

# LIGHT POGIL

**REMEMBER:** Throughout this paper, you will see some symbols.

The "stop sign" means STOP and check with a teacher before continuing.

Remember to stick to your roles. Only the "Speaker" comes up to the teacher!



1. Think back to what we learned about sound. Can humans hear ALL sound frequencies? \_\_\_\_\_
2. Do all sounds (even the ones we can't hear) travel at the same speed in the same medium? \_\_\_\_\_
3. Which travels faster – light or sound? \_\_\_\_\_
4. Just like we, as humans, are "deaf" to a large portion of the sound wave spectrum, we (humans) can only see with our eyes a TINY portion of the electromagnetic (EM) spectrum. We are "blind" to the rest. What do you think the portion we CAN see is called? \_\_\_\_\_
5. According to Einstein's theory of the **photo**electric effect, light consists of *particles* (massless bundles of concentrated energy) which we now call \_\_\_\_\_ (\*hint – look at the portion of Einstein's theory)
6. What is the speed of light? \_\_\_\_\_

**Use the information in the box to help you answer the following questions:**

Read This

Read This

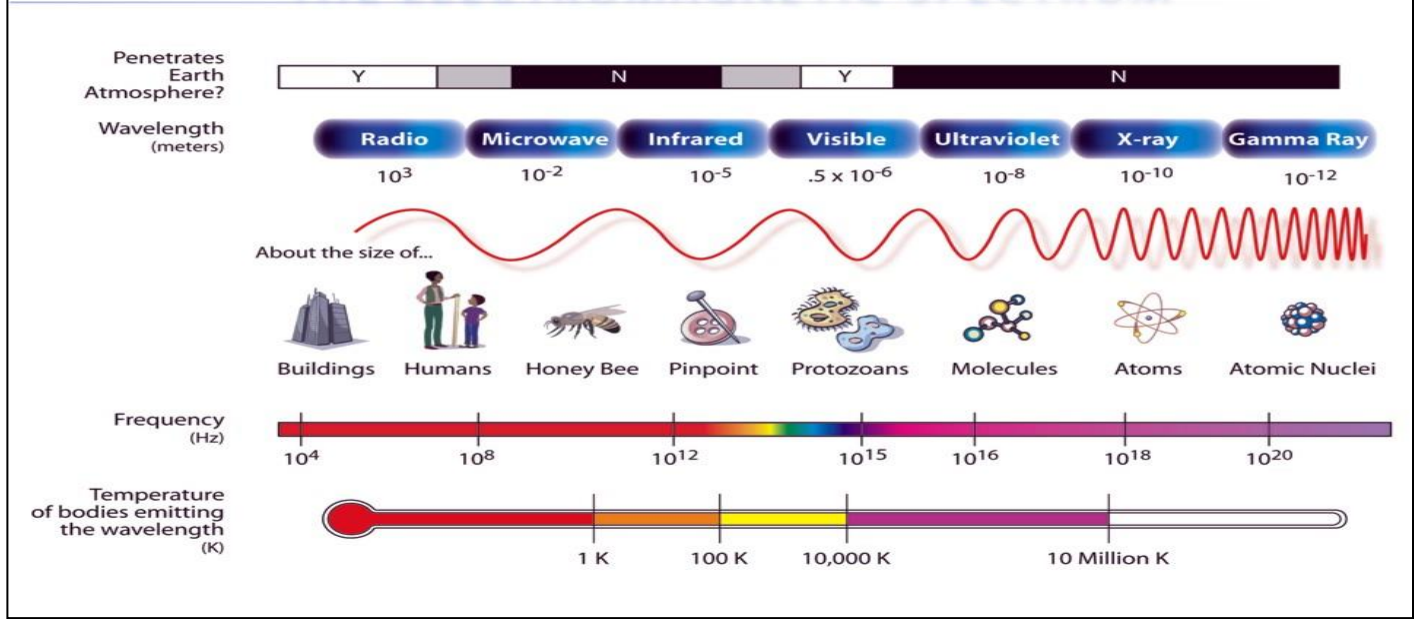
- Light waves are energy emitted by accelerating *electric* charges; so all light waves are part of the *electromagnetic spectrum*.
- Radio waves, microwaves, ultraviolet radiation, visible light, gamma rays, infrared waves, and X-rays are all types of electromagnetic (EM) waves. *They differ from one another only by frequency and wavelength.*
- The instruments of science now enable us to SEE other portions of the EM spectrum. Just as microscopes and telescopes allow us to more closely view the part of the spectrum we can see, infrared detecting devices and microwave and radio receivers allow us to explore the lower frequency end of the spectrum, while UV, X ray, and gamma ray detectors allow us to "see" the higher frequency end.
- Visible light is a small part of the EM spectrum and consists of the colors corresponding with the ROY G. BIV acronym; it is enlarged on the diagram below
- "Infra" means *less than*; "ultra" means *more than*
- Gamma rays are the highest frequency waves; radio waves are the lowest frequency waves.
- Microwaves have a larger wavelength than infrared waves
- X-rays have a higher frequency than ultraviolet waves

