Earth and Space Sciences

Earthquake and Sudden Geological Changes

Year 6 Unit of Inquiry

Planeteers Game-based Learning Platform

Science and Technology, Arts, Math and Engineering

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Outcomes and Content

Science and Technology

Curriculum Content Code: ACSSU096

Learning Outcomes

Explores ways to scientificcally understand natural disaster management to minimise both long- and short-term effects

Standards: Geological Changes on Earth's Surface; Robotics and Basics of Coding

1. How do you plan for community resiliency in case of an earthquake and volcanic eruption?
2. What are the effects of earthquakes and volcanic eruptions on the Earth's surface?
3. How can we minimize the damage from earthquakes?

- Envestigating major geological events such as earthquakes and volcanic eruptions
- Design an emergency and preparedness plan in case of an earthquake and volcanic eruption
- Describe the changes on the Earth's surface as a result of earthquakes and volcanic eruptions

Engineering

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

Learning Outcomes

Uses different materials to make a robot, and selects appropriate materials to meet the robot's design need

Standards: Design Process for Innovation

1. How can robots help with important tasks, such as preparing for a disaster and rehabilitating a community?

- Build, modify and upgrade a building or robot for a specific function or purpose
- Discuss functions of the robot on how it can help in disaster preparedness of a community
- Explain the purpose of simple machines and the common types

Mathematics and Arts

Learning Outcomes

Makes simple predictions of events based on the results of experiments; demonstrates understanding of shapes, colors, and the principles of contrast and harmony through the use of new media

Standards: Statistics and Probability; Art Processes

1. What's the probability that a building will withstand an 8.0 magnitude (The Big One) earthquake?
2. How do you apply art concepts on the use of computer softwares?

- Apply knowledge of the volume of solid figures and meter reading in mathematical problems and real-life situations
- Quantify the phrases "most likely to happen" and "unlikely to happen"
- Know that design principles and elements relates to everyday objects
- Utilize art skills in using new technologies (hardware and software)

Coding and Robotics

STEAM Curriculum Code: TC1.1 | TC1.3 TC1.4 |TC1.6

Learning Outcomes

Creates an algorithm for a complex machine (i.e. robot with specific functions and purpose) to follow; program a house or a robot to respond to external and internal changes (Triggers).

Standards: Coding and Block Code, Simple Events & Triggers

1. How do you design a robot that can help in preparing before, during and after an earthquake?

- Discuss the importance and the elements necessary to design a technology that can be used as part of the community's emergency and preparedness plan

Unit Summary

Grade:
6

Subject:
Science, Technology, English, Arts and Math

Duration:
1 week (50 minutes/day)

Syllabus Mapping:
- Earth and Space- Earthquakes
- Statistics and Probability
- Design Process for Innovation
- Making

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

Outcomes:
ACSSU096

Inquiry and Focus Questions:

Driving Question:
Since earthquakes are inevitable, how do you plan and build a disaster-ready community that could withstand extreme conditions such as earthquake and volcanic eruption?

Science and Technology Inquiries:
- How do you plan for community resiliency in case of an earthquake and volcanic eruption?
- What are the effects of earthquakes and volcanic eruptions on the Earth's surface?
- How can we minimize the damage from earthquakes?

Engineering, Coding and Robotics Inquiries:
- How can robots help with important tasks, such as preparing for a disaster and rehabilitating a community?
- How do you design a robot that can help in preparing before, during and after an earthquake?

Mathematics and Arts Inquiries:
- What's the probability that a building will withstand an 8.0 magnitude (The Big One) earthquake?
- How do you apply art concepts on the use of computer softwares?

Learning across the Curriculum:

Cross-curriculum priority
- Sustainability
- Environmental Awareness
- Technology

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

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 sudden geological changes in the earth's surface, particularly earthquakes and volcanic eruptions. Students use an individual inquiry-based approach to explore solutions to a multi-layered real-world question, while utilizing the use of 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 build a disaster-ready community by designing buildings, houses, or robots that can withstand, survive and help victims of earthquakes and volcanic eruptions. They strategize and learn about sustainable practices in preparing, rehabilitating, and making their community resilient. 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 the sudden geological changes and extreme weather events that can affect Earth's surface, particularly earthquake and volcanic eruptions. As part of the project based lesson, the teacher poses a challenge on how to make a disaster-ready and resilient community in case of sudden and extreme conditions. Students are tasked with researching on the importance of an emergency and preparedness plan--not just for humans, but for animals as well. As part of the research, students also learn about different technologies that help in making their community disaster-ready. They strategize and conceptualize innovative evacuation buildings for humans and animals, warning signals in order to prepare their community in case of sudden and massive dangers.

Assessment*: Quiz about sudden geological changes on Earth's surface (10 minutes)*

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

Begins with a discussion about how the Australia is prone to earthquakes and volcanic eruption, and how the communities have adopted and enforced strict policies on buildings to be earthquake-safe. Teacher shows pictures of places stricken by earthquakes and volcanic eruption, then sample technologies and engineering that helped lessen deaths in the community. Teacher explains the importance of knowing the safety measures before, during and after an earthquake or volcanic eruption, and highlights the importance of an emergency and preparedness plan during disasters.

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

Guiding Q. Since earthquakes are inevitable, how do you plan and build a disaster-ready community that could withstand extreme conditions such as earthquake and volcanic eruption?

Science and Technology Inquiries:

- How do you plan for community resiliency in case of an earthquake and volcanic eruption?
- What are the effects of earthquakes and volcanic eruptions on the Earth's surface?
- How can we minimize the damage from earthquakes?

