[Download all associated files for this lesson from our website](http://peer.tamu.edu/DLC/NSF_Resources.asp?ID=1413&type=browse&num=10&terms=&content=allcontent&subject=allsubjects&grade=allgrades&query=query&hl=no&count=537&number=6&view=yes).

**Summary:** This lesson introduces the electromagnetic spectrum and how light interacts with objects. The purpose of this lesson is to teach students about the effects of electromagnetic waves on various materials, including absorption, reflection, scattering, transmission, refraction, and change in temperature. This lesson also explores why materials are chosen based on their thermal or electrical properties for specific technologies. Conductors and insulators are also defined for thermal and electrical applications. This lesson includes three activity labs and five online games.

**Keywords:** Electromagnetic waves, absorption, reflection, transmission, refraction, conductor, insulator

**Subject TEKS:**

Science 6.P.3.2: Explain the effects of electromagnetic waves on various materials to include absorption, scattering, and change in temperature.

Science 6.P.3.3: Explain the suitability of materials for use in technological design based on a response to heat (to include conduction, expansion, and contraction) and electrical energy (conductors and insulators).

**Grade Level:** 6th/7th

**Learning Objectives:**

* Students will be able to define all terms in the vocabulary list.
* Students will be able to classify when light is absorbed, reflected, transmitted, or refracted.
* Students will be able to identify good thermal conductors and insulators.
* Students will be able to identify good electrical conductors and insulators.

**Time Required:** 1 hr

**Materials:**

* Paper and pencil
* Computer and projector
* Absorption, Reflection, or Transmission lab activity
* Aluminum foil
* Plastic saran wrap
* Wax paper
* Mirror
* Red tissue paper
* Blue tissue paper
* Green tissue paper
* Notebook paper
* Cardboard
* Angles in Reflection lab activity
* Flat mirror
* Laser
* Piece of white paper
* Pencil
* Protractor
* Spear Fishing Challenge lab activity
* Container of water (best with transparent sides e.g., glass cup/beaker)
* Penny
* Straws (need to be larger than average size to fit a pencil through or if larger straws are not available, try wooden bamboo skewers instead of pencils. These are available at Walmart/Target and will be small enough to fit through average sized straws).
* Pencil or wooden skewers (needs to fit within straw easily)
* Scissors

**Expendable Activity Cost:** ~$15

**Background and Concepts for Teachers:**

Browse and review these listed websites:

* The Electromagnetic and Visible Spectra

<http://www.physicsclassroom.com/Class/light/u12l2a.cfm>

* Light Absorption, Reflection, and Transmission

<http://www.physicsclassroom.com/Class/light/u12l2c.cfm>

* The Refraction of Light

<http://www.optics4kids.org/home/teachersparents/articles/the-refraction-of-light/>

**Vocabulary/Definitions:**

* **Electromagnetic Waves** – Group of energy waves that are mostly invisible and can travel through empty space.
* **Frequency** – Number of waves a vibration creates during a period of time.
* **Visible Light** – Range of electromagnetic spectrum that can be detected by the human eye.
* **Infrared** – Type of electromagnetic radiation that involves heat.
* **Absorption** – The loss of light as it passes through a material.
* **Reflection** – The return of light by a material.
* **Transmission** – The passage of light through a material.
* **Refraction** – The bending of light as they pass between mediums.
* **Translucent** – Allow only a part of the light through.
* **Opaque** – Reflect or absorb all light.
* **Thermal Conductors** – Materials that conduct heat readily.
* **Thermal Insulators** – Materials that limit heat transfer.
* **Electrical Conductors** – Materials that allow flow of electrical current.
* **Electrical Insulators** – Materials that limit the flow of electrical current.

**Lesson Introduction/Motivation:**

Teachers can review the “Thermal Energy” lesson plan, which should fulfill the Science 6.P.3.1 objective. [Download all associated files for this lesson from our website](http://peer.tamu.edu/DLC/NSF_Resources.asp?ID=1204&type=browse&num=10&terms=&content=allcontent&subject=allsubjects&grade=allgrades&query=query&hl=no&count=537&number=6&view=yes).