7. Fill in the 7 blank boxes below with the 7 types of EM waves in the **correct order**. Use the hints in the box to help you. ***\*You may want to use pencil for this part so you can erase\****

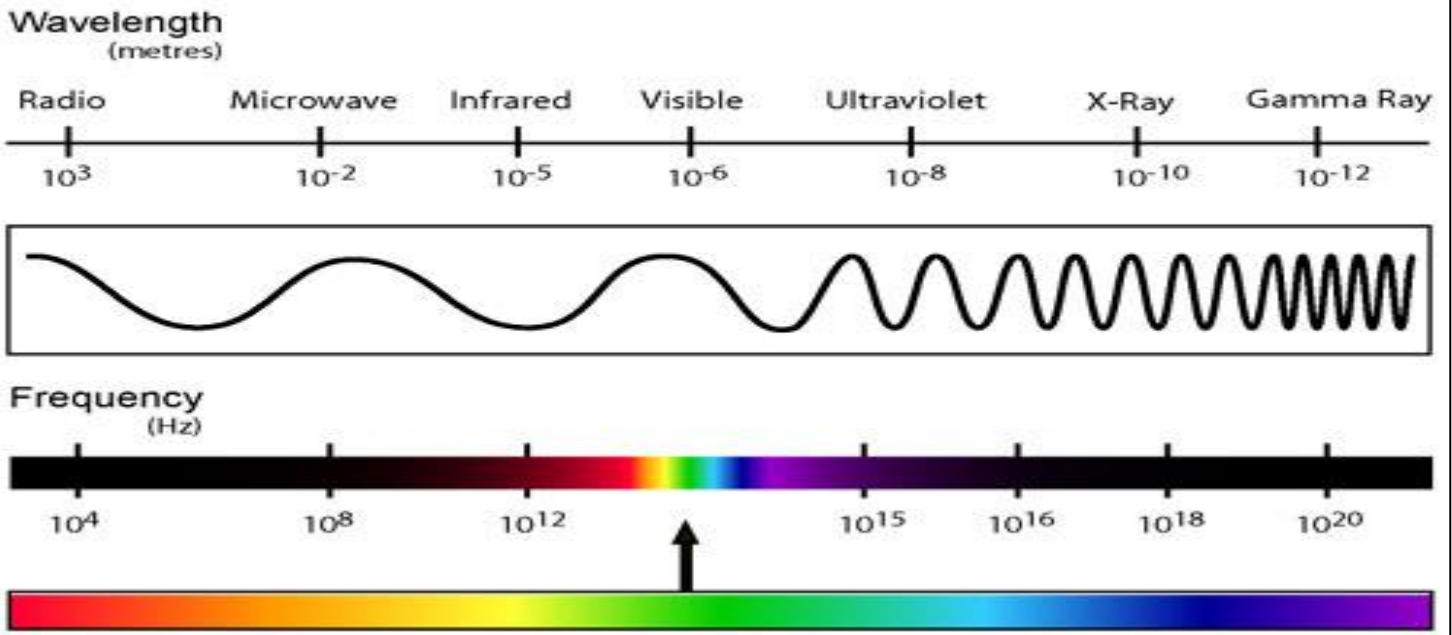
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# THE ELECTROMAGNETIC SPECTRUM



