Force and Motion
Motion of Objects

Grade 3 Unit of Inquiry – Term 3

Planeteers Game-based Learning Platform
Science and Technology, Arts, Math and Engineering

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Outcomes and Content

Science & Technology

Curriculum Content Reference: NCIE: Science/Stages 1&2/p.19

Learning Outcomes
Compare how things move on different surfaces

Standards: Force and Motion
1. How do objects move?
2. Why is reference point important in describing one's position?
3. How do distance, direction, and reference point help in describing a complete position?
4. What are the factors that affect an object's movement?
5. How does force help in making objects move?

- Describe the position of a person or an object in relation to a reference point such as chair, door, another person
- Identify things that can make objects move such as people, water, wind, magnets
- Notice that some forces need contact between two objects, but magnetic forces can act at a distance
- Describe the movements of objects such as fast/slow, forward/backward, stretching/compressing

Engineering

STEAM Curriculum Code: ED1.1 | ED1.2 | EN1.1 | EN1.2

Learning Outcomes

Selects appropriate materials to meet a design need; Identifies and creates simple or complex machines

Standards: Design Process for Innovation

1. How will you design or create an eco-friendly vehicle that can be used in case of extreme flooding?
- Identify and use appropriate materials in creating an eco-friendly, amphibious vehicle
- Build products that use appropriate elements and parts

Arts & Mathematics

Learning Outcomes

Constructs 3-D simple and complex vehicles using geometric shapes/blocks, polygons, space, and repetition of colors to show the balance of the structure and shape.

Standards: Elements of Design and Geometry

What shapes and materials should be used to create an eco-friendly amphibious vehicle?

- Demonstrate understanding of lines, colors, space and harmony through creating simple and complex machines with the use of 3D objects, and the right proportions of parts
- Identify and visualizes symmetry in the environment and in design
- Recognize and represent lines in real objects and designs or drawings, complete symmetrical designs, and create patterns of designs using square, triangle and other shapes that can tessellate
- Tessellate the plane using triangles, squares and other shapes that can be tessellated

Social Studies

Learning Outcomes

Creates a simple project that exemplifies the culture of different regions

Standards: Regions and Culture

1. How do we instill resilience among people through product creation, especially in times of flooding?
2. How do we encourage the community to help prevent flooding in their area?
- Develop an awareness campaign about flood prevention and safety
- Describe ways to prevent flooding in the community

Unit Summary

Grade:	Subject:	Duration:
3	Science & Technology	1 week (50 minutes/day)

Syllabus Mapping:
- Force and Motion
- Geometry
- Elements and Principles of Design
- Design Process for Innovation
- Making

Integration:
- Science
- Mathematics
- Arts
- Engineering
- Technology

Outcomes:
NCIE: Science/Stages 1&2/p.19

Inquiry and Focus Questions:

Driving Question:

Flooding is extremely dangerous. It has the potential to wipe away an entire city and cause extensive damage to life and property. How will you create an eco-friendly, amphibious vehicle that can be used in case of extreme flooding?

Science and Technology Inquiries:
- How do objects move?
- Why is reference point important in describing one's position?
- How do distance, direction, and reference point help in describing a complete position?
- What are the factors that affect an object's movement?
- How does force help in making objects move?

Mathematics, Arts and Engineering Inquiries:
- What shapes and materials should be used to create an eco-friendly amphibious vehicle?

Social Studies Inquiries:
- How do we encourage the community to help prevent flooding in their area?

