Glow Sticks and Light Energy Flow

By Seon S. Sloley, 2020 CTI Fellow
Barringer Academic Center

This curriculum unit is recommended for:
K-5 Science

Keywords: chemical reaction, temperature, fluorescence, law of conservation of mass, hands on science, molecules, light spectrum, matter, energy, glow sticks, chemicals, biological growth, thermal energy, photoluminescence, chemiluminescence, fluorescence.

Teaching Standards:
See **Appendix** for teaching standards addressed in this unit.

Synopsis: This unit will focus on elementary science students learning and gaining valuable information about the use of glow sticks and how they work. The scientific and inquiry method along with scientific experimentation will be used to assist students in better understanding concepts taught. Focus will be on the effects of glow sticks, how temperature affects the rate/speed of a chemical reaction and law of conservation of mass. There will be a lesson provided for each grade level, and background knowledge with videos and discussion for both students and teachers. Through structured inquiry and hands-on, students will participate in scientific experimentations that will help to improve their critical thinking skills and become more knowledgeable about Science and how it works.

I plan to teach this unit during the coming year to 533 students in K-5 in the Matter and Energy Units.

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Introduction

The world is changing and is becoming increasingly technologically and scientifically advanced, therefore, our students need to be equipped with the appropriate knowledge and skills in order for them to become scientifically literate (Connections Publishing, 2019)[i]. This unit will assist students by teaching them how to think, learn, solve problems, and make informed decisions through using the scientific method in daily science instruction. Through hands on and scientific experimentation, students will use glow sticks to answer questions such as; What chemical reactions are going on inside a glow stick to cause them to work? Students will be able to explain that glow sticks have a chemical reaction when peroxide is mixed with the phenyl oxalate ester. The per oxyacid decomposes spontaneously to carbon dioxide, releasing energy that excites the dye, which then relaxes by releasing a photon (Wikipedia, 2020)[ii]. How do I use glow sticks to prove law of conservation? What effects do glow sticks have on plants? This lesson on temperature will focus on the differences between glow sticks and sunlight. Sunlight gives off its own natural light, whilst glow sticks consists of a translucent plastic tube containing isolated substances that, when combined, make light through chemiluminescence so it does not require an external energy source (Wikipedia, 2020)[iii]. The light cannot be turned off and can be used only once. The lessons in the unit will be differentiated because of the various learning levels of the different learning groups. This will assist with meeting the needs of all students and help those students who learn best through the visual (special) learning style.

Rationale

"Science is one of the most important channels of knowledge. It has a specific role, as well as a variety of functions for the benefit of our society: creating new knowledge and improving education". (UNESCO, Why is Science Important)[iv]. Science is all around us and is fast becoming a growing field with more individuals seeing the need to study and know more about what is out in the scientific world. Being in this position has opened my eyes as to why most of our students enjoy this subject while others show no interest because they consider it a challenging subject. There are so many questions in the concepts I teach and it is interesting to see the knowledge some our scholars have on these topics.

Teaching K-5, there are variations of interest in science and apart from the everyday instruction, the school offers a yearly science fair and 3-5 students are given the opportunity to participate in the regional Science Olympiad competition. The only negative aspect of these events is the participation of our students in the academy program. The standardized test that is given to fifth graders yearly focuses more on the content of the test and not the skills needed to dig deeper to solve problems. In the first year as Science Lead, I began to incorporate other subject areas to make the lessons more interesting and meaningful. I plan to revamp our Maker-Space to include

more STEAM activities and turn it into a club activity where students will be able to just go in and discover on their own and in groups.

This unit will allow me to go more in depth with the scientific method. The job of the scientific method is to provide an objective, standardized approach to conducting experiments and, in doing so, improve student's results. In using the scientific method, the students will gain their information through direct observations and experiments. I plan to have students participate in hands-on experimentation collaborative and discover answers through questioning, discussion and critical thinking. Students conduct experiments in the lab based on concepts taught, however, it is my hope to create a space where science will be enjoyed by not only some of our students but by all.

This topic of Glow Sticks and Light Energy piqued my interest and as the unit I am writing will be focused on, using glows sticks to monitor temperature, chemical reaction and law of conservation of mass. Children love the concept of using glow sticks and adding it to a science lesson and experiments will draw their interest and help them to have a better understanding of topics they normally have difficulties to understand.

Student/School Demographics

Barringer Academic Center- National Magnet School of Excellence is located near the intersection of West Blvd and Clanton Road, in Charlotte, NC. It is a part of the Charlotte Mecklenburg School system. BAC first opened its doors in the 1950's but has seen many changes over the years. BAC is a unique school with four separate programs uniting an overall school.

