



Forensic Science: Glow Up!

Amount of time Demo takes: 3-5 minutes

Try this in the classroom!

Lesson's Big Ideas

- In some chemical reactions energy is released as light, due to an oxidation or hydrolysis reaction. This is called Chemiluminescence.
- Iron is present in hemoglobin in blood and carries oxygen to the cells
- The Iron acts as a catalyst, triggering a chemical reaction between luminol and hydrogen peroxide - producing a blue glow

Materials

- Luminol Solution
- Simulated Blood (Can be purchased) (Iron-based solutions such as a rust/water mixture or a red dye with hydrogen peroxide) (Can also use NaOH with H₂OH when recreating in a chemistry classroom)
- D.I. Water
- Plastic Pipettes/Droppers and/or
- spray bottle
- UV Flashlight or Black Light
- Gloves and protective goggles
- Paper plates

SAFETY!

- Must use safety goggles and gloves when handling chemicals, including luminol and simulated blood, hydrogen peroxide, etc.

Background Information

- **Chemiluminescence** is the emission of light as a result of a chemical reaction, without producing significant heat. It's used in glow sticks, forensic science, and some natural phenomena like firefly light.
- **Oxidation reactions** involve the transfer of electrons, often with oxygen being added to or removed from molecules. These reactions release

energy, which can be converted into light in chemiluminescence.

- **Luminol** is a chemical that glows blue when it reacts with specific oxidizing agents, like iron in hemoglobin. This reaction produces light through the release of energy from the rearrangement of electrons.
- In the luminol reaction, hydrogen peroxide (H_2O_2) acts as the oxidizer, and iron in hemoglobin speeds up the reaction, making it glow.
- The glow occurs because the reaction creates an excited molecule, which releases energy as light when it returns to a stable state.

Setup Instructions

1. Prepare the Test Surfaces
 - a. Before the activity, place small drops of simulated blood using the pipette or spray bottle on test surfaces (paper plates)
 - b. For an added challenge, let some areas appear clean (no visible stain) - Allow dry time
2. Prepare Station/Supplies
 - a. Provide students with gloves, goggles, and a spray bottle filled with a luminol solution
3. Prepare Area/Classroom
 - a. Make sure each group has a UV flashlight and if possible dim the lights

Instructional Procedure

1. Have each group spray their test surface lightly and observe with the UV flashlight
2. Have students record their observations
3. For an additional challenge, demonstrate what should happen with different test surfaces (simulated blood, water, etc.) and then have students perform the experiment and deduce what each test surface is

Tips & Tricks

- Dry Time: Allowing simulated blood time to dry is crucial to mimic real-world forensic conditions
- If using chemicals (hydrogen peroxide and baking soda in place of simulated blood) adjust the composition if needed to achieve a strong reaction

Assessment Questions

- What does the glowing reaction tell us about the substances we tested?
 - The glowing color tells us a chemical reaction occurred since the products show chemiluminescence
- Why is luminol useful in forensic science, and what are its limitations?
 - Luminol is useful in forensic science for testing the presence of blood. It's limited in that other substances (like bleach) can also cause an oxidation reaction and the glowing blue color

Careers & Real-World Applications

- Real World Applications:
 - Luminol is used at crime scenes to determine the presence of blood
- Careers:
 - Forensic Scientist: A forensic scientist analyzes physical evidence at crime scenes including blood and blood patterns
 - Chemist: A chemist works with chemical reactions regularly to provide a solution for problems they are faced with
 - Chemical Engineer: A chemical engineer designs processes to produce chemicals like luminol and ensures they work efficiently and safely for applications

Clean Up

- Rinse all surfaces with water to remove any remaining luminol
- Dispose of all simulated blood-stained materials following biohazard protocols if necessary
- Store unused materials/chemicals for future use

References

- <https://www.sciencedirect.com/topics/medicine-and-dentistry/luminol>
- <https://www.scienceinschool.org/article/2011/chemiluminescence/>
- <https://www.blood.ca/en/blood/am-i-eligible-donate-blood/abcs-eligibility/what-you-need-to-know-about-hemoglobin-hemochromatosis-iron-anemia>

Related Next-Generation Science Standards

- MS-PS1-2: Analyze and interpret data on the properties of substance to determine if a chemical reaction has occurred (glowing vs not glowing)

- HS-PS1-2: Determine the outcome of a chemical reaction (oxidation) based on the properties of Luminol (losing H and N, gaining O₂)
- MS-LS1-1: Living things are made of molecules with specific properties, such as iron in hemoglobin

Where to Purchase Supplies:

https://www.carolina.com/forensic-blood-analysis/carolina-luminol-reactive-forensic-blood-250-ml/212102.pr?utm_source=google&utm_medium=cpc&utm_term=&utm_campaign=ea+%7C+pmax&utm_source=adwords&utm_medium=ppc&hsa_acc=9131076190&hsa_cam=17231377884&hsa_grp=&hsa_ad=&hsa_src=x&hsa_tgt=&hsa_kw=&hsa_mt=&hsa_net=adwords&hsa_ver=3&qad_source=1&qclid=CjwKCAiAmMC6BhA6EiwAdN5iLUceuaM3xGXKUebi41QMshYIPyEYFTplAZnAw2o34rmvZX_9XDK1jRoC-ZIQA_vD_BwE

<https://www.carolina.com/forensic-blood-analysis/carolina-forensic-luminol-spray/212105.pr>