

Chemical Sciences

Changes to Materials

Year 6 Unit of Inquiry

Planeteers Game-based Learning Platform

Science and Technology, Arts, Math and Engineering

Email: education@steamcraftedu.com



Outcomes and Content

Science & Technology

Curriculum Content Code : ACSSU095

Learning Outcomes

Explore how reversible changes can be used to recycle materials

Standards: Changes to Materials; Robotics and Basics of Coding

1. How can changes to materials be reversible or irreversible?
2. What happens when materials are mixed?
3. What are the ways to segregate materials, such as waste?
4. How does separating mixtures like waste and water segregation benefit the community?
5. How can you identify and segregate waste or water using a machine?
6. How do you plan for an effective recycling and waste management in the community?
 - Explain how changes to materials can be reversible or irreversible
 - Describe what happens when materials are mixed
 - Discuss the benefits of separating mixtures such as waste and water segregation in community
 - Describe what happens when materials are mixed
 - Describe ways to recover useful materials from waste products using the appropriate separation technique/s
 - Discuss how waste can be segregated through robot functions

Engineering

STEAM Curriculum Code: ED1.1 | ED1.2 | ES1.1

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 can robots help with important tasks?
 - Build, modify and upgrade a robot for a specific function or purpose
 - Discuss functions of the robot in relation to waste management and conditions that affect the formation of mixture (e.g. size of particles, stirring of mixtures & temperature)
 - Explain the purpose of simple machines and the common types

Mathematics & Arts

Learning Outcomes

Apply the four fundamental operations involving fractions and decimals in mathematical problems and real-life situations; utilize art skills in using new technologies (hardware and software)

Standards: Number and Number Sense; Art Processes

1. How do you explain the composition of your robot using fractions and percentage?
2. How do you apply art concepts on the use of computer softwares?
 - Calculate fraction and percentage of materials used or composition of a machine (i.e. robot)
 - Apply concepts on the use of the software (commands, menu, etc.)
 - Use digital painting to add color to their robot

Coding & 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; program a robot to respond to external and internal changes (Triggers)

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

1. How does your robot react to different types of materials such as waste and water?
 - Discuss the functions of each robot parts that is used in waste or water segregation

Unit Summary

Grade:

6

Subject:

Science, Technology,
English, Arts and Math

Duration:

1 week (50 minutes/day)

Syllabus Mapping:

- Changes to materials
- Elements of Design
- Statistics and Probability
- Design Process for Innovation
- Making

Integration:

- Science
- Mathematics
- Arts
- Engineering
- Technology

Outcomes:

ACSSU095

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

How will you design a robot that helps in effective waste and water management in the community?

Science & Technology:

- How can changes to materials be reversible or irreversible?
- What happens when materials are mixed?
- What are the ways to segregate materials, such as waste?
- How does separating mixtures like waste and water segregation benefit the community?
- How can you identify and segregate waste or water using a machine?
- How do you plan for an effective recycling and waste management in the community?

Engineering, Coding and Robotics

- How can robots help with important tasks, such as waste and water management in the community?
- How will you program a robot to separate mixtures using different techniques (e.g. sieving and using magnet, decantation, evaporation & filtering)?

Mathematics and Arts

- How do you explain the composition of your robot using fraction and percentage?
- How do you apply art concepts on the use of computer softwares?

Learning across the Curriculum:**Cross-curriculum priority**

- Sustainability
- Environmental Awareness and Waste Management
- Technology

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 matter, with a focus on changes to materials. Students use an individual inquiry-based approach to explore solutions to a multi-layered real-world question, while utilizing technology. They are introduced to the basic concepts of robotics and coding such as robot design and construction, and to basic programming. They experiment with a number of in-game tasks to design a robot that can help in efficient and effective waste segregation. 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 describes the changes to materials to either be reversible or irreversible. As part of the project based lesson, the teacher cites or identifies common household materials, mixtures, solutions and their uses. Students are then tasked with researching on how they are properly disposed and segregated (e.g techniques in separating mixtures like decantation, evaporation, filtering, sieving and using magnet). As part of the research, students also learn about different technologies that help in segregating and separating materials such as robots that help in separating mixtures or those with abilities to separate mixtures.

Assessment: Quiz about changes to materials (10 minutes)

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

Begins with a discussion about common household materials, particularly mixtures, their uses, and the importance of properly segregating them upon disposal. Teacher says, *“Separating mixtures can benefit the community in many ways. Filtration, evaporation, and distillation for example, provides the community with drinking water, and by means of separating mixtures, people can distinguish biodegradable from non-biodegradable and recyclable materials can be a source of income from others in the community.”*

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

Q. How can you design a robot that helps in effective waste and water management in the community?

Science & Technology:

- How can changes to materials be reversible or irreversible?
- What happens when materials are mixed?
- What are the ways to segregate materials, such as waste?
- How does separating mixtures like waste and water segregation benefit the community?
- How can you identify and segregate waste or water using a machine?
- How do you plan for an effective recycling and waste management in the community?

Engineering, Coding and Robotics

- How can robots help with important tasks, such as waste and water management in the community?
- How will you program a robot to separate mixtures using different techniques (e.g. sieving and using magnet, decantation, evaporation & filtering)?

Mathematics and Arts

- How do you explain the composition of your robot using fraction and percentage?
 - How do you apply art concepts on the use of computer softwares?
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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 and watch documentary videos about mixture separation techniques and technologies being used to help the community or industries in waste and water management through mixture separation.

Science & Technology:

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Engineering, Coding and Robotics

- How can robots help with important tasks, such as waste and water management in the community?
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Mathematics and Arts

- How do you explain the composition of your robot using fraction and percentage?
- How do you apply art concepts on the use of computer softwares?

