

A photograph of several potted plants on a windowsill. The plants are in various stages of growth, with some showing small yellow flowers. The pots are dark-colored, and the windowsill is light-colored. The background is a window with blinds, and the lighting is soft and natural.

6<sup>TH</sup> GRADE  
STEM & SOCIAL STUDIES



# WINDOWS TO EFFICIENCY

## ▶ **Driving Question:**

How do different building materials change the rate at which thermal energy is transferred?

## • **Materials Needed:**

Sketchbook or science notebook, clear materials such as plastic, Plexiglas, cellophane, graph paper, computer, tablet or other technology for research, prototyping materials such as Plexiglas, glass, glue

## **In this lesson, students will:**

- recognize that, although thermal energy moves in a predictable pattern, energy transfer occurs at different rates depending on the type of material it is passing through.

## **National Learning Standards:**

Science: MS-PS3-3; MS-ETS1-2;  
MS-ETS1-3  
Social Studies: VIII,a  
Art: Cr2.1.6a



## SPINNING THE COCOON

Set up a demonstration with two panes of the same transparent substance with a light above each one and a cup of ice underneath each one. Before beginning the demonstration, ask students to hypothesize what will happen to the ice and write their responses on the board. As the ice melts, students should record or photograph what is happening. Ideally, the ice should melt at the same rate. As a class, discuss why this occurred. Explain that thermal energy travels in a predictable way from an area of higher heat to an area of lower heat, therefore it should travel through the same substance at the same rate. Give the class definitions for convection, conduction and density.

Set up a second demonstration with three different transparent panes such as glass, plastic wrap and Plexiglas with a cup of ice under them. Each transparent pane should have its own light source equal distance away. With the light on, students should observe and draw or photograph the progression of the ice melting under the transparent panes. Ice should melt at different rates due to the amount of thermal energy able to pass through each transparent material. Ask students for their ideas on why the ice melted at different rates. Student ideas should include that thermal energy will travel through different conductors at different rates based on parameters such as density.

Examine the windows in your classroom or other areas of your school. Ask students how the windows may affect the temperatures indoors.

Discuss how the higher temperatures in Texas mean that we need more efficient windows in buildings to better manage temperatures and reduce the environmental and economic costs of cooling indoor spaces.

### KERNEL OF KNOWLEDGE

Artificial lighting accounts for 44% of electricity use in office buildings. Make it a habit to turn off the lights when you're leaving any room for 15 minutes or more and use natural light when you can.



# METAMORPHOSIS

Using the classroom demonstration as a testing model, student groups will develop and test window prototypes that are best for energy conservation. Window prototypes should be transparent, but also energy efficient. Students should explore existing windows such as single pane glass, multi pane, and double hung windows to help contribute to their own ideas. Groups will complete brief drawings with a few lines denoting why they chose their specific design and material before creating and testing prototypes. Student groups will then choose their highest functioning prototype to present to the class. In their presentation, students will discuss the materials and design they chose as well as the results they concluded using the vocabulary terms learned in this unit.



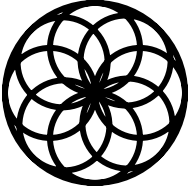
## THROUGH THE LENS

Instead of having each student create their own individual sun-faded artwork, place a large piece of colored butcher paper outside and make it a group project. Using a time-lapse app, document the process and create a video unveiling the artwork at the very end.

## UPCYCLE

Discuss with students the important role science has played in our society and its impact around the world. Ask them to research examples of technologies that are available all over the world. They may come up with examples like the iPhone, the internet or TV. Encourage them to think further back in time. For example, have them consider what U.S. farmers in the 1800s used to tend their crops and if the same technology was available in other countries then and now.

Explain that the resources we use are determined by the technology that is available, government policy and economic factors which can change over time. Batteries were not available until 1898 and are only recently being considered to power cars. The same concept applies to energy efficient windows, which were not available to the public until the energy crisis in the 1970s. This idea has grown into practice and is now the norm for many consumers and producers.



# KALEIDOSCOPE

As an extension or for extra credit, have students create a video to send to lawmakers that proposes a tax-cut for individuals and businesses that install energy efficient windows either on a new-build or as a replacement to conserve natural resources and minimize energy costs. Have them describe the design they created in the science lesson. They should emphasize how this scientific invention could help shape society in America and abroad. The video should provide several compelling reasons why the proposal will be beneficial to society, businesses and individuals.



## eARTh

The sun provides a powerful source of heat and energy for our planet. Art is among the many things which the sun has influenced. Using the sun as a source of artistic inspiration is one of the ways that art and science work together, and artist Michael Papadakis has found a beautiful way to harness that relationship. He uses different sizes of magnifying glasses to burn lines into wood to create beautiful pieces of art. Share his work and his process with your students using this [link](#).

Now, your students will create their own sun art. There are a couple of ways to do this. Solar print paper will provide the most dramatic results. It is fairly inexpensive and can be found online or at many art and craft supply stores. If you are unable to find it, you can also use construction paper, which fades easily. Anything thicker, like card stock, will not work because it does not fade as easily.

Take your students outside to a sunny area. Using the solar print paper or construction paper, have them place various objects on the paper. You could use this project to focus on any of the elements or principles such as line, balance, movement, shape, etc. Also, the choice of object is up to you. Students may look for natural objects such as small leaves or rocks, or you can give them an assortment of small objects from which to choose. They will place the objects in a purposeful way on top of the paper and leave the paper outside for a few hours. The light from the sun will fade the paper and the spaces where the objects are placed will remain the original shade. Collect each of the pieces and discuss with your students why the paper faded the way that it did. Also, each student should be able to talk about their artwork using correct vocabulary and explain why they placed the objects where they did on their paper.

### Community Garden

- Brainstorm with your students places around the school or community where there are little to no trees. Research the owner of the area chosen and create a proposal to send them, asking to plant trees there. Record the students speaking about the importance of trees to the environment and people, and have students create posters and other materials in support of their cause.



## CAREER CONNECTION

**Window Installer** - Window installers fit pre-made windows into window openings and door frames of homes and buildings. Some installers work on residential or smaller commercial buildings, while others work on large commercial buildings. This job requires a high school diploma and on-the-job training.

**Environmental Engineer** - These engineers deal with the potential environmental impacts of geothermal plants. Although geothermal energy is an environmentally friendly source of electricity, environmental engineers must consider a site's potential impact on local plants and wildlife. A bachelor's and possibly a master's degree is required for this career.



## CAREER HIGHLIGHT

Harnessing solar energy is nothing new. In 1839 Alexandre Edmond Becquerel discovered the photovoltaic effect which explains how electricity can be generated from sunlight. Although it would be years before solar energy would begin powering spaces as large as homes, his ideas sparked breakthrough conversations and inventions.



