

6th Grade Light Lesson

NC State Science Standards:

- 6.P.1.2** Explain the relationship among visible light, the electromagnetic spectrum, and sight.
- 6.P.3.1** Illustrate the transfer of heat energy from warmer objects to cooler ones using examples of conduction, radiation and convection and the effects that may result.
- 6.P.3.2** Explain the effects of electromagnetic waves on various materials to include absorption, scattering, and change in temperature.
- 6.E.1.1** Explain how the relative motion and relative position of the Sun, Earth and Moon affect the seasons, tides, phases of the moon, and eclipses.

Essential Questions:

- How do light and other electromagnetic waves warm objects?
- How is energy transferred from the Sun to the Earth?
- What happens to light energy when it interacts with matter?
- Why do temperatures vary across different locations on Earth?
- How does the tilt of Earth and its revolution around the Sun affect the amount of sunlight Earth receives?

Brief Lesson Description:

Students will learn about light, properties of light, and how the Earth receives light from the Sun through a series of station investigations and a final application challenge to build a hoop house prototype. *Note: this lesson will need to be completed during the colder months in North Carolina in order to effectively test the hoop houses.*

Performance Expectation(s) and Specific Learning Outcomes:

- Students will be able to describe materials that transmit light, including opaque, translucent, transparent materials.
- Students will be able to explain what happens to light when it encounters different types of materials, including absorption, reflection, and refraction.
- Students will be able to describe how light reaches the Earth from the Sun, including visible light on the electromagnetic spectrum
- Students will be able to explain how the tilt of the Earth changes the amount of light received by the Earth which causes seasons.

Prior Student Knowledge:

- Light is a form of energy that travels as a wave.
- Basic properties of waves
- Basic understanding of absorption and reflection of light
- Three forms of heat transfer: conduction, convection, and radiation
- The Earth receives solar radiation from the Sun.

Possible Preconceptions/Misconceptions:

- Light can only be reflected by shiny materials.
- An object cannot absorb and reflect light – it must do one or the other.
- The seasons are caused by the proximity of the Earth to the Sun.

- The Sun heats the earth directly instead of light energy from the Sun being absorbed by Earth materials and atmosphere. The Earth receives light from the Sun, not heat.
- The Earth receives equal amounts of sunlight all year round.

Materials:

Items from the Supplemental Materials section
 Construction paper (white, black, red, green, yellow, blue)
 Thermometers
 Heat lamps
 Beaker
 Water
 Pencil
 Computer
 Flashlight
 Cardboard
 Tissue Paper
 Aluminum Foil
 Wax Paper
 Plastic Wrap
 Cloth Fabric
 Coin
 Various materials for hoop house construction

LESSON PLAN - 5-E Model

ENGAGE: Opening Activity - Access Prior Learning / Stimulate Interest / Generate Questions:

Time: 30 minutes

Engage Question: Can we use our knowledge about light energy and the Sun to build a prototype hoop house to help a local farm extend their growing season.

1. Explain to students you need their help. A local farmer in the community came to you with a problem that they thought your science students could help with. The farmer needs to figure out a way to extend the growing season of his tomatoes so they can continue to sell them into the winter season at the farmers market. *It would be great to actually ask a local farmer to come in and help with this scenario. You could have them come back in after the hoop house prototype challenge to help "evaluate" the prototypes.*
 - a. Ask students what we need to know to help out the farmer and build a prototype hoop house or greenhouse for them?
 - b. To further get students thinking about the science, ask if any of them know how a greenhouse works. *You might also explain that hoop houses are just simpler forms of a greenhouse. This will hopefully spark ideas about light and solar energy. Here is an link to an informative article on the differences: <https://www.backyarddigs.com/uncategorized/hoop-house-vs-greenhouse/>*
 - c. Compile students' ideas using post it notes on a whiteboard or large post it paper. *Keep this as an anchor chart to be referenced later in the lesson.*

2. Explain to students that before they begin thinking about building their prototype they need to know more about light, solar energy, and how it interacts with materials. In order to do that they will explore concepts of light through the Light Station Lab.

