

Earth and Space

The Role of Water in Earth's Surface Processes

Grade 6 Unit of Inquiry – Quarter 3

Planeteers Game-based Learning Platform

Science and Technology, Arts, Math and Engineering

Prepared by STEAM Craft Edu for Department of Education - California

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Outcomes and Content

Science

Curriculum Content Code: MS-ESS2-4 | MS-ESS3-3 | MS-ESS2-5 | MS-ESS3-2
MS-ESS3-3 | MS-ESS3-4

Learning Outcomes

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment

Standards: Water in the Environment

1. How do the atmosphere and hydrosphere interact to control our valuable water resources?
2. How do we conserve water in our household and in the community?
3. How important is water in our daily activities?
 - Explain that water changes its state as it moves through the multiple pathways of the hydrologic cycle
 - Explain the use of water from different sources in the context of daily activities
 - Discuss ways to conserve water in the household and the community

Engineering and Technology

Curriculum Content Code: MS-ETS1-1 | MS-ETS1-2 | MS-ETS1-3

STEAM Curriculum Code: ED1.1 | ED1.2

Learning Outcomes

Use different materials to make a robot, and select appropriate materials to meet the robot's design need

Standards: Design Process for Innovation

1. How will you design an innovative and technology-centric water dam in order to conserve water, for home and community use?
 - Identify and use appropriate materials in creating a water dam
 - Build, modify and upgrade a robot for a specific function or purpose
 - Discuss functions of the robot in relation to conserving and optimizing water cycle to community use
 - Explain the purpose of simple machines and the common types

Arts and Mathematics

Curriculum Content Code: MP.1 | MP.2 | 6.G

Learning Outcomes

Construct 3-D projects using primary and secondary colors, geometric shapes, space, and repetition of colors to show balance of the structure and shape.

Standards: Elements of Design and Geometry

1. What shapes should be used to create useful products to design a technology-centric water dam?
 - Demonstrate understanding of lines, shapes, and space; and the principles of rhythm and balance through balance of design
 - Visualizes the volume of solid figures in different situations using non-standard and standard units
 - Construct polygons, circles, and solid figures

Coding and Robotics

STEAM Curriculum Code : TC1.1|TC1.3

Learning Outcomes

Create an algorithm for a complex machine, e.g robot with specific functions and purpose; programs a robot to respond to external and internal changes (Triggers).

Standards: Basics of Coding and Block Code, Simple Events & Triggers

1. How can robots function according to its intended purpose?
2. What types of materials are used for making a robot?
3. How does your robot react to different environmental conditions?
 - Identify parts of a robots
 - Understand the different uses for robots
 - Understand the concept of Artificial intelligence (AI)
 - Understand how programming is used to give robots instructions
 - Create a sequence of steps (an algorithm) for a robot to follow
 - Program a Robot to respond to external or internal changes (Triggers)

Unit Summary

Grade:

6

Subject:

Science, Technology,
English, Arts and Math

Duration:

1 week (50 minutes/day)

Syllabus Mapping:

- Earth and Space
- Geometry
- Elements of Design
- Design Process for Innovation
- Making
- Coding and Robotics

Integration:

- Science
- Mathematics
- Arts
- Engineering
- Technology

Outcomes:

**MS-ESS2-4 | MS-ESS3-3 | MS-ESS2-5 | MS-ESS3-2 MS-ESS3-3 | MS-ESS3-4
MS-ETS1-1 | MS-ETS1-2 | MS-ETS1-3 | MP.1 | MP.2 | 6.G**

Inquiry and Focus Questions:***Driving Question:***

Our water resources face a host of serious threats, all of which are caused primarily by human activity. How will you design a technology-centric water dam in order to conserve water in the community, and to ensure a sustainable water supply for current and future generations?

Science Inquiries:

- How do the atmosphere and hydrosphere interact to control our valuable water resources?
- How do we conserve water in our household and in the community?
- How important is water in our daily activities?

Engineering, Technology and Coding Inquiries:

- How will you design an innovative and technology-centric water dam in order to conserve water, for home and community use?
- How can robots function according to its intended purpose?

Arts and Mathematics Inquiries:

- What shapes should be used to create useful products to design a technology-centric water dam?