Learning across the Curriculum:

Cross-curriculum priority
- Sustainability
- Environmental Awareness

General Capabilities
- Teamwork & Collaboration
- Critical & Creative Thinking
- ICT Capability
- Numeracy
- Literacy
- Community Awareness

Skills Focus:

Working Scientifically
- Communicating
- Questioning and predicting

Personal and Social Capability
- Researching and planning
- Design and innovation
- Producing, implementing, testing, refining

Skills Focus:

This unit of investigation explores concepts from the core science standards for force and motion, with a focus on the movement of objects. Students use an individual inquiry-based approach to explore solutions to a multi-layered real-world question. They experiment with a number of in-game tasks to design and build an eco-friendly, amphibious vehicle that works on both land and water, and can be used in case of extreme flooding. They test and refine the effectiveness of their design and construction, while minimizing the environmental and financial cost. Students learn about sustainable practices flood control, safety and prevention. They take action to improve their own and their community's social and environmental wellness.

Teaching, Learning & Assessment Activities

NOTE: 'Quest Game Activity' describes activities that happen in-game while 'Unplugged' occur outside the game

Lesson 1: Project Orientation and Research

Summary: Teacher includes an introduction to floods within the context of the United Kingdom. As part of the project based lesson, the teacher poses a challenge on the devastating effects it may have on people, properties, and the environment. Students are tasked with researching the causes and effects of floods, and safety measures to prevent further damage. Also, they are to research about latest flood control innovations, such as creating a sustainable, eco-friendly, amphibious vehicle that work on both land and water and can be used during extreme flooding.

Assessment: Pre-test about force and motion (10 minutes)

Unplugged Activity: Driving Question (15 minutes) – Brainstorm (Guided)

Begins with a discussion about flooding, its causes, and its effects to the environment, people and animals, and the economy.

Teachers says "Flood is a natural event or occurrence wherein an area that is usually dry land suddenly gets submerged underwater. When floods happen in an area that people live, the water carries along objects like houses, bridges, cars, furniture and even people. It can wipe away farms, trees and structures. Floods can have devastating consequences and effects on the economy, environment and people."

Teacher poses driving questions for the students to investigate and discover possible solutions:

Q. Flooding is extremely dangerous and has the potential to wipe away an entire city and cause extensive damage to life and property. How will you create an eco-friendly, amphibious vehicle that can be used in case of extreme flooding?

Science & Technology Inquiries:
- How do objects move?
- Why is reference point important in describing one's position?
- How do distance, direction, and reference point help in describing a complete position?
- What are the factors that affect an object's movement?
- How does force help in making objects move?

Mathematics, Arts, and Engineering Inquiries:
- What shapes and materials should be used to create an eco-friendly amphibious vehicle?

Social Studies Inquiries:
- How do we instill resilience among people through product creation, especially in times of flooding?
- How do we encourage the community to help prevent flooding in their area?

Lesson 1: Project Orientation and Research (Continued)

Project Orientation (5 minutes)

- Teacher introduces the project and relates it to the discussion outcomes
- Teacher divides the class in research groups (recommend 4-6)
- Provides project guide and overview of the timeline of activities and assessments to students (organized by lesson)

Research and Design Journal (20 minutes)

- Students research, watch documentary videos, and read infographics about the effects of floods, flood control, and innovations made such as amphibious vehicles, as part of flood prevention and safety.

Science & Technology Inquiries:
- How do objects move?
- Why is reference point important in describing one's position?
- How do distance, direction, and reference point help in describing a complete position?
- What are the factors that affect an object's movement?
- How does force help in making objects move?

Mathematics, Arts, and Engineering Inquiries:
- What shapes and materials should be used to create an eco-friendly amphibious vehicle?

Social Studies Inquiries:
- How do we instill resilience among people through product creation, especially in times of flooding?
- How do we encourage the community to help prevent flooding in their area?

- Students brainstorm, plan and draft their ideas on a sheet of paper or project journal**

** If teachers run out of time in the lesson to meaningfully allocate time for this exercise, students can be given the design plan as homework.

