways to use 360 VR in the classroom

Lesson 4: How do you choose materials for a submarine?

Overview

This lesson discusses the properties of materials and their use in submersible design. Students will compare a variety of materials for their submersible and justify their choices. An investigation into how salt water affects materials allows pupils to make predictions, write conclusions and conduct a fair test.

Learning outcomes

- Discuss the properties of materials
- Compare and group materials based on their properties
- Give reasons for the uses of materials
- Explain the suitability of materials for certain uses
- Make predictions about how salt-water affects materials

Resources

Slideshow 4:
How do you choose materials for a submarine?

Student Sheet 4a:
Materials cards

Student Sheet 4b:
My submersible materials

Student Sheet 4c:
Salt water investigation

360 Video:
Submarine launch

Subject Update:
How to: Quick start to 360 VR in the classroom

Subject Update:
How to: Four ways to use 360 VR in the classroom

Lesson 5: How do you launch a submarine with strong structures?

Overview

Part one of this two-part lesson develops students understanding of strong structures and investigates how cranes work. Students work together to design and construct a crane using a variety of materials. They will adapt and evaluate their structure as they go along and make improvements where necessary. They will also construct a model submersible to launch and recover once their crane is complete.

Learning outcomes

- Describe how machines help people
- Describe and apply the features of a stable structure
- Construct a working model of a crane
- Reflect on learning and plan next steps

Resources

Slideshow 5:
How do you launch a submarine with strong structures?

Activity Overview 5a:
Designing a crane

Activity Overview 5b:
Submersible model

Student Sheet 5a:
Designing a crane

360 Video:
Submarine launch

Subject Update:
How to: Quick start to 360 VR in the classroom

Subject Update:
How to: Four ways to use 360 VR in the classroom

Lesson 6: How do you recover a submarine with levers and pulleys?

Overview

Part two sees students develop their understanding of levers and pulleys and relates this to how cranes launch and recover submersibles. Students will continue to develop their crane, this time adding a lever or pulley system which will raise and lower their submarine model. Students will reflect on their build, evaluate the effectiveness of their cranes and make suggestions for improvements. Finally, students will demonstrate their learning by creating a poster which describes and explains how cranes work to launch and recover submersibles, concluding the Submarine STEM unit.

Learning outcomes

- Apply understanding of levers and pulleys
- Construct a working model of a crane using levers and pulleys
- Reflect on learning and suggest improvements
- Explain why cranes are used and how they work

Resources

Slideshow 6:
How do you recover a submarine with levers and pulleys?

Activity 6a:
Levers and pulleys

Student Sheet 6a:
Levers and pulleys

Student Sheet 6b:
Poster

360 Video:
Submarine launch

Subject Update:
How to: Quick start to 360 VR in the classroom

Subject Update:
How to: Four ways to use 360 VR in the classroom