

# Matter & Properties

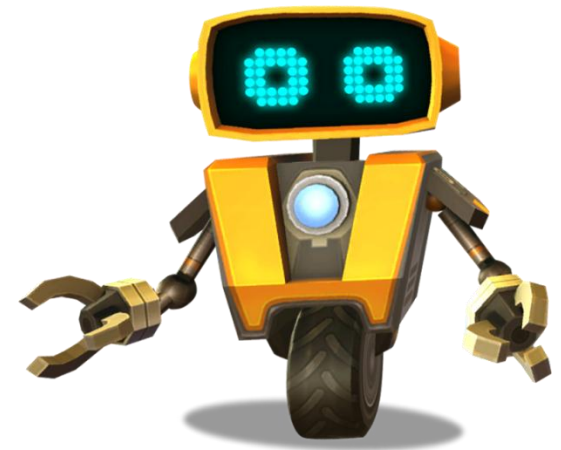
Grade 5 Unit of Inquiry

**Planeteers Game-based Learning Platform**

Science and Technology, Arts, Math and Engineering

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## Outcomes and Content

### Science & Technology

Curriculum Content Code: ACSSU077 | ACSIS231 | ACSIS086 | ACSIS091 | ACSIS093

#### **Learning Outcomes**

Solids, liquids and gases have different observable properties and behave in different ways

#### **Standards: Matter and Properties**

1. What types of materials can withstand the heat of the volcano?
2. How do you decide upon which material to use for a particular purpose?
3. How do properties of materials affect their use?
  - Explore the way solids, liquids and gases change under different situations such as heating and cooling
  - Recognize that substances exist in different states depending on the temperature
  - Recognize that not all substances can be easily classified on the basis of their observable properties
  - Discuss how models represent scientific ideas and constructing physical models to demonstrate an aspect of scientific understanding
  - Identify different properties of materials and different uses of materials
  - Design and build real world projects/products
  - Identify and use different elements to construct different products

### 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 your community to be disaster-ready?
  - Apply design thinking to build and create real world projects
  - Build products that use appropriate elements and parts

### Arts & Mathematics

Curriculum Content Code: ACMMG111 | ACMMG114 | ACMMG115  
ACAVAM114 | ACAVAM115

#### **Learning Outcomes**

Constructs 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**

What shapes should be used to create useful products to design a disaster-ready community?

- Select and manipulate combinations of materials and techniques
- Represent two-dimensional shapes such as photographs, sketches and images created by digital technologies
- Construct polygons, circles, and solid figures
- Demonstrate understanding of lines, shapes, and space; and the principles of rhythm and balance

### Humanities and Social Sciences

Curriculum Content Code: ACHASSI101 | ACHASSI102  
| ACHASSI103 | ACHASSI104 | ACHASSI105

#### **Learning Outcomes**

Reflect on learning to propose personal and/or collective action in response to an issue or challenge, and predict the probable effect

#### **Standards: Social Responsibility**

What is the relationship between environments and my roles as a consumer and citizen?

- Explain enterprising initiatives that address challenges

## Unit Summary

**Grade:**

5

**Subject:**

Science &amp; Technology

**Duration:**

1 week (50 minutes/day)

**Syllabus Mapping:**

- Matter and Properties
- Elements of Design
- Geometry
- Design Process for Innovation
- Making

**Integration:**

- Science
- Mathematics
- Arts
- Engineering
- Technology

**Outcomes:**

ACSSU077 | ACSIS231 | ACSIS086 | ACSIS091 | ACSIS093

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

With limited resources, what can we do in order improve our town's disaster readiness in the event of a volcanic eruption?

*Science & Technology:*

- How do we prepare for volcanic eruptions to protect land and property and allow for evacuation?
- What types of materials can withstand the heat of the volcano?
- How do you decide upon which material to use for a particular purpose?
- How do properties of materials affect their use?
- How can we investigate the observable changes that occur in volcanos?

*Engineering:*

- How will you design your community to be disaster-ready?

*Humanities and Social Sciences:*

- What shapes should be used to create useful products to design a disaster-ready community?

*Arts & Mathematics:*

- What is the relationship between environments and my roles as a consumer and citizen?