The Horizons program is for students who are highly gifted (at least two or more years above grade level) and go through an application process to enter the program. The Talent Development (TD) program is for students who are identified as Academically and Intellectually Gifted. These students are placed in an all-day TD classroom where they receive accelerated and advanced curriculum form a gifted certified teacher. The Learning Immersion (LI) program is for students in grades K-2 who are seeking an accelerated curriculum that will prepare them ultimately for the 3-5 TD program. There is no application process for this program, but students do need to be able to handle a rigorous pace as well as being above grade level in all subject areas. The Academy program serves students in the historic West Charlotte neighborhood and is attendance zone for BAC. This is a K-5 program.

The school houses about 549 students. Of which 99.4% are free and discounted lunch recipients. The ethnic composition of the student population is 55.4% African American, 24.4% Asian, 14% white, Hispanic 4.2%, American Indian 0.4%, Pacific Islander 0.4% and two or more 1.3%. There are 48 teachers: 37.2% (16) teachers hold a Bachelor's degree and 62.8% (27) have Advanced degrees. There are 40 (93%) who are Highly qualified and 3 (7%), that are Not Highly Qualified. Years of experience ranges from 0-20+ years. BAC became a Title One school in the year 2015. We operate on a Traditional school calendar (10 months).

My role at Barringer Academic Center is the Science Lead. I teach grades K-5 and am responsible for the yearly Science Fair and Science Olympiad competitions. There are four different programs with different academic levels and various learning styles that I have the pleasure of serving daily. Fifth grade is the only Grade level that sits a state test in Science (EOG), which is administered by the state of North Carolina. However, grades 3-4 have formative assessments that covers concepts learned in Science. Each class has fifty minutes (5mins) during a regular school session, however, due to the covid pandemic, there is only 45 minutes of Science. This course is a Special Area, but I do teach to the North Carolina Core Standards.

Unit Goals

My first goal/objective is to give students information on glow sticks. I will share with them videos, readings, and through discussion, they will gain knowledge as to the reason they will be experimenting with glow sticks. The primary objective of this curriculum unit is for students to have fun while conducting experiments while gaining insight and the critical information they need to grasp the concept being taught.

Figure 1: Image of glow sticks students will have access to

How do glow sticks heat and cool? "Increase in temperature will increases the rate of the chemical reaction in a glow stick. The increase of temperature will speed up the motion of molecules, so they are more likely to bump into each other and react. A hotter temperature on glow sticks will make them glow more brightly, whilst on the other hand, cooler temperature on the reaction will allow the glow sticks to glow less (Helmenstine, 2018)[v].

Hands-on-experiments will be conducted to refresh students' knowledge of this concept. Teacher will introduce what is "cold light", otherwise known as 'chemiluminescence. Students will know through observation that glow sticks do not give off any heat like the sun. The light in the glow sticks is from a chemical reaction (High Touch High Tech, 2020)[vi]. They will then be engaged in an activity that will use glow sticks in the process of heating and cooling. Students will have access to materials and before they are given the instructions for the experiment provided for them, they will be asked to develop their own experiment through collaboration.

This process is learning through inquiry while increasing student engagement and will help to develop the scientific experimentation process.

The North Carolina Standards of Learning in the Energy, Matter and Living and Non-Living things. Students will use their prior knowledge of these concepts. Throughout this unit, I will explain what students need to know and make the lessons so that other teachers easily understand them and incorporating other subject areas for a stronger understanding of the importance of science. Through science journaling, writing, art, math and engineering, students will discover something new.

Finally, students will grow in their critical thinking skills and learn to have fun with new and evolving materials in science. They will also learn that Glow sticks are often used for recreation, but may also be relied upon for light during military, police, fire, or emergency medical services operations. Military and police to mark "clear" areas also use them.

Content Research

> Why is science education important in our schools? We are surrounded by technology and the products of science every day. Public policy decisions that affect every aspect of our lives are based in scientific evidence. In addition, of course, the immensely complex natural world that surrounds us illustrates infinite scientific concepts. As children grow up in an increasingly technologically and scientifically advanced world, they need to be scientifically literate to succeed[vii]. (UTA, 2017)

According to Walden University (2020), "Science is the systematic study of the structure and behavior of the physical, social, and natural worlds through observation and experimentation. It's key to innovation, global competitiveness, and human advancement". Science helps students by giving them the ability to ask questions, collect information, organize and test their ideas, solve problems, and apply what they have learned in class to real world problems (WU, 2020)[viii].

