Chemical Sciences

Properties of materials

Year 4 Unit of Inquiry

Planeteers Game-based Learning Platform

Science and Technology, Arts, Math and Engineering

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Outcomes and Content

Science & Technology

Curriculum Content Code: ACSSU074

Learning Outcomes

Considers how the properties of materials affect the management of waste or can lead to pollution

Standards: Properties of Materials

1. How do the physical properties of natural and processed materials influence their use?
2. What are the proper ways to dispose waste based on the properties of its materials?
3. How do you plan for effective waste management in your community?
4. What are the safety precautions that must be observed in disposing waste?

- Demonstrate proper disposal of waste according to the properties of its materials
- Select materials for uses based on their properties
- Investigate a particular property across a range of materials
- Describe a range of common materials, such as metals or plastics, and their uses
- Identify ways of disposing waste according to the properties of its materials
- Demonstrate understanding of changes that waste materials undergo when exposed to certain conditions

Engineering

STEAM Curriculum Code: ED 1.1 | ED 1.2

Learning Outcomes

Selects appropriate materials to meet a design need

Standards: Design Process for Innovation

1. How will you design a trash bin that segregates waste according to the properties of its materials?

- Apply design assessment to build and create real-world projects
- Build products that use appropriate elements and parts

Mathematics & Arts

Learning Outcomes

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

Standards: Geometry and Elements of Design

1. What shapes should be used to design and create useful products such as a trash bin?

- Perform a series of two or more operations
- Demonstrate understanding of the concepts of parallel and perpendicular lines, angles, triangles, and quadrilaterals
- Describe the attributes/properties of triangles and quadrilaterals using concrete objects or models
- Demonstrate understanding of lines, texture, shapes, balance of size, and repetition of patterns

Social Studies

Learning Outcomes

Discusses practices for civic efficacy as part of a community, such as cleaning the environment

Standards: Civic Efficacy and Well-being

1. How do we practice cleanliness in our community?
2. How do we encourage and organize recycling in our community?
3. What are the benefits of recycling?

- Develop a plan to segregate recyclable materials
- Develop community awareness about waste management

Unit Summary

Grade:
4

Subject:
Science, Technology, English, Arts and Math

Duration:
1 week (50 minutes/day)

Syllabus Mapping:
- Properties of Materials
- Geometry an Elements of Design
- Design Process for Innovation
- Making

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

Outcomes:
ACSSU074

Inquiry and Focus Questions:

Driving Question:
How will you design a trash bin for an effective waste disposal and management, in order to make your environment a pleasant place to live in?

Science and Technology Inquiries:
- How do the physical properties of natural and processed materials influence their use?
- What are the proper ways to dispose waste based on the properties of its materials?
- How do you plan for effective waste management in your community?
- What are the safety precautions that must be observed in disposing waste?

Mathematics and Arts Inquiries:
- What shapes should be used to design and create useful products such as a trash bin?

Social Studies Inquiries:
- How do we practice cleanliness in our community?
- How do we encourage and organize recycling in our community?
- What are the benefits of recycling?

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 states for matter and properties of materials, with a focus on waste management and recycling. 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, test and refine effectiveness of materials used in building an innovative trash bin as part of proper waste disposal, while minimizing environmental and financial costs. They learn about sustainable practices in keeping their community clean. 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 how natural and processed materials have a range of physical properties that can influence their use. Teacher relates how these properties affect the management of waste and can lead to pollution. Teacher explains the benefits of proper waste disposal, and ways to manage it. As part of the project-based lesson, the teacher poses a challenge on designing and building an innovative trash bin as a way to manage solid waste disposal. Students are tasked with researching possible effects to the community (ie. humans and animals) when exposed to discharged waste or garbage. As part of the research, students also learn about recycling and how it helps the community.

Assessment*: Quiz about Properties of Materials (10 minutes)*

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

Begins with a discussion about proper disposal of waste according to the properties of its materials.

Teacher says, *"Proper disposal of waste should be observed in all areas, such as within the household, classroom, and community, especially in dumpsites and canals. Too much exposure to improperly-handled waste can result to various diseases and health hazards. Proper disposition of discarded material must be in accordance with the local environmental guidance or laws."*

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

Driving Q. How will you design a trash bin for effective waste disposal and management, in order to make your environment a pleasant place to live in?

Science and Technology Inquiries:

- How do the physical properties of natural and processed materials influence their use?
- What are the proper ways to dispose waste based on the properties of its materials?
- How do you plan for effective waste management in your community?
- What are the safety precautions that must be observed in disposing waste?

Social Studies Inquiries:

- How do we practice cleanliness in our community?
- How do we encourage and organize recycling in our community?
- What are the benefits of recycling?

Mathematics and Arts *Inquiries:*

- What shapes should be used to create useful products to design a trash bin?

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 proper waste disposal, waste segregation, and the materials they will be using in the Planeteers game.

Science and Technology Inquiries:

- How do the physical properties of natural and processed materials influence their use?
- What are the proper ways to dispose waste based on the properties of its materials?
- How do you plan for effective waste management in your community?
- What are the safety precautions that must be observed in disposing waste?