Mathematics and Arts Inquiries:

- What's the probability that a building will withstand a 8.0 magnitude (The Big One) earthquake?
- How do you apply art concepts on the use of computer softwares?

Engineering, Coding and Robotics Inquiries:

- How can robots help with important tasks, such as preparing for a disaster and rehabilitating a community?
- How do you design a robot that can help in preparing before, during and after an earthquake?

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 earthquakes and volcanic eruptions. They also watch news clips, and analyze infographics about technologies, such as earthquake-proof houses, innovative evacuation buildings for humans and animals, warning and communication systems, survey drones to monitor volcanoes, in order to prepare communities for possible massive effects from calamities.

Science and Technology Inquiries:

- How do you plan for community resiliency in case of an earthquake and volcanic eruption?
- What are the effects of earthquakes and volcanic eruptions on the Earth's surface?
- How can we minimize the damage from earthquakes?

Mathematics and Arts Inquiries:

- What's the probability that a building will withstand an 8.0 magnitude (The Big One) earthquake?
- How do you apply art concepts on the use of computer softwares?

Engineering, Coding and Robotics Inquiries:

- How can robots help with important tasks, such as preparing for a disaster and rehabilitating a community?
- How do you design a robot that can help in preparing before, during and after an earthquake?

- 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 sudden geological changes on Earth's surface
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: 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 the robots. The students are introduced to the essential parts of a robot, concept of artificial intelligence (AI), automation and how they can reduce workloads. The 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 precautionary measures in case of disasters, specifically earthquake and volcanic eruption. Based on their design plan from lesson 1, students can now start prototyping within the game. They should be able to design and build an earthquake-proof house or evacuation building, not just for humans but for animals. They should be able to explain the functionality of each part of their building/robot design, especially how it aids in preparing for an emergency or disaster. They should analyze building structure such as shape, height, layers and other considerations to ensure the effectiveness of the building. In terms of improving their community's disaster-readiness in case of an earthquake or volcanic eruption, students should consider strategies to safely evacuate humans and animals in safe and secure buildings. Their design should include a warning system or emergency communication system to help alert the community of imminent dangers.

Students test and refine their building/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 make an inventory of blocks and their properties.
2. Use the *Builder Tool* to construct a building/robot which has features that can withstand a 8.0 magnitude earthquake (i.e The Big One). It can be an evacuation building for either humans or animals.
    - Ideally, their house should have a good foundation by making sure it stands on good, hard soil.
    - Use the *Terraforming tool* in game to flatten surfaces for your building.
    - Students should consider using various shapes in building their house to help it remain steady in case of an earthquake.
    - Their house should include a wall that uses appropriate materials to withstand earthquakes.
    - Ideally, building blocks should include a combination of earthquake-resistant materials such as steel and wood, and innovative futuristic materials such as memory alloy and bamboo.
    - The students can opt to make their building eco-friendly by adding features, such as solar panels, camera, lights, antenna, data link, sensors, etc.
3. In addition to the building, a warning system or emergency communication system should be built. This may be a technology-centric design using the game's block code.

Lesson 3: Prototyping, testing and refining (continued)

Refining the Prototype:

1. Students add Block Code to the building and the warning system, in order to improve functionality.
2. Students use the following to evolve the building's AI: Loop condition, If conditions, If Press conditions, Motion codes, and Action codes.
3. The code design for the building's AI should enable the following:
    a. Open the door when the owner is near.
    b. Turn-on the lights when it's night time.
    c. Say something when it's day or night or when the owner is near.
    d. Activate the in-game camera for taking photos to monitor its surroundings.
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 building and warning system.

Documentation using Mission Journal

1. Using the game's *Mission Journal,* students should explain each feature of their building and how they function to withstand earthquakes.
2. Students should add notes on their journal describing how their building 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 the social and environmental impact of building an earthquake-proof house or evacuation building, not just for humans, but for animals as well. Teacher highlights the importance of innovating new technologies that would help in improving a community's disaster-readiness in the event of an earthquake or volcanic eruption. The students make connections between robotics and coding, and how these make buildings or machines 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 design/project.

Game Sandbox Activity (30 minutes)

Final Project

1. Use the Builder tool and the Block Code to make any final improvements to their building and warning system.
2. Students should finalize any additional design and codes in making their building 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 for each photo taken using the mission journal.
- They should explain the functionality of their building, especially in making their community disaster-ready.

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 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 building/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 do you plan for community resiliency in case of an earthquake and volcanic eruption?
- What are the effects of earthquakes and volcanic eruptions on the Earth's surface?
- How can we minimize the damage from earthquakes?
- What are the precautionary measures before, during and after an earthquake?
- Why is emergency and preparedness plan for disasters important?
- How do you plan for an emergency and disaster-preparedness for your community?
- How can robots help with important tasks, such as preparing for a disaster and rehabilitating a community?
- How do you explain the composition of your building/robot?
- What environmental conditions did you design your robot for?
- What's the probability that a building will withstand an 8.0 magnitude (The Big One) earthquake?
- What we 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 sudden geological changes on Earth's surface (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!

- Recent news indicate that forces tugging at the Earth's surface will trigger more earthquakes and volcanic eruptions. READ HERE.
- Disaster preparedness is now possible in architecture with earthquake-proof buildings. READ HERE.
- Try this STEAM activity to let learners know how they can make a mini-volcano. READ HERE.

Other Multimedia Resources

- Earthquakes are actually pretty hard to predict. Ted-ED tells us the reason why. WATCH HERE.
- SciShow imparts to us the looming future of earthquake-proof buildings. WATCH HERE.
- When a natural disaster such as an earthquake or volcanic eruption happens, engineer Robin Murphy and her search-and-rescue robots are on the rescue. 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