Students are afraid of science because of the stigma attached to it. Most students believe that science is one of most difficult subject areas in school. As educators, it is our job to aide them in seeing the importance of science in our everyday lives. Science is everywhere. When students play soccer, they are transferring energy. Potential to kinetic and with that there is also motion energy. Science is fascinating and has vast areas of study that students would enjoy. "Teaching the scientific method to students is teaching them how to think, learn, solve problems and make informed decisions. These skills are integral to every aspect of a student's education and life, from school to career" (UTA, 2017)[ix].

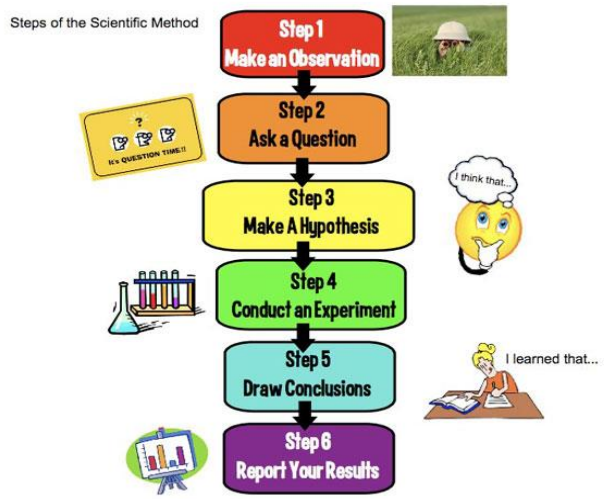
"Chemiluminescence is the production of light from a chemical reaction. Two chemicals react to form an excited (high-energy) intermediate, which breaks down releasing some of its energy as photons of light" (Science in School, 2011)[x]. Let us think about fireflies, jellyfish and glow sticks – one flies, one lives deep in the ocean and one provides entertainment in night clubs. What is the link? The answer is some intriguing chemical reactions that produce light. Many times, students will ask us why a jellyfish, firefly and glow sticks glow. The glow in jellyfish occurs because a substance called luciferin reacts with oxygen. When this happens, oxygen releases energy, and light is emitted. An enzyme called luciferase facilitates this reaction (American Museum of Natural History, 2020)[xi].

"Glow sticks emit light when two chemicals are mixed. A base, usually sodium salicylate, catalyzes the reaction between the two chemicals. This creates an exergonic reaction. The chemicals inside the plastic tube are mixture of the dye, the base catalyst, and diphenyl oxalate" (Wikipedia, 2020)[xii]. The difference between photoluminescence and chemiluminescence is, in photoluminescence a substance's glow is triggered by light, in contrast to the glow being caused by a chemical reaction.

Scientific Method

We use the scientific method to come to conclusions and make decisions. It helps students to acquire knowledge, involves careful observation and applies rigorous skepticism about what is observed. Yearly, our students are taught about the six steps of the scientific method: Question. Research, Hypothesis, Experiment, Observations, Results/Conclusions. The University of Texas Arlington (2017) in its online article, "importance of Science Education in Schools" states that, "In the fields of hard science, the process of inquiry is more direct and finite: Take a question; use evidence to form an explanation; connect that explanation to existing knowledge; and communicate that evidence-based explanation"[xiii].

Figure 2 Scientific method – Image courtesy of Science Trek



Critical Thinking

This methodology helps students develop a deeper understanding of any given concepts being taught. "This is problem-solving: using critical thinking and evidence to create solutions and make decisions. Problem-solving and critical thinking are two of the most important skills students learn in school. They are essential to making good decisions that lead to achievement and success during and after school" (UTA, para 8)[xiv]. Students should be able to take information and analyze it, draw conclusions, form and defend opinions with data and reflect on their work. When students become critical thinkers, it helps to develop their judgment, evaluate and problem solve. "Although inquiry and the scientific method are integral to science education

and practice, every decision we make is based on these processes" (UTA, 2017, para. 7)[xv]. Learning critical thinking skills can also enhance academic performance.

Glow Sticks

Glow sticks contain potential energy in the form of chemicals: fluorescent dyes and a chemical called hydrogen peroxide. No light can be released until the chemicals are mixed together. Students often play with glow sticks and adults use them often for night parties providing a fascinating source of light, but do they know the history behind these colorful objects? The fascination for our children is the different colors and the light they produce in the dark. "A glow stick is a self-contained, short-term light-source. It consists of a translucent plastic tube containing isolated substances that, when combined, make light through chemiluminescence so it does not require an external energy source. The light cannot be turned off and can be used only once" (Wikipedia)[xvi]. Glow sticks are one example of chemiluminescence. A similar principle, bioluminescence, gives fireflies the power to light up and promotes the glow of some biochemical experiments.