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

Design and Production

- Researching and planning
- Design and innovation
- Producing, implementing, testing, refining

Skills Focus:

This unit of investigation explores concepts from the core science standards for earth and space, with a focus on atmosphere, particularly, the role of water in Earth's Surface Processes. 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 a technology-centric water dam. They test and refine the effectiveness of their design and construction, while minimizing the environmental and financial cost. Students learn about sustainable practices in conserving water resources without the degradation of the ecosystem. They take action in improving their own and others' 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 discusses about the role of water in the Earth's surface processes, its sources, and its importance in our daily lives. As part of the project-based lesson, the teacher poses a challenge on the threats to water resources and the consequences of excessive water withdrawal, which are caused primarily by human activities. Students are tasked with researching some innovative technologies for water conservation. As part of the research, students learn about ways to conserve water and augment sustainable supply for current and future generations.

Assessment: Pre-test about the role of water in the Earth's surface processes (10 minutes)

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

Begins with a discussion the role of water in the Earth's surface processes, its sources, and its importance in our daily lives.

Teacher says, *"Water is our most precious natural resource. How we manage it today will greatly affect nearly every aspect of our future. Water use is sustainable when the use does not harm ecosystems, degrade water quality, or compromise the ability of future generations to meet their own needs. According to a study made by Metropolitan Council, 63% of the municipal water can be conserved in residential areas."*

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

Q. Our water resources face a host of serious threats, all of which are caused primarily by human activity. How will you design a technology-centric water dam in order to conserve water in the community, and to ensure a sustainable water supply for current and future generations?

Science Inquiries:

- How do the atmosphere and hydrosphere interact to control our valuable water resources?
- How do we conserve water in our household and in the community?
- How important is water in our daily activities?

Engineering, Technology and Coding Inquiries:

- How will you design an innovative and technology-centric water dam in order to conserve water, for home and community use?
- How can robots function according to its intended purpose?

Arts and Mathematics Inquiries:

- What shapes should be used to create useful products to design a technology-centric water dam?
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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 water resources, ways to conserve water, and innovative water dams.

Science Inquiries:

- How do the atmosphere and hydrosphere interact to control our valuable water resources?
- How do we conserve water in our household and in the community?
- How important is water in our daily activities?

Engineering, Technology and Coding Inquiries:

- How will you design an innovative and technology-centric water dam in order to conserve water, for home and community use?
- How can robots function according to its intended purpose?

Arts and Mathematics Inquiries:

- What shapes should be used to create useful products to design a technology-centric water dam?

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- Students brainstorm, draft their design and plans 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 during extra time.

Lesson 1 Assessment Ideas

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

1. Quiz about the role of water in the Earth's surface processes
2. Quality of student research and project journal
3. Design assessment and reasoning, problem solving
4. Group skills, time management, collaboration
5. Project works (later lessons)
6. Photo Essay (later lessons)

Lesson 2: Introduction to Robotics & Coding with Blockly**

Introduction to the Lesson

Teacher explains that Robotics is the science behind our favorite machines and includes designing, coding, manufacturing, and operating robots. Teacher explains the basic concepts of robotics, identify essential parts of a robot and its relevance to our daily lives. Teacher also includes the concept of Artificial Intelligence, automation and on how they can reduce work loads. Teacher guides the students in making connections between robots and the computer programs that give them instructions. Similarly, a technology-centric water dam is considered a robot because it's run by a program.

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 the lesson activity. *m*

minutes)

Guided Game Quest Activity (30 minutes)

Robotics Blockly Coding Quests:

1. Students complete the guided robotics and coding quests inside the game.
2. Scaffolded game quests teach students the following skills as they debug and repair a broken robot:
 - Basics of coding & Block Code
 - Explain what coding is
 - Explain commands, sequencing, and basic coding terms like program, run and debug.
 - Identify parts of the coding user interface (UI): commands, scripts area, stage
 - Connect/fix Block Codes in a robot
 - Explain and validate the importance of sequencing codes and pattern recognition to create algorithms
 - Introduce and emphasize the concept of debugging
 - Using simple events and triggers

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 thinking and reasoning, including material uses and reasoning in relation to properties
3. Time management, collaboration, problem-solving skills
4. Logical and computational thinking
5. Badges earned competing the guided quests

Lesson 3: Prototyping a Technology-Centric Water Dam

Introduction to the Lesson

Teacher guides the students in identifying parts of a robot in order to build an innovative and technology-centric water dam. Based on their design plan from lesson 1, and the skills developed in Lesson 2, students can begin a robot prototype using the games *Builder Tool*. They should be able to explain appropriate materials and design considerations used in making the water dam sustainable. This should help conserve water and augment sustainable supply of current and future generations.

