**Light Energy:**
Grades 5-8 Saturday Science Lesson Plan

**Objectives:**

* After completing activities in which they have the opportunity to explore translucency by observing how ultraviolet radiation passes through certain materials, students will begin to understand the movement of light energy. Students will be responsible for listing at least three different materials that fit into the three categories: transparent objects, translucent objects, and opaque objects.
* After completing activities in which they have the opportunity to explore the concepts behind light sticks, students will begin to understand the relationship between chemical energy and light energy. Students will be able to describe at least two characteristics of how chemical energy and light energy are related. The two characteristics do not have to be specifically related to light sticks.
* After completing an activity on glow toys, students will begin to understand how light energy can be stored or emitted. Students will be responsible for drawing two diagrams of atoms; one showing the storing of light energy and the other showing the emission of light energy. The students must be able to place the electrons in the right positions and draw arrows showing which directions the electrons move.
* After completing an activity on solar beads, students will begin to understand the differences between ultraviolet light and artificial light. Students will be responsible for listing at least two differences between ultraviolet light and artificial light.
* After completing the activities and brainstorming as a class about how the sun contributes to the production of light energy, students will begin to make connections between solar energy and other forms of energy, and specifically light energy. Students will be responsible for taking notes on the connections but the final assessment strategies will occur during the final lessons when students construct a flow chart showing how the energy from the sun is used for many different purposes and how it is transformed to different forms of energy.

**Standards:**

* 6.3.17 - Recognize and describe that energy is a property of many objects and is associated with heat, light, electricity, mechanical motion, and sound. **(Core Standard)**
* 6.3.23 - Explain that electrical circuits provide a means of transferring electrical energy from sources such as generators to devices in which heat, light, sound, and chemical changes are produced.
* 7.3.11 - Explain that the sun loses energy by emitting light. Note that only a tiny fraction of that light reaches Earth. Understand that the sun's energy arrives as light with a wide range of wavelengths, consisting of visible light and infrared and ultraviolet radiation. (Core Standard)
* 8.3.13 - Explain that energy cannot be created or destroyed but only changed from one form into another. **(Core Standard)**
* 8.3.15 - Identify different forms of energy that exist in nature. **(Core Standard)**

**Teacher Content Knowledge:**

Teachers should have a strong understanding of:

* **Artificial light** –
	+ Artificial light is any light that does not come from sunlight. Man-made lighting, such as light from fluorescent, tungsten, mercury vapor, sodium vapor, halogen, compact fluorescent, and other types of bulbs is artificial light. All artificial light can be turned on and off with a switch.
* **Atomic structure** –
	+ An atom consists of a central, positively charged nucleus and a number of negatively charged electrons revolving about it in various orbits. The number and arrangement of electrons vary in different elements.
* **Chemical energy** –
	+ Chemical energy is energy stored in the bonds of atoms and molecules. It is the energy that holds these particles together. Biomass, petroleum, natural gas and propane are examples of stored chemical energy; batteries are an example of a man-made object with stored chemical energy. Solar energy contributes to the production of potential chemical energy through its role in the food chain.
* **Light energy** –
	+ Light IS energy; it is a way of transferring energy through space. Light can more generally be referred to as electromagnetic radiation. The word "light" is often used to mean only the electromagnetic radiation visible to human eyes, but this visible light is only a tiny portion of the electromagnetic spectrum.
* **Opacity** –
	+ Objects that are opaque are impenetrable by light; such objects may also be impenetrable by forms of radiant energy other than visible light.
* **Radiant energy** –
	+ Radiant energy is energy transmitted in the form of electromagnetic waves, such as heat waves, light waves, radio waves, and X-rays.
* **Solar energy –**
	+ Solar energy is any form of energy radiated by the sun, including light, radio waves, and X rays. (In general use, this term usually refers only to the visible light of the sun.) Solar energy is needed by green plants for photosynthesis; the energy in fossil fuels (e.g., coal and oil) and other organic fuels (e.g., wood) is also derived from solar energy.
* **Translucence** –
	+ Objects that are translucent allow light to pass through them; transmitting light through a translucent object diffuses the light so that objects beyond it cannot be seen clearly.
* **Transparency** –
	+ Objects that are transparent allow light to pass through them without significant scattering so that objects beyond are seen clearly. Transparent objects may also allow the passage of radiation such as X-rays or ultraviolet light.
* **Ultraviolet radiation** –
	+ Ultraviolet radiation consists of invisible rays that are part of the energy that comes from the sun. Ultraviolet radiation is also produced by sun lamps and tanning beds.