Figure 3 This figure explains how glow sticks work. Image courtesy of Wikipedia

1. The Plastic casing covers the inner fluid

2. The glass capsule covers the solution.

3. Diphenyl oxalate and fluorescent dye solution

4. Hydrogen peroxide solution

5. After the glass capsules is broken and the solutions mix, the glow stick glows.

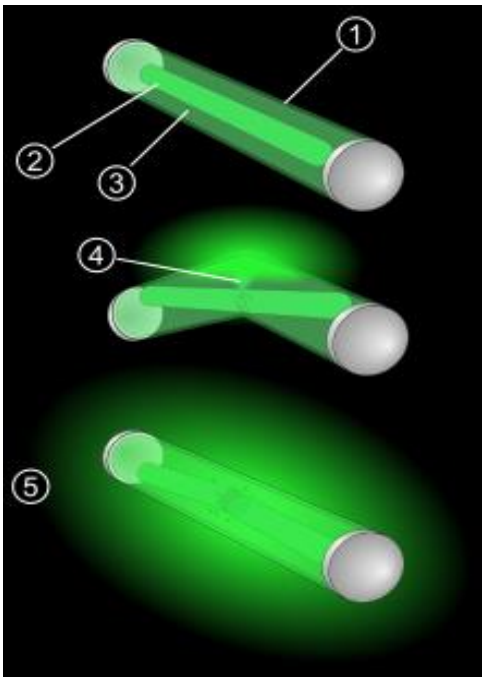


Figure 4 Students use glow stick to make bracelets image courtesy of Wikipedia

Law of Conservation of Mass

The Law of Conservation of Mass says that the amount of matter stays the same, even when matter changes form. Sometimes it may seem that matter disappears during a science experiment, but this law tells us that matter cannot magically appear or disappear, it simply changes from one form to another (Generation Genius, 2020)[xvii]. Mass is conserved in chemical reactions because the same atoms are present in the reactants as in the products, although they are combined in different ways. For example, calcium (Ca) can react with oxygen (O_2) to form the compound calcium oxide (CaO): $2\ Ca + O_2 \rightarrow 2\ CaO$. (Britannika Kids, 2020)[xviii]. The law of conservation of mass is not always correct, however. Albert Einstein's special theory of relativity, introduced in 1905, showed that mass and energy are equivalent, so mass can be converted into energy and vice versa.

Fluorescent

Fluorescent dyes are also used in the solvent (mixture of dye) to alter the color of the light emitted in glow sticks. The dye is important because it absorbs the energy released by the reaction causing it to glow. When the stick bends, the glass vial breaks allowing the two liquids to mix. Once these substances contact each other, a reaction starts taking place. The reaction releases light, causing the stick to glow.

Instructional Implementation

Teaching Strategies

To begin my unit, students need to **Visualize.** Students will observe and collect data while they are cracking open various colors of glow sticks. Teacher will ask questions and students will be

guided to make a hypothesis**.** They will watch videos on chemical and physical reaction, and how glow sticks work. Photos of the concepts will be visible in the classroom. This will bring dull academic concepts to life with visual and practical learning experiences helping students to understand concepts. K-2 students will be given the opportunity to play and explore with glow sticks that will be provided by teacher.

Cooperative Learning

Students of mixed abilities will work together. This will be done by promoting small groups and whole group activities. Cooperative learning will develop their self-confidence as well as enhance their communications and critical thinking skills, which are vital.

Name: Date:

Glow Sticks Lab

Materials: 2 cups, warm water in cup 1, cold water in cup 2, 2 glow sticks

Directions: Read the mini article below. Work with your group to discuss what visually occurred during your lab after the glow sticks were broken and placed in water.

Glow Sticks

Glow sticks are great party favors and fun to play with during the dark, but did you know that the science behind this temporary glow stick is quite scientific? Inside the plastic shape is first glass. Within the glass are chemicals. When the chemicals are released and come in contact, they create a **chemical reaction**.

Glow Stick # 1	Glow Stick # 2

Using your knowledge of the states of matter, what would happen if the glow sticks were exposed to different types of water or varied temperature?

Worksheet courtesy of TPT – Teacher Pay Teachers

Turn and Talk

Students will use turn and turn, a quick and informal teaching strategy, which the teacher gives the opportunity for students to turn to another student and talk something through for a very brief period before whole group discussion, or lecture resumes (Teacher Toolkit, 2020)[xix]. Students will talk about glow sticks and other critical thinking questions posed by teacher during lesson. During this strategy, students verbalize their thoughts and build on understanding each other's opinions and voices. "All students are able to process new learning while engaging in meaningful conversation with a classmate" (Teacher Toolkit, 2020)[xx].