EXPLORE: Lesson Description - Materials Needed / Probing or Clarifying Questions:

Time: 120 minutes

1. Show students the picture of snow rings around trees. (In supplemental materials section)
 - a. Ask students to think about what might be happening within this situation. Explain to students that they are going to try to answer this question by learning about how light interacts with materials.
2. Introduce the **Light Station Lab** to students. Allow students to work through stations in groups of 2 to 3. *Depending on the number of students, it may be necessary to set up multiples of stations. Student lab sheet is located in the supplemental materials.*
3. When students are finished with their lab, come back together to discuss findings.
 - a. Use the brainstorm chart from the introduction to help students reflect on if they learned what they needed to know about how light interacts with materials.
 - b. Show the snow rings around the tree picture again.
 - a. Ask students to develop a Claim Evidence Reasoning chart (located below the picture of the snow rings) based on what they learned about light in the previous station lab to explain the phenomenon. *If you have never used CER with your students, here is a link to a great article on how to incorporate and use it with your students: : <https://www.edutopia.org/blog/science-inquiry-claim-evidence-reasoning-eric-brunsell>*

EXPLAIN: Concepts Explained and Vocabulary Defined:

Time: 30 Minutes

1. Pass out the Light foldable to students (located in the Supplemental Materials section).
 - a. Fill out the foldable with students.
 - b. Have students glue/tape the foldable into their science notebooks.
2. Ask students what they learned about how light reaches the Earth from their station lab.
 - a. Have students draw and label the diagram of the Earth/Sun system (located in the Supplemental Materials section) in their notebooks with the Earth correctly tilted at the winter, spring, summer, and, fall locations. *Be sure to emphasize the light connection and that when the light is absorbed by the Earth, it gets converted to heat energy.*
 - b. Have students add the average temperature for their location during that season using the following website: <https://www.ncdc.noaa.gov/cdo-web/datatools/normals>. *Be sure to emphasize the light connection and that when the light is absorbed by the Earth, it gets converted to heat energy. This may also be a good time to talk about NOAA and what kind of information they provide.*
 - c. Have students tape/glue their diagram into their notebooks.

Vocabulary: absorption, reflection, refraction, opaque, translucent, transparent, solar radiation, electromagnetic spectrum

ELABORATE: Applications and Extensions:

Time: 180 Minutes

1. Explain to students that since they have learned so much about light and how it interacts with different materials, they will now build a small scale hoop house prototype to present to the farmer.
2. Explain that their challenge is to build a hoop house that will maintain temperatures between 55° and 75° F.
 - a. Furthermore, our farmer friend would like for you to make recommendations on when to set up their hoop house so they will need to investigate average frost and freeze dates for NC.
 - b. Lastly, the farmer is on a budget and will need you to complete the prototype within that budget. Your group will need to build your prototype for under \$12.00.
 - c. Hoop houses will be tested for effective temperature control by placing them outside on a day when temperatures are below 55°. *If this is not an option, the prototypes can still be placed outside and data taken. The difference in heating can then be compared to a temperature below 55°.*
3. Divide students into groups of 2-3. *You might consider using group roles here such as manager, recorder and researcher.*
 - a. Pass out the Hoop House Design Challenge student pages and allow students to work through the challenge. *Be sure to provide students with lots of different materials including opaque, translucent, transparent, light, dark, and a variety of colors. You will also need to provide materials for structural support such as wire, toothpicks, glue, tape, etc.*

EVALUATE:

Time: Variable

Formative Monitoring (Questioning / Discussion):

Formative assessment can be included throughout the lesson as students are discussing, exploring the stations, and building their prototype.

Summative Assessment (Quiz / Project / Report):

Final assessment will be taken on the Google Slide Presentation and hoop house design/function. The rubric is included in the Supplemental Materials section. Having a group of community agriculturists come in to hear the presentations and give feedback to students would make the project more meaningful to them. This could be included in the assessment portion.

Elaborate Further / Reflect:

Time: Variable

If time allows, students can be given an opportunity to modify their designs, rebuild, and actually grow a plant in their hoop house to further test its function!