**Requires:** Computer and projector

**Presentation/Explanations:**

Go over the PowerPoint presentation to get a feel for the animations. Some slides have notes in the note section.

**Activity/Application:**

Class experiments: instructions in each lab document.

1. **Absorption, Reflection, or Transmission**

Materials used in this lab activity can be changed to better reflect supplies already in the classroom (e.g., instead of tissue paper use construction paper, instead of saran wrap use plastic sandwich bags), as long as you use a variety of materials to show how light can either be absorbed, reflected, or transmitted.

1. **Angles in Reflection**

Students will break up into small groups and shine a laser onto a flat mirror to trace the beam of light and measure the angles.

The purpose of this lab is for students to see that the incoming and outgoing angle of the light are the same.

1. **Spear Fishing Challenge**

In this activity students will explore the property of refraction by attempting to spear a penny “fish” with a straw and skewer in a large container of water.

The purpose of this lab is for students to discover that light bends when passing between mediums due to refraction.

Online Games:

The below activities are fun, online games or experiments that are interactive for the students. Teacher may pick and choose which to do. (Note: advertisements on the website may not be suitable for students, teacher could demonstrate the games with a projector with advertisements occluded) or class could work together to solve the games with the teacher in charge of clicking.

1. **Too Hot to Handle** – This is an online game where students can see the temperature effects of choosing various materials for the handle of a pot on the stove. Students can pick multiple handle materials, and observe whether that material will be a good thermal insulator or conductor.

**Requires:** Computer lab

<http://gtm-media.discoveryeducation.com/videos/dsc/externalApplications/virtual_labs/TooHottoHandle/index.html>

1. **Refraction of Light** – This is an online game where students can observe the effects of refraction by varying the mediums and angles in which materials pass through.

**Requires**: Computer lab

<http://www.physics.uoguelph.ca/applets/Intro_physics/refraction/LightRefract.html>

1. **Reflections** – This is an online game where students can select objects with various light properties to complete each level. The game provides a great challenge to students, since there are many combinations that could result in completion of the level.

**Requires**: Computer lab

<http://games.erdener.org/laser/>

1. **Refraction** – This is an online game, much like #3, where students place reflective objects to power up spaceships. The game provides a good challenge to students as the levels progress.

**Requires**: Computer lab

<http://www.phyfun.com/Games/1-3019-Refraction.aspx>

1. **Circuits & Conductors** – This is an online game where students can learn about electricity circuits by selecting various materials to complete a circuit. Students will be able to learn which materials conduct electricity better than others.

**Requires**: Computer lab

<http://www.sciencekids.co.nz/gamesactivities/circuitsconductors.html>

**Lesson Closure:**

At the end of the lesson, ask students to reflect on what they learned about electromagnetic waves and light interactions. Things such as definitions and examples of the covered topics could be discussed. This could either be done in an interactive manner with the whole class or individually on paper.

**Safety Issues:**

Instruct students not to shine lasers into each other’s eyes in Angles in Reflection activity.

Shishka bob skewers are pointed and sharp. Students should not run with them or point them at each other.

**Resources:**

* Electromagnetic Spectrum

<http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html>

* Heat Transfer

<http://www.wisc-online.com/Objects/ViewObject.aspx?ID=SCE304>

* The Electromagnetic Spectrum Tutorial

<http://school.discoveryeducation.com/lessonplans/interact/electromagneticspectrum.swf>

* Light Properties

<http://www.easycoursesportal.com/basicphotographycourseiii/coursec/Less-8.htm>

[\](http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/heatingandcooling/heatingrev1.shtml)

**References:**

All images found on Google.

* Workshop 2: Laws of Light

<http://www.learner.org/workshops/sheddinglight/materials/pdf/shlos2.pdf>

* Exploring Light: Absorb, reflect, transmit, or refract?

<http://www.teachengineering.org/view_activity.php?url=collection/van_/activities/van_troll/van_troll_lesson02_activity1.xml>

**Author:**

Graduate Fellow: Bagrat Grigoryan and Jennifer Graham