Lesson 1 Assessment Ideas

Teachers should consider different assessment options throughout the project phases, including for example:

1. Pre-test on force and motion
2. Quality of student research and project journal
3. Design thinking and reasoning, problem solving
4. Group skills, time management, collaboration
5. Project works (later lessons)
6. Photo Essay (later lessons)

Lesson 2: Prototyping an Amphibious Vehicle

Introduction to the Lesson
Teacher guides the students in identifying basic parts of an innovative and eco-friendly amphibious vehicle. Based on their design plan from lesson 1, students can start prototyping within the game. They should be able to explain the parts and how each constitutes to an effective and sustainable transportation that works on both land and water. They should also describe the usefulness of the materials based on functions, properties and how their vehicle can be used in case of extreme flooding.

Teacher-Led Unplugged Activity (10 minutes)
- Teacher gives an overview of lesson goals, and reiterates the driving question.
- Teacher gives students the opportunity to ask questions before beginning their prototype.

Guided Game Quest Activity (30 minutes)

In-Game Prototype:
1. Use the Builder Tool to make an inventory of blocks and basic parts in building a vehicle -- either a car or a bike.
2. Use the Builder tool to create a sustainable and eco-friendly amphibious vehicle that works on both land and water.
   - Ideally, the vehicle should include essential parts: blocks, wheels, engine, and battery, cockpit and steering wheel of a car, or bike seat and handle.
   - Students should consider using blocks that are able to give their vehicle maximum performance even on moving water, which exerts strong force to make the vehicle move.
     - Ideally, building blocks should be a combination of cube, pie, triangle, and concave.
     - Change the properties of the blocks (i.e. wood, carbon fiber, etc.) in order to strengthen the foundation and reduce weight of the vehicle.
     - The vehicle should include solar panels for sustainable energy.

Documentation using Game Camera:
- Using the Camera, students should take pictures of their prototype at different stages of construction.
- Later, in lesson 5, the photos will be used in their reflection and presentation i.e. they will create a photo essay and present their project in class.

Lesson 2 Assessment Ideas
Teachers should consider different assessment options throughout the project phases, including for example:
1. Quality of student research and project journal
2. Design assessment and reasoning, including material uses and reasoning in relation to force and motion
3. Engineering approach, including aspect, size, parts that are amphibious, environmentally-friendly, and other considerations that students should explain
4. Time management, collaboration, problem-solving skills

Lesson 3: Testing and Refining

Introduction to the Lesson

Students test and refine their vehicle by discovering different textures in the Builder tool, trying out vehicle parts to affect motion, adjusting the weight, size and length of their vehicle. With consideration of the flood hazards in the community, students should strategize ways to prevent flooding from having a massive impact on people, properties, environment, and the economy.

Teacher-Led Unplugged Activity (10 minutes)
- Teacher gives an overview of lesson goals, and reiterates the driving question.
- Teacher gives students the opportunity to ask questions before they begin testing and refining their prototype.

Guided Game Quest Activity (30 minutes)

Refining and Testing the Prototype:
1. Using the game's Builder Tool, the students spend time in finishing their amphibious vehicles.
2. When their basic prototype is completed, students should test different strategies to make their vehicle move and be stable on both land and water.
3. After their initial testing, they can refine their design based on initial observations and opportunities for improvement.
4. Students should explain their reasoning behind refining the design in their project journal.

Documentation using Game Camera
- Students should take pictures of their prototype at different stages of construction.
- They should take photos to illustrate how they refined their designs.
- Later, in lesson 5, the photos will be used in their reflection and assessment i.e. they will create a photo essay about their project.

Lesson 3 Assessment Ideas

Teachers should consider different assessment options throughout the project phases, including for example:
1. Quality of student research and project journal
2. Design assessment and reasoning, including material uses and reasoning in relation to force and motion
3. Engineering approach, including aspect, size, parts that are amphibious, environmentally-friendly, and other considerations that students should explain
4. Time management, collaboration, problem-solving skills
5. And specifically for Lesson 3:
   - Design changes to improve functionality based on students' observation
   - Their reasoning and explanation for making these changes

Lesson 4: Project Finalization

Introduction to the Lesson
Teacher explains the social and environmental impact of creating sustainable, eco-friendly and cost-effective vehicle that works on both land and water, especially in case of flooding. Teacher highlights the importance of having flood safety measures and prevention to ensure that this phenomenon won't devastate many properties and lives.

