

# Chemical Sciences

## Changes that Materials Undergo

Year 3 Unit of Inquiry – Chemical Science

### **Planeteers Game-based Learning Platform**

Science and Technology, Arts, Math and Engineering

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



## Outcomes and Content

### Science and Technology

**Curriculum Content Code: ACSSU046**

#### **Learning Outcomes**

Understands that change of state between solid and liquid can be caused by adding or removing heat

#### **Standards: Properties of Matter and Chemical Reactions**

1. What types of materials can withstand fire?
2. What causes different materials to have different properties?
3. How do you decide upon which material to use for a particular purpose?
4. How do properties of materials affect their use?
5. How does heat affect the states of matter of some materials?
  - Describe matter based on their characteristics
  - Classify objects and materials as solid, liquid, and gas based on some observable characteristics
  - Measure quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved

### Engineering

**STEAM Curriculum Code: ED 1.1 | ED 1.2**

#### **Learning Outcomes**

Selects appropriate materials to meet a design need

#### **Standards: Optimizing the Design Solution**

1. How will you design a house to be fire-resistant and disaster-ready?
  - Apply design assessment to build and create real world projects
  - Build products that use appropriate elements and parts

### Arts and Mathematics

#### **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 and textures should be used in designing and creating a fire-resistant building?

- Demonstrate understanding of lines, shapes, and space; and the principles of rhythm and balance
- Select and manipulate combinations of materials and techniques
- Recognize volume as an attribute of solid figures and understand concepts of volume measurement
- Classify two-dimensional figures into categories based on their properties.
- Construct polygons, circles, and solid figures

### Social Sciences

#### **Learning Outcomes**

Creates awareness and develops a plan for fire-prevention

#### **Standards: Disaster-Preparedness**

How do we prepare and prevent an occurrence of fire in our household and community?

- Develop community awareness about fire-prevention

# Unit Summary

**Grade:**

3

**Subject:**

Science & Technology

**Duration:**

1 week (50 minutes/day)

**Syllabus Mapping:**

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

**Integration:**

- Science
- Mathematics
- Arts
- Engineering
- Technology

**Outcomes:**

ACSSU046

## Inquiry and Focus Questions:

*Driving Question:*

Because fire is a risk in any building, how will you design and create a technology-centric house that can withstand fire?

### **Science and Technology Inquiries:**

- What types of materials can withstand fire?
- What causes different materials to have different properties?
- How do you decide upon which material to use for a particular purpose?
- How do properties of materials affect their use?
- How does heat affect the states of matter of some materials?

### **Engineering Inquiries:**

- How will you design a house to be fire-resistant and disaster-ready?

### **Arts and Mathematics Inquiries:**

- What shapes and textures should be used in designing and creating a fire-resistant building?

### **Social Science:**

- How do we prepare and prevent an occurrence of fire in our household and community?

## Learning across the Curriculum:

### **Cross-curriculum priority**

- Sustainability
- Disaster-readiness

### **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 chemical science, with a focus on matter and its structure and properties, particularly, the changes it undergoes based on the effect of temperature. 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, build a fire-resistant house or building. Students test and refine the effectiveness of the materials used, while minimizing the environmental and financial cost. They learn about sustainable practices in fire-prevention in their household and community. They take action in improving their own and others' social and environmental wellness, and keeping their community disaster-ready.

## 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 that every material has specific properties, and that it has observable characteristics (i.e. mass, volume, shapes and ease of flow). Teacher also facilitates how matter changes with temperature, and how the mass of materials changes (or does not) under different conditions. As part of the project based lesson, the teacher includes an introduction to fire and the the importance of fire prevention. Teacher explains its usefulness in certain situations and elaborates on its hazards if not properly managed. Students are tasked with researching fire-resistant materials in building a house and fire-safety practices that can be observed in people's homes and in the community.

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

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

*Begins with a discussion about fire hazards and the importance of fire safety and prevention.*

Teachers says “ Fire has many properties which can be beneficial to life, but if not carefully managed, it can be extremely hazardous. It may cause significant damage to property, community and the environment. In order to minimize the risk of fire, it is important to observe fire-safety measures in your homes and in the community.”

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

**Q.** Because fire is a risk in any building, how will you design and create a technology-centric house or a building that can withstand fire?

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#### **Science and Technology Inquires:**

- What types of materials can withstand fire?
- What causes different materials to have different properties?
- How do you decide upon which material to use for a particular purpose?
- How do properties of materials affect their use?
- How does heat affect the states of matter of some materials?

#### **Engineering Inquires:**

- How will you design a house to be fire-resistant and disaster-ready?

#### **Arts and Mathematics Inquiries:**

- What shapes and textures should be used in designing and creating a fire-resistant building?

#### **Social Science Inquires:**

- How do we prepare and prevent an occurrence of fire in our household and community?
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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 fire, fire-safety and the materials they will be using in the Planeteers game.

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#### **Science and Technology Inquires:**

- What types of materials can withstand fire?
- What causes different materials to have different properties?
- How do you decide upon which material to use for a particular purpose?
- How do properties of materials affect their use?
- How does heat affect the states of matter of some materials?

#### **Engineering Inquires:**

- How will you design a house to be fire-resistant and disaster-ready?