Social Studies Inquiries:

- How do we practice cleanliness in our community?
- How do we encourage and organize recycling in our community?
- What are the benefits of recycling?

Mathematics and Arts *Inquiries:*

- What shapes should be used to create useful products to design a trash bin?

- 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. Pre-test on Properties of Materials
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: Prototyping

Introduction to the Lesson

Teacher guides the students in identifying materials that can be used to build an innovative trash bin. Based on their design plan from lesson 1, students can start prototyping within the game. They should be able to explain the usefulness of those materials based on their properties. They should analyze the bin structure such as shape, parts, height, size, and other considerations to ensure the proper disposal of waste. In terms of improving the community's cleanliness through effective waste management, students should strategize which areas to put those bins (ie. one near the coastal area, one near a household, etc.).

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. Students are tasked to use the games' *Builder Tool* to make an inventory of blocks and their properties.
2. Use the *Builder Tool* to construct a trash bin:
    - Ideally, the trash bin should have at least 3-5 pits to segregate waste according to its properties (i.e 5Rs -- Reduce, Reuse, Recycle, Recover, Repair)
    - Students should consider the shape, height, size, to ensure the proper disposal of waste.
    - Ideally, building blocks should include a combination of the following, depending on the student's design: metal, iron, carbon fiber, and nickel.
3. In addition to the building, students need to strategize where to locate their trash bin/s in different parts of their community to ensure proper waste management (e.g near a house, near the coastal area, beside a farm, etc.).

Documentation using Game Camera

- Using the game's Camera, students should take pictures of their prototype trash bin at different stages of construction.
- 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 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 properties
3. Time management, collaboration, problem-solving skills
4. Engineering approach, including aspect, sizes, structure and other considerations students should describe/explain

Lesson 3: Testing and Refining

Introduction to the Lesson

Students test and refine their trash bin by discovering different textures in the Builder tool, adjusting height and size. With consideration of the social and environmental impact to the community, students should create campaigns and strategies on where to effectively locate or place the trash bins in different areas of their community.

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 the Prototype:

1. Using the game's *Builder Tool,* students should spend time to finish their innovative trash bins.
2. When their prototype is completed, students should strategically locate their bin in different areas of their community.
3. Ideally, it can be near a household, or a coastal area, near a farm, etc.
4. Students should explain their reasoning behind refining the design and its location 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 based on locations around their community that are ideal for a trash bin.
- 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 functionality and its benefit to their community
3. Creativity, time management, collaboration, problem-solving skills
4. Engineering approach, including aspect, construction, and other considerations that the student should describe/explain
5. And specifically for Lesson 3:
   - Students' strategies on location of the trash bins around the community
   - Design changes to ensure effectiveness on their bins based on their strategies
   - Their reasoning and explanation for making these specific changes

Lesson 4: Project Finalization

Introduction to the Lesson

Teacher explains the social and environmental impact of proper disposal and management of waste in the community. Teacher highlights the importance of recycling and of innovating new technologies that would revolutionize ways of keeping the community clean.

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 composition, parts, sizes, and structure of the trash bin.
2. In addition, students should make any final adjustments to the strategic locations of their bins.
3. Students should finalize any additional design strategies to ensure that their community practices proper waste disposal and management.

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 functionality of their innovative trash bin, especially in keeping their community clean.

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 functionality and its benefit to the community
3. Creativity, time management, collaboration, problem-solving skills
4. Engineering approach, including aspect, construction, and other considerations that the student should describe/explain
5. And specifically for Lesson 4:
    - Final project design, including all components based on their own merit
    - Explaining changes and modifications to their prototype and why they made them
    - Extra credit if students used the painter to color their creations

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 physical properties of natural and processed materials influence their use?
- What are the proper ways to dispose waste based on the properties of its materials?
- What are the safety precautions that must be observed in disposing waste?
- How can you make your environment a pleasant place to live in?
- How do you plan for effective waste management in your community?
- How do we practice cleanliness in our community?
- How do we encourage and organize recycling in our community?
- What are the benefits of recycling?
- 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 does recycling help your community and the environment?
- What else would you have done, or do differently if you had more time?

***Assessment**: Post-test about Properties of Materials (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!

- Learn about the effects of improper garbage disposal on the environment. READ HERE.
- Learn about the different types of material waste and the effects of improper waste disposal on the environment. READ HERE.
- The United Nations Environmental Programme (UNEP) has an infographic on waste management and recycling. SEE HERE.
- Did you know that there are new technologies created to manage special types of material waste? READ HERE.
- Want some ideas on potential trash and recycle bin designs for the future? READ HERE.

Other Multimedia Resources

- A life of 'zero waste' is not that hard to attain. Here's 10 ways on how to achieve a zero-waste lifestyle. WATCH HERE.
- Here's a list of 10 innovations that makes use of waste to help save the environment. WATCH HERE.

Other Reference Material

- Australian Curriculum (ACARA) Science Sequence of Content F-6: Strand READ

Support & Help

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

Email: education@steamcraftedu.com