A question on glow sticks, jellyfish and other objects that glow will be posed. They will be given 1-2 minutes to discuss. Students will turn to a specific partner; this can be done by using shoulder buddies or an eyeball partner. They will then talk while a timer is set. When time is up, partners will share out thoughts and ideas for discussion.

Inquiry-based instruction

Teacher will pose thought-provoking questions, which will inspire students to think for themselves and become learners that are more independent. They will be encouraged to ask questions and investigate their own ideas that will help to improve their problem-solving skills as well as gain a deeper understanding of academic concepts.

Name: _____

Inquiry Lab: Glow Stick Heat Lab

Materials:

3 glow sticks, clear cups, warm water, cold water, and thermometers for each cup

Question:

Does temperature change the glowing of glow sticks?

Hypothesize:

What do you think will happen when a glow stick is placed in cold water?

What do you think will happen when a glow stick is placed in warm water?

Procedure:

1. Place a thermometer in each cup and measure the temperature of the water or air. Record in the table.
2. Bend/snap the 3 glow sticks until they start glowing. Place one in each cup.
3. Wait for 2 minutes. Then, observe what happens and record your observations on the table on the back of this page.

Worksheet courtesy of TPT – Teacher Pay Teachers

Lessons (This lesson was adapted from: Glow Stick Science Experiment for Kids. Liz Heinecke. 2018. Candidate added to lesson.

Please find link to other lessons: https://www.scholastic.com/parents/school-success/learning-toolkit-blog/glow-stick-science-experiment-kids.html

Lesson 1 K-2 Introduction to Glow Sticks and temperature

Strategies: Collaborative learning, turn and talk, inquiry based, critical thinking, Scientific method

Time: 45 Minutes x 2

During the study of glow sticks and what they are, students will develop their science skills through inquiry, prediction, observation, exploration, discussion and recording. These lessons

focus on students collaboratively problem solving, discovering and investigating to find answers and solutions. They will make a hypothesis with teacher's guidance, make observations and answer questions such as; what are glow sticks? Why do they glow? What happens when they light up? How do we use our five senses to discover? Each lesson includes science and engineering practices, disciplinary core ideas and crosscutting concepts, which are a part of NCDPI Science Standards.

Teacher Notes: Stored energy is called potential energy. Glow sticks contain potential energy in the form of chemicals: fluorescent dyes and a chemical called hydrogen peroxide. No light can be released until the chemicals are mixed together.

When you mix the chemicals together by cracking the glow stick, they react to make new chemicals and release excess energy in the form of light, transforming chemical energy into light energy. How brightly the sticks glow depends on the temperature of their environment.

Adding heat to a chemical reaction makes it happen faster, so adding heat to a glow stick makes it produce more light energy for a short period. However, a colder glow stick will glow longer since its reacting and releasing light energy more slowly.

Materials

- 3 glow sticks that are the same size and color
- 2 foam cups
- A thermometer (optional)
- Ice
- Kitchen tongs
- Permanent marker
- Black light
- Science journals
- My Five Senses (Book) by Aliki

https://www.youtube.com/watch?v=eXgKjHlFHAg How do Glow sticks Work?

Engage: Read the book My Five Senses aloud to the class. Teacher will explain that they will get together with a partner and explore their glow sticks. Talk about what they think is in a glow stick. What are the bubbles that they see in the glow stick, and what they are used for? (Teacher will tell students that the bubbles contain chemicals). They will draw and label two examples of each of the five senses, and how they are used to explore glow sticks. Students will then be showed a clip-on glow stick.

Explore: As students finish their first journal page, they can discuss their drawings and explore the journal with their friends. Teacher will fill a cup with hot water. They will have a second cup

filled with ice and cold water. Use the permanent marker to label one stick "hot," one stick "cold," and the third stick "room temperature." Students will be asked if glow sticks will low brighter in hot or cold water.

Students will bend each of the three glow sticks until it cracks (to activate it). They will then shake the sticks up to mix the chemicals inside together.

Use the tongs to place one glow stick in the hot water and one in the ice water. Leave the third glow stick on the table. (Sunglasses are optional, just for fun!)

Each team will set a timer for 3 minutes and they will observe the glow sticks to see what is happening.

After three minutes, they will remove the glow sticks from the water and place them side-by-side on the table with the room temperature glow stick. Ask: Is there a difference between both glow sticks?

Students will put the sticks in order from brightest to dimmest. Ask: Were their predictions correct?

Students can test the same thing using different colored glow sticks to see whether some colors glow brighter than others do.

Explain: After the kids explore, they will write in their journals, and they will share with class what 2 senses were the focus while exploring their glow sticks with different temperature.