**Materials List:**

* 1 Plastic Bucket for Water
* Water
* 15 Pairs of Scissors
* 15 Sheets of Construction Paper
* 1 Box of Wax Paper
* 1 Box of Clear Plastic Wrap
* 1 Package of Transparent Tape
* 15 Sheets of Light-Sensitive Paper
* Clock (the clock inside the classroom is sufficient)
* 34 Glow Sticks
* 34 Clear Plastic Cups (the glow sticks must be able to fit inside of these)
* Ice
* 10 Glow in the Dark Toys
* 10 Sheets of Black Construction Paper
* 170 Solar Beads (they appear to be glow in the dark beads but they change to different colors when put under UV rays)
* 1 Ball of String
* 2 or 3 Heat Lamps (in case of a cloudy day)

**Lesson:**

This lesson will consist of activities that will be used to introduce students to light energy, how we use light energy, and how solar energy is connected to light energy. We will also revisit our food chain activity from last week and finish up our discussion to find out if we answered the questions that the students posed as a class. This is the final lesson to be taught before students synthesize all the information they have learned during the past four weeks and create a visual representation of their understanding.

**Engage: KWL Charts**

The students will begin the day with a Know, Want to Know, and Learned (KWL) chart. The students will be asked to write anything they know about light energy in the “Know” portion of their chart and write down any questions they would like to answer about light energy in the “Want to Know” portion of their chart. These questions should be listed on the board for all students to see. As the class completes the activities, they will revisit the questions on the board to see if they have answered any of them and if so, discuss how they were answered. Students should record the answers in their journals or on the back of their charts.

**Explore and Explain:**

**Activity 1: Solar Paper**

The teacher should begin the activity by passing out the necessary materials to each student. It would be useful to have the tape already cut into strips and stuck on the side of the students’ tables so they are easily accessible. Students should be instructed to create a chart on which to record their predictions and observations. Follow these steps:

1. Fill a plastic pail about a third of the way with water.
2. Students should cut out different shapes from the pieces of construction paper, wax paper, and plastic wrap.
3. They should then use pieces of tape to attach their shapes to the blue side (or light-sensitive side) of their solar paper and place these sheets in a darkened room.
4. Ask the students what they think will happen to the part of the paper covered with the construction paper, wax paper, and plastic wrap. Students should record their predictions in their table. Students should be able to explain their predictions.
5. The students should then remove their shapes from the darkened room and take the papers outside to allow the sun to shine directly on the paper for about one minute. If the sun is not shining, a heat lamp can be used instead.
6. Return to the darkened room and have the students remove their shapes from the light-sensitive paper. Students should then take turns soaking their paper in the pail of water for about one minute. The papers should then be set out to dry.

This would be a good time to complete another activity. The paper will take a little while to dry.

1. Once the papers have dried, students can then compare and contrast the three shapes on the paper. They should record their observations on their charts. The students could draw what they see or even attach their light-sensitive paper to their journals.
2. Discuss:
* Which material blocked the most sunlight? The least?
* Why did different materials block different amounts of sunlight?
* How does this activity relate to energy change?

Once the students have been able to share their thoughts, the teacher should allow them to pose any new questions they may have about light-sensitive paper and translucency. These questions should be written on the board for students to jot down for reference during the wrap-up discussion at the end of the day. The final week will be spent mostly on synthesizing their knowledge with little time devoted to “new” activities’ but it would be interesting to hear students’ thoughts on how they could go about answering their new questions in the future.

**Activity 2: Light Sticks**The teacher should begin the activity by asking students if they have ever seen a light stick. Students will need to be instructed on how to appropriately “open” their light sticks. It is important for students to understand that if their light sticks break completely open, they have to inform their instructor immediately so the mess can be cleaned up. Follow these steps:

1. Bend the light sticks until the glass containers inside the sticks break. The students should shake up their light sticks in order to mix up the chemicals inside the sticks. (Do not specifically say the word “chemicals” to students). Observe the amount of light the light sticks produce.
2. Students will then place one light stick in warm water and another one in ice water. Observe any changes that occur in the light sticks.
3. Discuss:
* What is happening inside the light sticks?
* How does heat affect the chemical reaction in a light stick?