# THE ELECTRO MAGNETIC SPECTRUM



**Check your chart on the previous page with the correct one on this page – fix any errors you might have!**

8. Which electromagnetic (EM) wave on the above spectrum has the **LARGEST wavelength**? \_\_\_\_\_
9. Which EM wave on the above spectrum has the **SMALLEST wavelength**? \_\_\_\_\_
10. Which EM wave on the above spectrum has the **HIGHEST frequency**? \_\_\_\_\_
11. Which EM wave on the above spectrum has the **LOWEST frequency**? \_\_\_\_\_
12. Are wavelength and frequency **DIRECTLY** or **INVERSELY** proportional? \_\_\_\_\_
13. Which EM wave on the above spectrum has the **MOST energy**? \_\_\_\_\_



14. Would you say that high frequency or low frequency EM waves are most dangerous? EXPLAIN why (hint – use any prior knowledge or experience):

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15. Your friend says that microwaves and ultraviolet light have different wavelengths but travel through space at the same speed. Do you agree or disagree? EXPLAIN: \_\_\_\_\_

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16. Why don't you notice light "traveling" to you from a light bulb after you flip the "on" switch?

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17. Your friend says that any radio wave travels MUCH faster than any sound wave. Do you agree or disagree, and why? (\*Hint – check #4 on this POGIL) \_\_\_\_\_

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18. Where does sound fit on the EM spectrum (or does it????) Explain: \_\_\_\_\_

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**EM Waves in Our Everyday Lives: Read each piece of info and answer the questions**

TSA (Transportation Safety Administration...the airport security people) recently introduced 2 types of controversial imaging technology, millimeter wave and backscatter.



- Millimeter wave technology (photo on left) bounces high frequency radio waves off the body to create a black and white three-dimensional image. The technology emits 10,000 times less radio frequency energy than the average cell phone.
- Backscatter x-ray technology (on the right) uses low frequency x-rays.

19. Based on what you know about EM waves, to which one of these security devices would you rather be exposed? Why?

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### ***Some real world information about EM waves...***

- **Radio waves:** used mainly for satellite communication purposes (has your Blackberry ever had no signal and has said “Radio Off”? That is because it is unable to communicate with the satellite responsible for transmitting network signals via radio waves). Also used for RADAR.
- **Microwaves:** also used for satellites communication (for radios, phones, TV signals, etc) through space; used for cooking
- **Infrared:** Certain medical equipment can create an “infrared photo” (thermogram) of the blood circulation within your body – this thermogram can be used to diagnose certain diseases. Night vision goggles are able to detect infrared waves, too. Your TV remote control uses infrared, as do portable gaming systems that can “link up” wirelessly with one another. also, the ‘face detection’ technology in digital cameras relies on infrared – more on that later this unit!
- **Visible Light:** it’s all we can see!
- **Ultraviolet:** Emitted by the sun and UV bulbs; Responsible for triggering skin to produce melanin and tan/burn; used to kill germs (nail salons use them to sanitize equipment – they look like toaster ovens that glow purple. Also, the goggle cabinet in the back of this room uses UV light)
- **X-rays:** Emitted by electrons outside the nucleus. Dangerous in large doses, but the *preventative* health benefits of limited exposure outweigh the cons of not using X-rays. Used in the medical field for imaging and to fight cancer (radiation therapy). Nuclear reactions inside the sun (as well as many other stars) produce X-rays, too.
- **Gamma Rays:** Emitted by the nucleus. Used to kill living cells, making it a tool in fighting some types cancer (radiation therapy). However, can also be very dangerous to human health – usually when you hear stories of nuclear meltdowns causing radiation poisonings/deaths, it comes from this type of radiation. Nuclear reactions inside the sun (as well as many other stars) produce gamma rays, too.

**20. True or false: *High frequency radiation is always bad.* EXPLAIN:**

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**21. Why do you think that EM waves with frequencies ranging from those of visible light to lower frequencies are used in many everyday devices, while the EM waves with frequencies higher than visible light are not used as freely?**

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