Lesson 2 (Adapted from: Science Fair Topics with Glow Sticks. Jeremy Cato. 2017.

Candidate added to lessons and made adjustments.

More information and experiments are available at https://sciencing.com/science-fair-topics-glow-sticks-8148748.html

K-2 Effects of Glow Sticks on Plants – Temperature

Sub-Topic: Can light produced by glow sticks substitute for sunlight that plants need to grow?

Duration- One Week

Strategies: Collaborative learning, inquiry based, turn and talk, critical thinking, Scientific method

Materials:

- Three identical plants

- Several glow sticks (red, orange, green and yellow)
- Journals

https://www.youtube.com/watch?v=89QRrnnYPNw How do Plants Grow? Knowsy Nina Wants to Know.

Engage: Students and teacher will discuss plant growth and what plants need to grow. Students' will watch YouTube video. Ask: Can glow sticks help plants to grow? Why? Students will turn and talk and the share with class their thoughts.

Explore: Students will be placed in groups (Collaborative). Each class will be given three plants in pots and six glow sticks.

Each glass will be given a different color.

Students will label plants with name of group. Students will make a hypothesis based on discussion and materials given. Hypothesis will be recorded. They will set plants up in their classrooms for daily observations. ***Figures below are examples of how glow sticks maybe placed in plant.***

Students will use table below to make observations and drawings of each initial stages for each sample.

Plants and Glow Sticks

My observations and Findings

Days	Plant # 1 Observation/s	Plant # 2 Observation/s	Plant # 3 Observation/s
Day 1	Observation/s:	Observation/s:	Observation/s:
Day 2	Observation/s:	Observation/s:	Observation/s:

Day 3	Observation/s:	Observation/s:	Observation/s:
Day 4	Observation/s:	Observation/s:	Observation/s:
Day 5	Observation/s:	Observation/s:	Observation/s:
Day 6	Observation/s:	Observation/s:	Observation/s:
Day 7	Observation/s:	Observation/s:	Observation/s:

One plant will be exposed to constant sunlight for one week.

The second plant will be exposed to sunlight for three days and 12 hours, and then the duration of the time to light from only glow sticks (6 glow sticks will be placed in a circle around the plant in the soil).

The third plant will only be exposed to glow sticks for one week.

Students will observe daily and journal daily process with notes and pictures.

Explain: students will explain their observations through discussion and illustrations.

Lesson 3

Topic: Making your Own Glow sticks. (Adapted from Science Fair Topics with Glow Sticks – Jeremy Cato. 2017). https://sciencing.com/science-fair-topics-glow-sticks-8148748.html

Grades 3-5

Duration 45 Minutes

Strategies: Collaborative learning, turn and talk, inquiry based, critical thinking, Scientific method

In order for the upper grades to better understand glow stick standards, they will make glow sticks in the lab. Glow sticks work through a process called chemiluminescence, whereby the mixing of two chemicals creates light.

Materials:

- 2 liters distilled water
- 50 mL 3% hydrogen peroxide
- 0.4 g copper sulfate pentahydrate
- 4 g sodium carbonate
- 0.2 g luminol and 0.2 g ammonium carbonate
- 2 large mixing bowls
- Glass stirrer
- Large test tube or graduated cylinder
- Safety goggles
- Gloves
- Protective clothing

https://www.youtube.com/watch?v=uJgNTeBWhDk Science of Glow sticks

https://www.youtube.com/watch?v=oKjFVBVGad0 The Brilliance of bioluminescence – Leslie Kenna

Engage: Students and teacher discuss glow stick. What are they? What are they used for? Are glow sticks important? Turn and talk then share whole group. Watch video on glow sticks history and bioluminescence.

Explore: Students will be placed in groups and handed materials. Each group will receive one item from each set of materials. They will have job responsibilities. They will use the learning inquiry and scientific methods for this hands-on experiment while recording with notes and pictures for each step.

Step 1: Pour 1 liter of distilled water and the hydrogen peroxide into a large mixing bowl and stir.

Step 2: Pour the other liter of water, sodium carbonate, copper sulfate pentahydrate, luminol and ammonium carbonate into the other bowl and stir.

Step 3: Pour 1/2 cup of both solutions into the test tube or cylinder. The solution will glow for only a few seconds.

Ask: What will happen when both solutions are mixed?

Why did the solution only glow for a few seconds?

What gases were present?

What changes were made (Physical or chemical change)?

Explain: Students will share findings with class.

Lesson 4

Grades 3-5 Duration: 45 Mins.

Topic: Glow sticks and Law of Conservation of Mass.