#### **Arts and Mathematics Inquiries:**

- What shapes and textures should be used in designing and creating a fire-resistant building?

#### **Social Science Inquires:**

- How do we prepare and prevent an occurrence of fire in our household and community?

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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 assessment and reasoning, problem solving
4. Group skills, time management, collaboration
5. Project works (later lessons)
6. Photo Essay (later lessons)

## Lesson 2: Prototyping a Fire-Resistant Building and a Firewall

### *Introduction to the Lesson*

Teacher guides the students in identifying materials that can be used to build a technology-centric house and able to withstand the heat of fire. 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 building structure such as shapes, height, size, layers, sections, and other considerations to ensure the effectiveness of their fire-resistant house. In terms of creating awareness about the importance of fire safety, students should develop a fire-safety plan for their house and the community in order to minimize its risks.

### *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 fire-resistant house or any building.
  - Ideally, the house or the building should be constructed using appropriate materials to withstand the heat of fire.
  - The house should be spacious and use various shapes for its sections.
  - Students should consider the size, height, and other important elements (see assessment for the component list) in creating the house.
  - Ideally, building blocks should include a combination of the following, depending on the student's design: iron, nickel, cobalt, titanium, metal, brick and stone.
3. In addition to the fire-resistant house or a building, students should create a technology-centric firewall, which restricts the spread of fire and extends continuously from the foundation to or through the roof a building.
4. The students should add fire-prevention measures, such as installing fire alarms, smoke alarms, and other devices to their building. This may be technology-centric features using the game's block code.

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

- Using the Camera, students should take pictures of their prototype house/building 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 and heat resistance
3. Engineering approach, including aspect, size, height, structure, and other considerations that 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 house by discovering different textures in the Builder tool, adding sections and features, adjusting shapes, sizes, and height. With consideration of the social and environmental impact to the community, students should conceptualize and develop a fire-safety plan, which may include fire safety training and fire risk assessment.

### *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 work.

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

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

1. Use the game's *Builder Tool*, students should spend time in finishing their fire-resistant building with firewall.
2. When their prototype is completed, students should stop building and use pen and paper to draw the distance of the firewall from the house, which should be strategically constructed and located in order to keep the fire from doing further damage to the property.
3. Students should try to estimate speed of fire and how long the wall and the house will last under its extreme heat.
4. After their analysis, they can refine their design based on initial observations and opportunities for improvement.
5. Students should explain their reasoning behind refining the design 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 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 assessment and reasoning, including material uses and reasoning in relation to properties and heat resistance
3. Engineering approach, including aspect, size, height, structure, and other considerations that students should describe/explain
4. Time management, collaboration, problem-solving skills
5. And specifically for Lesson 3:
  - Design changes to improve the fire safety feature of their building, 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 fire-resistant house and a firewall. Teacher highlights the importance of fire-safety plan in order to minimize the risks of fire in the homes and in the community.

### *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 fire-resistant house.
2. In addition, students should make any final adjustments to the design of their technology-centric firewall.
3. Students should finalize any and all additional design strategies in making their household and community disaster-ready in case of fire.

#### **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 fire flow and estimate how long the firewall will last under the extreme heat and force of the fire, and how the fire alarm 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 assessment and reasoning, including material uses and reasoning in relation to properties and heat resistance
3. Engineering approach, including aspect, size, height, structure, and other considerations that 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
  - Their reasoning and explanation for final design
  - Any worthy design elements e.g. smoke alarm, fire alarm, etc.
  - Extra credit if students used the Painter Tool in game to color their creations, and/or added Block codes

## Lesson 5: Presentation and Reflection

### *Introduction to the Lesson*

Teacher asks the students to write about their project, their fire-resistant building and fire-safety measures 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 types of materials can withstand fire?
  - What causes different materials to have different properties?
  - How do you decide upon which material to use for a particular purpose?
  - How do properties of materials affect their use?
  - What types of materials can withstand fire?
  - How do you decide upon which material to use for a particular purpose?
  - What shapes and textures should be used in creating a fire-resistant building?
  - How do we prepare and prevent an occurrence of fire in our household and community?
  - What risks do fire poses to a community?
  - What is the idea behind your fire-resistant house or building?
  - What important things were you trying to achieve with your design? e.g.
    - a. Install fire and smoke alarms
    - b. Fire safety plans
    - c. Build Emergency exits or routes for evacuation
  - 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 Matter and the properties of materials and how these change with temperature. (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!*

- Every country is prone to fire-related incidents. Fire prevention is key. [READ HERE.](#)
- Fire prevention continues to improve through the latest innovations of modern technology. [READ HERE.](#)
- An effective way to ward off fire is constructing a firewall. For basics on how to construct one. [READ HERE.](#)

### *Other Multimedia Resources*

- Fire-related incidents can lead to major loss of lives and property. Watch this video of the 2003 Station Nightclub Fire. [WATCH HERE.](#)
- In case of fire, we all have to be aware of important tips for fire safety and survival. To know more, [WATCH HERE.](#)
- FuseSchool - Global Education presents an interactive video on the changes of state of matter. [WATCH HERE.](#)
- Check out this cool video on matter change, wherein milk can turn into plastic as hard as stone. [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](mailto:education@steamcraftedu.com)