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

- Sustainability

**General Capabilities**

- Critical & Creative Thinking
- ICT Capability
- Numeracy
- Literacy
- Personal and Social Capability

**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 materials and their properties, and how these are affected by environment. 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 test and refine effectiveness of materials used while minimizing the environmental and financial cost. They learn about sustainable practices in keeping their community disaster-ready. They take action to improve 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 explains the concept of solids, liquids, gases and their observable properties (i.e. malleability, ductility, elasticity, brittleness), and how these change with temperature, and discusses their usefulness in certain situations. As part of the project based lesson, the teacher includes an introduction to volcanoes within the context of Australia, and the changes volcanoes undergo when erupting, including lava and its properties. Students are tasked with researching disaster-readiness solutions based on their understanding of the properties materials and volcanoes.

**Assessment:** *Pre-test about Matter and its properties, and how these change with temperature. (10 minutes)*

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

*Begins with a discussion about volcanic eruptions and its hazards .*

Teachers says “ Volcanic eruptions can drastically alter the geography of a region. Hot, liquid lava flowing downslope can force people living near volcanoes to flee their homes. Even more dangerous, however, are pyroclastic flows and lahars, in which volcanic rock fragments travel in fast-moving clouds and mudslides.”

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

**Q.** With limited resources, what can we do in order improve our town’s disaster readiness in the event of a volcanic eruption?

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#### **Science & Technology:**

- How do we prepare for volcanic eruptions to protect land and property and allow for evacuation?
- What types of materials can withstand the heat of the volcano?
- How do you decide upon which material to use for a particular purpose?
- How do properties of materials affect their use?
- How can we investigate the observable changes that occur in volcanoes?

#### **Engineering:**

- How will you design your community to be disaster-ready?

#### **Humanities and Social Sciences:**

- What shapes should be used to create useful products to design a disaster-ready community?

#### **Arts & Mathematics:**

- What is the relationship between environments and my roles as a consumer and citizen?
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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 about volcanoes, and volcano readiness, and about the materials they will be using in the Planetears game

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#### **Science & Technology:**

- How do we prepare for volcanic eruptions to protect land and property and allow for evacuation?
- What types of materials can withstand the heat of the volcano?
- How do you decide upon which material to use for a particular purpose?
- How do properties of materials affect their use?
- How can we investigate the observable changes that occur in volcanoes?

#### **Engineering:**

- How will you design your community to be disaster-ready?

#### **Humanities and Social Sciences:**

- What shapes should be used to create useful products to design a disaster-ready community?

#### **Arts & Mathematics:**

- What is the relationship between environments and my roles as a consumer and citizen?

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- Students brainstorm, plan and draft their design 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 Matter
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 a Lava Wall and Volcano Warning System

### *Introduction to the Lesson*

Teacher guides the students in identifying materials that can be used to build a fire-resistant wall that could withstand the heat of volcano lava. Based on their design plan from lesson 1, students can start to prototype within the game. They should be able to explain the usefulness of those materials based on their properties. They should analyze building structure such as appropriate angle, shape, depth, height, layers and other considerations to ensure the effectiveness of their wall. In terms of improving the community's disaster-readiness in case of volcanic eruption, students should consider strategies to divert the lava flow away from their community. Their design should include a volcano warning system to help alert the community of imminent eruptions.

### *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)*

#### **In-Game Prototype:**

1. Use the Builder Tool to make an inventory of blocks and their properties
2. Use the Builder tool to construct a lava wall
  - Ideally, the wall should be multi-layered and use various shapes to divert the lava flow.
  - Students should consider height, depth and other important elements (see assessment for component list).
  - The wall should be constructed using appropriate materials to withstand lava heat.
  - Ideally, building blocks should include a combination of the following in different layers, depending on the student's design: iron, nickel, cobalt, titanium, metal, brick and stone.
3. In addition to the wall, a volcano warning system should be built. This may be a technology-centric design using the game's block code, an observation tower, or students could simply create a combustible alarm close to the volcano to trigger smoke signals (these are just examples, student choice is important).

#### **Documentation using Game Camera:**

- Using the Camera, students should take pictures of their prototype wall and warning system 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 thinking and reasoning, including material uses and reasoning in relation to properties and heat resistance.
3. Engineering approach, including aspect, distance from town, angle to the lava flow, and other considerations students should describe/explain.
4. Time management, collaboration, problem-solving skills.

## Lesson 3: Testing and Refining

### *Introduction to the Lesson*

Students test and refine their wall by discovering different textures in the Builder tool, building multiple layers, adjusting the height, and angle. With consideration of the social and environmental impact to the community, students should consider strategies to divert the lava flow away from their community; for example by terraforming tranches or adjusting angle of the wall in order to effectively divert the lava.