(Adapted from: Ian Elliot. The Law of Conservation of Mass)

http://www.umanitoba.ca/outreach/crystal/Grade%2010/Cluster%202/S2-2-05%20-%20Conservation%20of%20Mass%20-%20Lesson.doc

Strategies: Collaborative learning, turn and talk, inquiry based, critical thinking, Scientific method

Materials:

- Walnut
- Sandwich bags
- Hammer (student friendly)
- Measuring masses in chemical changes handout
- Safety goggles
- Electronic balance scale
- Erlenmeyer flasks (1 per student group)
- Small test tubes (1 per student group)
- Glow sticks
- Brain pop video
- Alka-Seltzer tablets
- Journals
- Chart paper
- Smart board
- computer

Essential Science knowledge. Mass is conserved in chemical reactions. They will be given a definition of the Law of Conservation of Mass, which states that, in a chemical reaction, the total

mass of the reactants is always equal to the total mass of the products. They will be taught that in a chemical reaction the total mass of the reactants is always equal to the total mass of the products. In chemical reactions, the atoms are not changed and the number of each type of atom remains the same. The atoms are simply rearranged.

Engage: Begin lesson with a Brain Pop video on: "Conservation of Mass"
https://www.brainpop.com/search/?keyword=conservation%20of%20mass
Students will turn and talk after video clip. They will also share one take take-away from video.

Step 1: Begin lesson by showing the class a walnut sealed in a sandwich bag. Measure the mass of the walnut and bag using an electronic balance. Record the value. Ask students "What do you think the mass of the walnut and bag would be if I break the walnut with a hammer?" Allow students to make predictions. Break apart the walnut using a hammer (making sure that the bag remains sealed) and take the mass again. Ask students "Why is it still the same mass?"

Step 2: Show students a glow stick and find its mass. Ask, "What would happen to the mass of the glow stick if I bend it to light it up?" Measure the mass of the glow stick and record the value. Then, light up the glow stick and find its mass. Ask, "What type of reaction is this?" and "Why did the mass remain the same?"

Step 3: Next, separately find the mass of a 250ml Erlenmeyer flask with 100ml of water in it and an Alka-Seltzer tablet and record their values. Students will drop the tablet into the flask and answer this question: "What type of reaction is this?" and "What do you think the mass of the Erlenmeyer flask with the water and Alka-Seltzer tablet is now?" Measure the mass of the flask and discuss the results. Ask, "Why do you think the mass has changed?"

Explain: Step 4: When students are finished with the lab, each student pair will record their observations for both activities on chart paper (i.e. mass before the reactions, mass after the reactions, and mass difference before/after). This will be presented and displayed in the lab.

Appendix

Standards

1.L.2.1 Summarize the basic needs of a variety of different plants (including air, water, nutrients, and light) for energy and growth.

1. L.2.2 Summarize the basic needs of a variety of different animals (including air, water, and food) for energy and growth.

Unpacking: What does this standard mean a child will know, understand and be able to do?

1. L.2.1 Students know plants are living things that need energy and grow. Students know plants need to take in water, nutrients and light (to make their own food) for energy and growth.

1. L.2.2 Students know animals are living things that grow and have basic needs for energy, air, and water. Animals depend on plants to provide them with energy directly or indirectly. Animals take in plants or other animals as an energy source.

5. P.3 Explain how the properties of some materials change because of heating and cooling.

5. P.3.1 Explain the effects of the transfer of heat (either by direct contact or at a distance) that occurs between objects at different temperatures. (Conduction, convection or radiation)

5. P.3.2 Explain how heating and cooling affect some materials and how this relates to their purpose and practical applications.

Unpacking: What does this standard mean a child will know, understand and be able to do?

5. P.3.1 Students know that when warmer things are put with cooler things, the warmer things lose heat and the cool things gain it until they are all at the same temperature. Students know that a warmer object can warm a cooler object by contact or at a distance. Conduction is the transfer of thermal energy between things that are touching. Conduction can happen within one object. (For example, thermal energy can be conducted through the handle of a metal pot.) Convection is the movement of thermal energy by the movement of liquids or gases. Convection in the oceans and atmosphere helps to move thermal energy around Earth, and is an important factor influencing weather and climate. Radiation is the transfer of energy by electromagnetic waves. Electromagnetic waves can carry energy through places with or without any matter. The Sun is the main source of electromagnetic energy on Earth. Part of this energy, light, is used by producers to make food. Radiation can also happen in other circumstances (i.e. sitting in front of a fireplace).

5. P.3.2 Students know that heating and cooling can cause changes in the properties of materials, but not all materials respond the same way to being heated and cooled. Students know that heating and cooling cause changes in the properties of materials, such as water turning into steam

by boiling and water turning into ice by freezing. Students know and notice that many kinds of changes occur faster at higher temperatures. Students know that some materials conduct heat much better than others do, and poor conductors can reduce heat loss.

