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| **Light and Flame Test****Day \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
| Standards: **MS-PS1. Matter and its Interactions*** **MS-PS1-6.** Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

**MS-PS4. Waves and Electromagnetic Radiation*** **MS-PS4-1.** Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
* **MS-PS4-2.** Develop and use a model (color wheel) to describe that waves are reflected, absorbed, or transmitted through various materials.

Core Ideas:**MS-PS1. Matter and its Interactions*** **MS-PS1-B.** Chemical reactions. Some chemical reactions release energy, others store energy.

**MS-PS4—Waves and Electromagnetic Radiation*** **MS-PS4-A.** Wave properties. A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
* **MS-PS4-B.** Electromagnetic radiation. When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light.

Objectives:Introduce the idea that light exists at different wavelengths which correspond to different energies. Introduce the visible EM spectrum and how perceived colors relate to wavelength and energy. Explore the concept that adding energy to different substances causes them to give off light of specific energies, and hence colors. Explain that light reflects and absorbs different wavelengths based on the properties of the object the light is interacting with. Use diffraction lenses to explore how white light and colors are actually composed of many different wavelength colors. |
| Materials:* Lighter or propane-fueled culinary torch (students will not handle this)
* Wood sticks or [Pt wires](https://www.amazon.com/Mountain-Home-Biological-Re-usable-Inoculation/dp/B06WWHJRFG/ref%3Dpd_bxgy_328_img_2/130-7298435-9547261?_encoding=UTF8&pd_rd_i=B06WWHJRFG&pd_rd_r=8f67e63f-758d-4f7e-80ac-54029b4483e6&pd_rd_w=vAhPp&pd_rd_wg=RoUGi&pf_rd_p=09627863-9889-4290-b90a-5e9f86682449&pf_rd_r=NNB0RNDGRD6DFC02CDAQ&psc=1&refRID=NNB0RNDGRD6DFC02CDAQ)
* 10 g of Copper Chloride (CuCl2): Blue flame
* 10 g of sodium carbonate (Na2CO3): Yellow flame
* 10 g of Potassium Chloride (KCl): Violet flame
* 10 g of Strontium Chloride (SrCl2): Red flame
* 10 g of Copper sulfate (CuSO4): Green Flame
	+ [Link for the metal salts](https://www.amazon.com/Science-Company-NC-12053-Flame-Chemical/dp/B01LZ8LOC0/ref%3Dsr_1_1?crid=1YR7TZG16WJ1U&keywords=metal+salts+for+flame+test&qid=1575418477&sprefix=metal+salts%2Caps%2C196&sr=8-1#detail-bullets)
* Color wheel/light spectrum chart (powerpoint image)
* 7 test tubes or small (100 mL) beakers
* [Diffraction glasses](https://www.amazon.com/GloFX-Paper-Cardboard-Diffraction-Glasses/dp/B00CMGNNR2/ref%3Dsr_1_4?keywords=cardboard+diffraction+glasses&qid=1574813500&sr=8-4)
* Yellow, purple, and orange light bulbs
* 3 [Lamps](https://www.amazon.com/Obell-Waterproof-Rotatable-Decorations-Pack-Solar/dp/B07JNKBQQQ/ref%3Dsr_1_29?keywords=lamp+light+bulbs+colorful&qid=1575417243&sr=8-29)

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| 20 minutes | **Engage**-The students will be given the lenses to take turns looking around the classroom. The students are then asked to write down why they think the light looks different when looking through the lenses (Developmental Learning Theory).-Introduce the EM spectrum, white light and how it is composed of many different wavelengths/energies/colors.-Students are asked to speak to their groups (Social Learning Theory) and predict how the colored light diffraction pattern would look through the lenses. Students are given the opportunity to test their hypothesis.-Introduce absorption and reflection of light and how they affect color. The group will then discuss that the light is being absorbed only by some wavelengths of light and not others.The main point of this exercise is to get them thinking about light and its properties. |
|  10 minutes | **Explore**-The students are shown the metal salt solutions and the Bunsen burner and asked to predict (Developmental Learning Theory) what will happen when the metal salts are burned in the flames. Go through all 7 metal salts.- Let the students go back to their groups and have them discuss (Social Learning Theory) possible reasons that the metal salt solutions gave off light as they burned? Why the metal salt solutions burned different colors? |
| 10 minutes | **Explain****-**Do a formative assessment of the students' understanding of atomic structures. Ask the students to draw what an atom looks like. Ask the students if they know what electrons are. Ask the students if they know what photons are.- Show or draw a picture of the color spectrum. Then explain the concept of exciting an electron and the fact that when an excited electron relaxes it releases a photon. |
| 10 minutes | **Expand** -Ask the students to get together in groups and come up with examples of light being generated from exciting electrons and giving off Photons? In hope that they will realize that this is used all around them. Examples Neon signs, fireworks, sodium vapor lamps. Ask the students if the energy is high or low based on the color. (social Learning theory) -Ask the students to discuss if they think that there exist materials that could not go through this process or if they believe all materials could. |
| 10 minutes | **Evaluate**-Ask the students to get in groups and answer the following questions (social learning theory)-Why do we see the colors that we see? Is the color that we see the absorbed light or reflected light?-Ask the students to draw the light spectrum and label which side has higher and lower energy. -Ask the students why burning the metal salts makes different colors? |

**Reflection:** Collect the drawings and written answers from the evaluation section of the activity. Look through the answers the groups gave based on how correct the answers are and how much explanation the students went into. This information can see which areas may need more explanation the next time the activity is done. Also a few minutes after the activity should be taken to note which parts of the activity took more time than expected, needed more explanation, and the questions the students asked.