

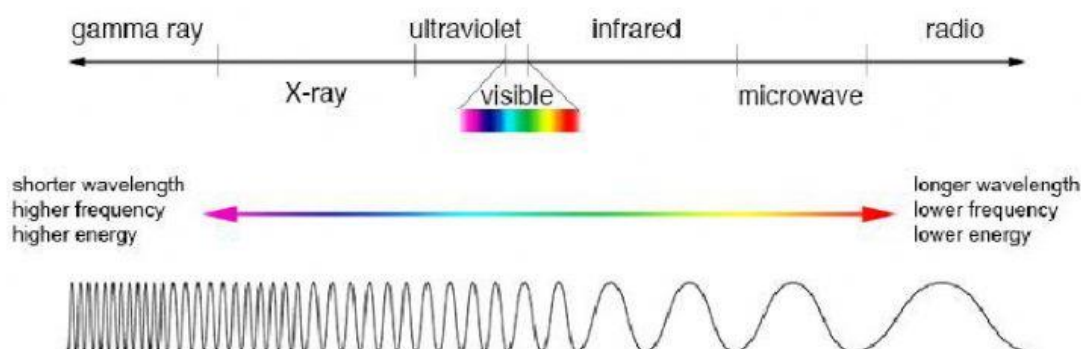
## PHYSICS: Light and Optics

### Activity: PHET Molecules and Light

Open a web browser and go to: PHET Molecules and Light

[https://phet.colorado.edu/sims/html/molecules-and-light/latest/molecules-and-light\\_en.html](https://phet.colorado.edu/sims/html/molecules-and-light/latest/molecules-and-light_en.html)

**Electromagnetic radiation (EMR) is light.** There are seven classes of electromagnetic radiation in the electromagnetic spectrum: Gamma, Xray, Ultraviolet, Visible, Infrared, Microwave, & Radio. Gamma rays are the most energetic with the highest frequency. In contrast, radio waves have the least energy with the lowest frequency.



Because of differences in the frequency and energy of the light waves, different forms of light interact differently with different types of matter. This activity will explore how different forms of electromagnetic radiation (light) with different amounts of energy, when passed as a beam through clouds of gasses, interact with different gases.

|                                 |                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IONIZATION</b>               | The light wave breaks chemical bonds. The energy of the photon breaks the molecule into atoms that move separately.                                                                            |
| <b>EXCITATION/<br/>EMISSION</b> | The light wave is absorbed by the gas molecule, giving the gas molecule extra energy (excited). The gas molecule glows. Then, the molecule releases that extra energy as different light wave. |
| <b>ROTATION</b>                 | The light wave causes the molecule to spin. The molecule releases energy in the form of a different light wave, stopping the rotation.                                                         |
| <b>VIBRATION</b>                | The light wave causes the atoms of the molecule to vibrate (wiggle) at their chemical bonds. The molecule releases the energy in the form of a different light wave, stopping the vibration.   |
| <b>NOTHING</b>                  | No interaction. The light wave does not disturb or change the molecule.                                                                                                                        |

Name: \_\_\_\_\_ Date: \_\_\_\_\_

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**Instructions**

1. Write the number of atoms that make up the molecule in the first column.
2. Point the light beam at the molecules.
3. Turn on the light beam to the fastest setting.
4. Place the molecules of the different gases in front of the light beam.
5. Observe what happens to the molecules at the light beam interacts with the molecules.
6. Identify the interaction between the beam of light and the gas molecule. Write that interaction in the data table.

**Data Table**

|                  |                  | Beams of Light |          |         |             |
|------------------|------------------|----------------|----------|---------|-------------|
| GAS              | Number of atoms? | Microwave      | Infrared | Visible | Ultraviolet |
| Carbon Monoxide  |                  |                |          |         |             |
| Nitrogen gas     |                  |                |          |         |             |
| Oxygen gas       |                  |                |          |         |             |
| Carbon Dioxide   |                  |                |          |         |             |
| Methane          |                  |                |          |         |             |
| Water vapor      |                  |                |          |         |             |
| Nitrogen dioxide |                  |                |          |         |             |
| Ozone gas        |                  |                |          |         |             |

Which interactions happened with which class of EMR?

| <b>Beam of Light</b> | <b>2 atoms in a molecule</b> | <b>3 atoms in a molecule</b> | <b>4 or 5 atoms in a molecule</b> |
|----------------------|------------------------------|------------------------------|-----------------------------------|
| <b>Microwave</b>     |                              |                              |                                   |
| <b>Infrared</b>      |                              |                              |                                   |
| <b>Visible</b>       |                              |                              |                                   |
| <b>Ultraviolet</b>   |                              |                              |                                   |

Based on your observations, answer the following questions.

|                                                            |  |
|------------------------------------------------------------|--|
| What happens to make things “glow in the dark”?            |  |
| How do microwave ovens heat up food and water?             |  |
| How do greenhouse gases trap infrared light?               |  |
| How does the ozone layer protect the surface of the Earth? |  |