Students need not come out of this grade span understanding heat or its difference from temperature. More important, students should become familiar with the warming of objects that start out cooler than their environment, and vice versa. Computer lab ware probes and graphic displays that detect small changes in temperature and plot them can be used by students to examine many instances of heat exchange. Because many students think of cold as a substance that spreads like heat, there may be some advantage in translating descriptions of transfer of cold into terms of transfer of heat.

Endnotes

[i] Connections Publishing. “Benefits of Science Education in School”.
[ii] Wikipedia. “Glow sticks”.
[iii] Wikipedia. “Glow sticks”.
[iv] UNESCO. “Why is Science Important?”
[v] Helmenstine. A. 2018. Glow Stick Experiment- Rate of Chemical Reaction
[vi] High Tough High Tech. 2020. “Light Stick Chemeluminiscence”
[vii] University of Texas Arlington. “Importance of Science Education in Schools”.
[viii] Walden University. “The Importance of Learning Science”.
[ix] University of Texas Arlington. “Importance of Science Education in Schools”.
[x] Science in School. “What is Chemiluminescence?”
[xi] American Museum of Natural History. “How the Jelly Got its Glow”.
[xii] Wikipedia. “Glow sticks”.
[xiii] University of Texas Arlington. “Importance of Science Education in Schools”.
[xiv] University of Texas Arlington. “Importance of Science Education in Schools”.
[xv] University of Texas Arlington. “Importance of Science Education in Schools”.
[xvi] Wikipedia. “Glow sticks”
[xvii] Generation Genius. “Law of Conservation of Mass”.
[xviii] Britannica Kids. “Law of Conservation of Mass”.
[xix] The Teacher Toolkit. “Turn and Talk”.
[xx] The Teacher Toolkit. “Turn and Talk”

Annotated Bibliography

American Museum of Natural History. 2020. How the Jelly Got Its Glow. Retrieved from: www.amnh.org

This article informs us about the glow of jellyfish and other glowing objects. Bioluminescence is light produced by a chemical process within a living organism. This glow occurs when a substance called luciferin reacts with oxygen.

Britannica Kids. 2020. Law of Conservation of Mass. Retrieved from: kids.britannica.com

This article reiterates the fact that matter can neither be created nor destroyed. It also states that the law of conservation of mass is a fundamental principal of physics. It dives into conservation of mass in chemical and physical systems. Matter is also in conserved when matter undergoes physical changes, such as changes of state.

Connections Publishing. 2019. Benefits of Science Education in School. Retrieved from: www.conpub.com.au

This article speaks to the fact that Science is a core part of a school's curriculum. The reasons why Science education should continue to be supported and what science does for students, including, enhancing critical thinking.

Generation Genius. 2020. Law of Conservation of Mass. Retrieved from: https://www.generationgenius.com/

This video shows hands-on on the law of conservation of mass. It explains what it is and the formulas associated with this concept.

Helmenstine. A. 2018. Glow Stick Experiment – Rate of Chemical Reaction. Retrieved from: https://www.thoughtco.com/glow-stick-rate-of-chemical-reaction-607631

This article looks closely on glow sticks and chemical reaction. Hotter temperature allows the glow stick to glow brighter, whilst a cooler temperature does not allow for a bright glow.

Science in School. The European Journal for Science Teachers. 2011. What is Chemiluminescence? Retrieved from: www.scienceinschool.org

This article is about chemiluminescence as a production of light from a chemical reaction and how two chemicals react to form an excited (high-energy) intermediate, which breaks down releasing some of its energy as photons of light.

The Teacher Toolkit. 2020. Turn and Talk. Retrieved from: www.theteachertoolkit.com

This article dives into the importance of turn and talk, which gives all students the opportunity to participate in discussion rather than just a few students participating in a class wide discussion.

University of Texas Arlington. 2017. Importance of Science Education in Schools. Retrieved from: academicpartnerships.uta.edu

This article talks about the importance of Science in education, how Science is involved in students everyday life and the scientific inquiry method used with critical thinking.

Walden University. 2020. The Importance of Learning Science: Teaching Strategies for Today's Educators. Retrieved from: waldenu.edu

This article gives a detailed definition of Science and how Science affects us on a daily basis. It also talks about the value of learning Science and Teaching Strategies for educators and the need for more individuals in the field of Science.

Wikipedia. 2020. Glow sticks. Retrieved from: en.m.wikipedia.org

This resource looked at what are glow sticks and the isolated substances that when combined, make light though chemiluminescence.