Teacher-Led Unplugged Activity (10 minutes)
- Teacher gives an overview of lesson goals, and reiterates the driving question.
- Teacher gives students the opportunity to ask questions before using game to finalize their design/project.

Game Sandbox Activity (30 minutes)
Final Project
1. Use the Builder tool to make any final improvements to the vehicle: properties of blocks, size, weight, length, essential and additional parts.
2. Students should finalize any and all additional design strategies in ensuring that their amphibious vehicle works on both land and water, and is flexible in case of extreme flooding.

Documentation using Game Camera
- Students should take photos to illustrate and record their final designs.
- Later, in lesson 5, the photos will be used in their reflection and assessment i.e. they will create a photo essay about their project.

Lesson 4 Assessment Ideas
Teachers should consider different assessment options throughout the project phases, including for example:
1. Quality of student research and project journal
2. Design assessment and reasoning, including material uses and reasoning in relation to force and motion
3. Engineering approach, including aspect, size, parts that are amphibious, environmentally-friendly, and other considerations students should explain
4. Time management, collaboration, problem-solving skills
5. And specifically for Lesson 4:
    - Final project design, including all components based on their own merit (solar panels, propellers, etc.)
    - Their reasoning and explanation for final design
    - Extra credit is students used the *Painter Tool* to color their vehicle, or even coded it

Lesson 5: Presentation and Reflection

Introduction to the Lesson
Teacher asks the students to write about their project and design assessment using the game's photo essay tools.

Game Sandbox Activity (30 minutes)
Photo Essay
1. Using the game's *Mission Log*, students finalize their photo essay about the project.
2. In the photo essay, students should organize and name photos by activity and stage of the project, and insert them into their essay.
3. For example, some questions students might be asked to answer in their photo essay, may include:

   - How do objects move?
   - Why is reference point important in describing one's position?
   - How do distance, direction, and reference point help in describing a complete position?
   - What are the factors that affect an object's movement?
   - How does force help in making objects move?
   - What is the idea behind your eco-friendly amphibious vehicle?
   - What shapes and materials should be used to create an eco-friendly amphibious vehicle?
   - What important things were you trying to achieve with your design?
       - Energy-sufficient
       - Works on both land and water
       - Reduces carbon emission
       - Fast/speedy
   - How many blocks and what kinds of blocks were used?
   - What were the differences in design considerations and materials for each? And why?
   - What changes did you make after the initial prototype and why?
   - How do we instill resilience among people through product creation, especially in times of flooding?
   - How do we encourage the community to help prevent flooding in their area?
   - What else would you have done, or do differently if you had more time?

Assessment: *Post-test about about force and motion (10 minutes)*

Final Assessment
1. Photo essay
2. Post-test
3. Previous assessments made during the other lessons

Teacher Handy Links and Resources

From Us to You!

- To understand force and motion, it is important to remember Newton's Law of Motion. READ HERE.

- Position and displacement are the result of motion on objects. To know more, READ HERE.

- Floods are natural disasters that can cause property damage and loss of life. See this infographic regarding flood safety. SEE THIS.

- Amphibious vehicles are an improved form of transportation across land and water. Here are 9 amphibious cars you should know about. SEE HERE.

Other Multimedia Resources

- Teach children how to create a DIY Flood Disaster Model to observe how flooding affects the environment. WATCH HERE.

- Watch this video on how to be prepared in the events of flooding. WATCH HERE.

- Check out these amazing anti-flood inventions made possible by modern technology. WATCH HERE.

Other Reference Material

- National Curriculum in England: Science programmes of study: key stages 1 and 2, September 2013 READ

Support & Help

Please feel free to contact the STEAM Craft Edu team for any inquiries or support needs

Email: education@steamcraftedu.com