Once the students have been able to share their thoughts, the teacher should allow them to pose any new questions they may have about light sticks and the relationship between chemical energy and light energy. These questions should be written on the board for students to jot down for reference during the wrap-up discussion at the end of the day. The final week will be spent mostly on synthesizing their knowledge with little time devoted to “new” activities, but it would be interesting to hear students’ thoughts on how they could go about answering their new questions in the future.

**Activity 3: Glow Toys**

The teacher should begin this activity by distributing two glow toys, a sheet of black construction paper, and a few pieces of tape to each student. Follow these steps:

1. Make a pouch using one piece of black construction paper. Place one glow toy inside the pouch.
2. Leave the pouch and an uncovered glow toy in the sun or under a lamp for five minutes.
3. Take the glow toy and the pouch back into a darkened room. Observe. The students should look at both the exposed glow toy and the glow toy inside the pouch. They should not remove the glow toy from the pouch.
4. Discuss:
* How does the energy from the sun affect a glow toy?
* Do you think artificial light, such as a lamp, affects a glow toy the same way as sunlight does?
* How do humans use glow toy technology to keep them safe?

There is a handout that will be passed out to students that demonstrates how the movement of electrons affects how a glow toy works. This will be read aloud as a class. Once the students have been able to share their thoughts, the teacher should allow them to pose any new questions they may have about glow toys and the relationship between radiant energy and glow toys. These questions should be written on the board for students to jot down for reference during the wrap-up discussion at the end of the day. The final week will be spent mostly on synthesizing their knowledge with little time devoted to “new” activities, but it would be interesting to hear students’ thoughts on how they could go about answering their new questions in the future.

**Activity 4: Solar Beads**

The teacher should pass out ten solar beads to each student and enough string to fit around each student’s wrist. This activity will be more interesting if students are unaware of the fact that the beads are solar beads. Instead, the teacher should lead the students to believe that the beads are just a little discolored because they are older, for example. Follow these steps:

1. Place the beads on the string in a darkened room. The teacher should walk around and assist the students when tying the bracelets on their wrists.
2. Have the students hold their bracelets close to an indoor light. Observe.
3. Go outside into the sun (or use a heat lamp if the sun is not shining) and have students hold their bracelets up that light. Observe.
4. Move into a shaded area to observe the intensity of the color in the beads.
5. Discuss:
* Do both artificial light and sunlight contain ultraviolet radiation? If not, which one does?
* Do you think suntan lotion would affect the solar beads?

Once the students have been able to share their thoughts, the teacher should allow them to pose any new questions they may have about solar beads and ultraviolet radiation. These questions should be written on the board for students to jot down for reference during the wrap-up discussion at the end of the day. The final week will be spent mostly on synthesizing their knowledge with little time devoted to “new” activities, but it would be interesting to hear students’ thoughts on how they could go about answering their new questions in the future.

**Elaborate:**

The students will further their understanding of light energy by brainstorming ideas about how the sun contributes to the production of each type of energy. These ideas will be shared with the entire class and recorded on the board for everyone to see. The teacher will then explain the connections and clear up any misconceptions students may have had.

**Evaluate:**

The students will be evaluated based on their KWL charts. The students will fill in the “Learned” portion of their KWL charts. The charts will make it obvious which students retained the information they learned during the activities because their charts will be more complete and detailed than others. The teacher should look for the items listed in the objectives at the beginning of this lesson plan. It would also be preferable if students put some of the information they found most interesting to them instead of only including what is expected of them.

**Factual Knowledge:** Students will be assessed on their ability to identify differences between ultraviolet light and artificial light, describe the relationship between chemical energy and light energy, and identify transparent, translucent, and opaque objects. These three things will be written in their journals which will allow the teacher to be able to assess whether they are able to demonstrate their factual knowledge since they will be listing, or identifying, specific facts about the topics covered in the lesson.

**Conceptual Knowledge:** This will be covered in next week’s lesson plan.

**Procedural Knowledge:** Students will create a chart in their journals to record their observations. They will learn how to organize and analyze their data. Also, students will be expected to label the parts of an atom and show how the diagrams differ when light is absorbed versus when light is emitted. These ideas apply to the *Analyze* and *Remember* portions of Procedural Knowledge.

**Metacognitive Knowledge:** This will be covered in next week’s lesson plan.

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