### *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 testing and refining their prototype.

### *Game Sandbox Activity (30 minutes)*

#### **Refining the Prototype:**

1. Use the game's *Builder Tool* students should spend time to finish their wall and early warning system.
2. When their prototype is completed, students should pause building and use pen and paper to draw the lava flow, and try to estimate its speed and direction, and how long the wall will last under the extreme heat and force of the lava flow.
3. After their analysis, 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 wall and warning system at different stages of construction.
- They should take photos to illustrate how they refined their designs after their pen and paper analysis
- 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 and heat resistance.
3. Engineering approach, including aspect, distance from town, angle to the lava flow, and other considerations students should describe/explain.
4. Time management, collaboration, problem-solving skills
5. And specifically for Lesson 3:
  - Students analysis of the lava flow, its effects on their wall and warning system
  - Design changes to improve their disaster readiness project based on their analysis
  - Their reasoning and explanation for making these changes

## Lesson 4: Project Finalization

### *Introduction to the Lesson*

Teacher explains the social and environmental impact of building a lava wall, strategizing ways to divert lava flow through trenches, and innovating a volcano warning system to the community. Teacher highlights the importance of being creative and innovative in improving a community's disaster readiness in the event of a volcanic eruption.

### *Teacher-Led Unplugged Activity (10 minutes)*

- Teacher gives an overview of lesson goals.
- Teacher gives students the opportunity to ask questions before using the game to finalize their designs/project.

### *Game Sandbox Activity (30 minutes)*

#### **Final Project**

1. Use the *Builder tool* to make any final improvements the composition, foundation, and structure of the lava wall.
2. In addition, students should make any final adjustments to the design of the volcano signal system.
3. Students should finalize any and all additional design strategies in making their community disaster-ready in the event of a volcanic eruption.

#### **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.

#### **Final Analysis**

With their project complete, students use pen and paper to draw the lava flow again and estimate how long the wall will last under the extreme heat and force of the lava flow, and how the warning system and any other strategies will be triggered/last.

### *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 thinking and reasoning, including material uses and reasoning in relation to properties and heat resistance.
3. Engineering approach, including aspect, distance from town, angle to the lava flow, and other considerations students should describe/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 (wall, warning system, others)
  - Their reasoning and explanation for final design, including analysis of the lava flow, its effects on their wall and warning system
  - Any worthy design elements e.g. trenches, watch towers, signs, escape routes, etc.
  - 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, their disaster readiness design plan, and design thinking 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 project, and insert them into their essay.
3. For example, some questions students might be asked to answer in their photo essay, may include:
  - What threats do volcanoes pose to a nearby community?
  - What is the idea behind your disaster-ready design?
  - What important things were you trying to achieve with your design e.g.
    - a) Protect village or community
    - b) Sound an alarm/alert to give community time to evacuate
    - c) Deflect or stop lava
    - d) Plot or create an escape route
  - How many blocks and what kinds of blocks were used?
  - What properties of materials were used to build the wall versus the warning system?
  - 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 were the results of your analysis of your design and how it meet the requirements?
  - How long do you think your design would give the community to evacuate?
  - What else would you have done, or do differently if you had more time?

**Assessment:** *Post-test about Matter and its properties, and how these change with temperature. (10 minutes)*

#### **Final Assessment**

1. Photo essay
2. Post-test about matter (10 minutes)
3. Previous assessments made during the other lessons

## Teacher Handy Links and Resources

### *From Us to You!*

- Check out this list of materials that can withstand Magma. [READ](#)
- See this list of fire-resistant building materials that your students can explore and use in making their Volcano Wall. [READ](#)
- Ever wondered if there was a successful Lava Diversion in history? Learn more strategies [HERE](#).

### **Other Multimedia Resources**

- Learn more Volcano Facts from National Geographic Kids. [READ](#)
- Learn more about Volcanic Eruptions and Hazards from National Geographic. [READ](#)
- Learn more about Volcanoes 101 from National Geographic. [WATCH](#)
- Check out this easy-to-do Volcano project, which can be adopted for a fun and interesting STEAM project with Science. [WATCH](#)
- Read more about how you can do Blended Learning: Making it Work in Your Classroom [WATCH](#)

### *Support & Help*

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

**Email:** [education@steamcraftedu.com](mailto:education@steamcraftedu.com)