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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 on changes to 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: Introduction to Robotics and Coding with Blockly

Introduction to the Lesson

Teacher explains the basic concepts of robotics and its relevance in real life scenarios. Teacher explains that robotics is the science behind our favourite machines and includes designing, coding, manufacturing, and operating robots. The students are introduced to the essential parts of a robot, concept of artificial intelligence (AI), automation and how they can reduce workloads. Teacher guides the students in making connections between robots and the computer programs that give them instructions.

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 guided game quests.

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 assessment 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, testing and refining

Introduction to the Lesson

Teacher guides the students in identifying ways and benefits of waste and water management in the community. Based on their design plan from lesson 1, students can now start prototyping within the game. They should be able to explain the functionality of each part of their robot design, especially how it aids in waste and water management. In terms of improving their community's waste and water management practices, students should explain how their design can be sustainable and scalable for other communities.

Students test and refine their robot by discovering different machine blocks and action blocks that can be used to upgrade their robot features.

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.

Game Sandbox Activity (30 minutes)

Prototype:

1. Students are tasked with using the games' *Builder Tool* to construct a robot which has features that help in separating mixtures like in waste and water segregation.
2. Students may also opt to design innovative technologies for separating other mixtures such as a water management system (i.e. water filtration system for household, water dams in community, neighborhood depository, recycling centers).
3. The robot design should include important components e.g. Camera - for recognition, locomotion unit, battery, engine, camera, solar panels, data link, lights, antenna.
4. The robot should also be constructed with appropriate parts and materials to make it useful for segregation.
5. Ideally, the robot should have features that can perform segregation and separating of mixtures or waste e.g. magnetic waste separators, solid & liquid waste/water separators using the builder tool.
6. Students can also use the Painter Tool to add a color scheme to their robot
 - a. Students should consider color coding based on proper waste and water management standards.

Lesson 3: Prototyping, testing and refining (continued)

Refining the Prototype:

1. Students add Block Code to the robot to improve its functionality.
2. Students use the following to evolve the Robot's AI: Loop condition, If conditions, If Press conditions, Motion codes, and Action codes.
3. The code design for the robot AI should enable the following:
 - a. Activate the remote control
 - b. Make the robot play a "beep" sound while it is moving
 - c. Activate the in-game camera for taking photos
4. The code can be tested using the 'Play' icon in the Blockly coding environment.
5. Students can also use the Painter Tool refine/finalize the color scheme to their robot.

Documentation using Mission Journal

1. Using the game's *Mission Journal*, students should explain each feature of their robot and how they function to separate mixtures.
2. Students should add notes on their journal describing how their machine design benefits the community.

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 the community
3. Creativity, time management, collaboration, problem-solving skills
4. Logical and computational thinking
5. Engineering approach, including aspect, construction, and other considerations that the student should describe/explain

Lesson 4: Project Finalization

Introduction to the Lesson

Teacher explains social and environmental impact of proper waste segregation and the importance of recycling. Teacher highlights the importance of innovating new technologies that would help in sustainable and scalable waste and water management in the community. The students make connections between robotics and coding and how these make machines or robots useful for the household and the 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 using game to finalize their designs/project.

Game Sandbox Activity (30 minutes)

Final Project

1. Use the Builder tool and the Block Code to make any final improvements to their robot/s.
2. Students should finalize any additional design and codes in making their robot function efficiently and effectively.

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 of each photo taken using the mission journal.
- They should explain the functionality of their robot, especially in helping the community with waste and water management.

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. Logical and computational thinking
5. Engineering approach, including aspect, construction, and other considerations that the student should describe/explain
6. 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
 - Explaining how their AI works to control the robot, and describing the different parts of their program and what each does

Lesson 5: Presentation and Reflection

Introduction to the Lesson

Teacher asks the students to write about their project, their robot design, 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 can changes to materials be reversible or irreversible?
 - What happens when materials are mixed?
 - What are the ways to segregate materials, such as waste?
 - How does separating mixtures like waste and water segregation benefit the community?
 - How can you identify and segregate waste or water using a machine?
 - How do you plan for an effective recycling and waste management in the community?
 - How can robots help with important tasks, such as waste and water management in the community?
 - How do you explain the composition of your robot using fractions and percentage?
 - What environmental conditions did you design your robot for?
 - What were the major design considerations and why? What materials did you use and why?
 - What form of locomotion did you use and why did you choose it?
 - What kind of power source did you use and how long would it last?
 - What sensors did you include on your robot and why?
 - What kind of data would you collect using the sensors?
 - How did you paint your robot and why did you choose the color scheme?
 - What kind of AI did you create in block code, what did it do to enhance the robot's usefulness?
 - What else would you have done, or do differently if you had more time?

Assessment: *Post-test about changes to 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!

- For more information on the characteristics and types of mixtures, check this article by ThoughtCo. [READ HERE.](#)
- Supplement your knowledge by getting to know different kinds of mixtures in everyday life. [READ HERE.](#)
- How can mixtures become harmful to the environment? This STEAM experiment on an oil spill can show students how. [READ HERE.](#)
- A key element in waste segregation is knowing how waste is classified. See this infographic for reference. [SEE HERE.](#)
- Technology continues to make things possible, such as providing 'smarter' ways to manage waste. [READ HERE.](#)

Other Multimedia Resources

- To know more about mixtures, see this other video by TED-Ed on types of mixtures. [WATCH HERE.](#)
- FuseSchool demonstrates different ways of separating mixtures. [WATCH HERE.](#)
- Check out this video on how trash is managed and how it can possibly affect our future. [WATCH HERE.](#)
- Check out this simplified video on how to properly segregate waste. [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