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)

In-Game Prototype:

1. Students are tasked with using the games' *Builder Tool* to construct a technology-centric water dam.
3. The water dam should be constructed using appropriate materials to make it sustainable.
4. Building blocks should include a variety of geometric shapes and materials including stones, metal.
5. The design should include important components (e.g. data link, sensors, etc).
6. Students can also use the Painter Tool to add a color scheme to their water dam.

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 thinking and reasoning, including material uses and reasoning in relation to properties.
3. Time management, collaboration, problem-solving skills.
4. Engineering approach, construction, and other considerations that the student should describe/explain
5. Logical and computational thinking.

Lesson 4: Testing and Refining the Robot's AI and Project Finalization

Introduction to the Lesson

Teacher explains the importance of water in our daily lives, especially for the community. Teacher presents the possible consequences of excessive water withdrawal from its sources, esp. in meeting the needs of current and future generation. Teacher also highlights the importance of innovating water dams in order to conserve water, without the degradation of the ecosystems.

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)

Testing and Refining the Prototype:

1. Using the game's Builder Tool, the students spend time in refining their water dam.
2. They should build multiple shapes and layers.
3. Students should also discover different textures, and adjust sizes and heights of their dam.
4. When their basic prototype is completed, students should test different strategies to collect and conserve water for future use.
5. After their initial testing, they can refine their design based on initial observations and opportunities for improvement.
6. Students should explain their reasoning behind refining the design in their project journal.
7. Students can also use the Painter Tool refine/finalize the color scheme to their water dam.

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.
- With their project complete, students should write captions for each photo taken.
- Using the mission journal, they should explain the importance of water in our lives.

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. Literacy and photography skills, specifically for the Mission Journal
3. Design thinking and reasoning, problem solving
4. Engineering approach, including aspect, functionality and other considerations students should describe/explain
5. Time management, collaboration, problem-solving skills
 - Final project design, including all components based on their own merit
 - Their reasoning and explanation for final design
 - Extra credit is students used the *Painter Tool* to color their creation

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 the atmosphere and hydrosphere interact to control our valuable water resources?
 - How do we conserve water in our household and in the community?
 - How important is water in our daily activities?
 - How do we conserve water in our household and in our community?
 - How do we encourage and organize water conservation in our community?
 - What are the benefits of conserving water?
 - What are the consequences of excessive water withdrawal?
 - How is climate change affecting water resources?
 - How can robots function according to its intended purpose?
 - How does your robot react to different environmental conditions?
 - What shapes and materials should be used to create a technology-centric water dam?
 - 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?
 - What else would you have done, or do differently if you had more time?

Assessment: Post-test about the role of water in the Earth's surface processes (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!

- Check out this infographic on the water cycle. [SEE HERE.](#)
- Read about the importance of water in all living processes. [READ HERE.](#)
- How is water pollution a huge concern in the modern age? The National Resources Defense Council elaborates. [READ HERE.](#)

Other Multimedia Resources

- Water affects life, including the biodiversities that depend on it. To understand how, [WATCH HERE.](#)
- Is the world running out of clean water? DW News investigates about the global water crisis. [WATCH HERE.](#)

Other Reference Material

- [2016 Science Framework for California Public Schools \(Kindergarten Through Gade 12\)](#)

Planeteers Robotics Fun Facts

- Arms, sensors, and wheels, oh my! Robots can have them all. A robot has four essential characteristics: sensing, movement, energy, and intelligence. Artificial Intelligence (AI)” comes from instructions sorted in the robot’s central processing unit or CPU.
- Robots that can function on their own are called ‘autonomous’ and are very useful in remote exploring, space flight, and even dangerous missions! Advanced autonomous robots have lots of sensors and an AI system can learn from the environment, experience, and build on what it can do.
- So basically, “Us robots ask a lot of questions! The CONDITION is the response to those questions. If the response is YES, the condition is TRUE. If the response is not a yes, the condition is FALSE and the program will not do anything. IF statements like this are a called CONTROL STRUCTURES because they control the flow of a program. Cool Huh!”

Support & Help

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

Email: education@steamcraftedu.com