Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hr \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Electromagnetic Radiation Notes**

Visible light is an EM wave. Just as we can \_\_\_\_\_\_\_\_\_\_\_ only some frequencies of sound, we can only \_\_\_\_\_\_\_ some frequencies of EM waves. There are \_\_\_\_\_\_ more types of EM waves which we cannot see.



**RADIOWAVES**

* **Wavelength:** 1m to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Frequency:** 3 x 109 to 3 x 104 Hz
* **Uses:** Telecommunications, TV, Radio
* **Dangers:** none
* We use \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ to listen to the radio and watch TV.
* The \_\_\_\_\_\_\_\_\_\_ changes the signal into \_\_\_\_\_\_\_\_\_\_, and the TV changes it into \_\_\_\_\_\_\_\_\_.
* Radio waves are stopped easily by \_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ use radio waves to let you connect to the internet without a cable.
* Radio waves travel in \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_. Part of the atmosphere round the earth can reflect radio waves.
* This means we can send signals over long distances by bouncing the signal off the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_e.

**MICROWAVES**

* **Wavelength:** 0.001m to \_\_\_\_\_\_\_\_\_\_
* **Frequency:** 3 x 1012 to 3 x 109 Hz
* **Uses:** Telecommunications, RADAR, Cooking
* **Dangers:** can produce burns, clouds eye, cancer (?)
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ use microwaves to send the phone signal
* Microwaves are used for cooking food. So what happens? Food has \_\_\_\_\_\_\_\_\_ inside it. The microwaves make the water in the food \_\_\_\_\_\_\_\_\_. The water molecules bang into each other. This makes \_\_\_\_\_\_\_\_\_\_\_\_, which makes heat.

**INFRA-RED**

* **Wavelength:** 740nm to 0.01m
* **Frequency:** 4 x 1014 to 3 x 1011 Hz
* **Uses:** Heating, cooking, TV remotes, night-vision
* **Dangers:** can burn
* We can see infra-red radiation using a \_\_\_\_\_\_\_\_\_\_ camera.
* How is this useful? This is the infra-red radiation. The \_\_\_\_\_\_\_\_\_\_\_\_ can see it, even though your \_\_\_\_\_\_ can’t!

**VISIBLE LIGHT**

* **Wavelength:** 370nm (violet) to 740nm (red)
* **Frequency:** 8 x 1014 to 4 x 1014 Hz
* **Uses:** seeing
* **Dangers:** eye damage from bright lights
* Visible light is best at getting through our \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – which is why we use it to see!
* \_\_\_\_\_\_\_\_\_\_ light is made up of different colors. We can see this in a rainbow. The drops of water in the air are splitting the light from the sun into its different colors by \_\_\_\_\_\_\_\_\_\_\_\_.

**ULTRAVIOLET**

* **Wavelength:** 10-9 m to 370nm
* **Frequency:** 3 x 1017 to 8 x 1014 Hz
* **Uses:** tanning salons, fake money detections, pollination
* **Dangers:** \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

*Bees see in UV to help them find pollen!*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ comes from the sun. UV can be useful, BUT…ultraviolet light causes sunburn. Skin cells \_\_\_\_\_\_\_\_\_\_ the UV radiation. The \_\_\_\_\_\_\_\_\_ of the radiation causes damage to the cell. \_\_\_\_\_\_\_\_\_\_\_ travels to the skin to try and fix the damage. This is why skin goes red. How can you protect yourself from sunburn? Ingredients in sun screen \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_ UV radiation or \_\_\_\_\_\_\_\_\_ the radiation and turn it into heat.

**X-RAYS**

* **Wavelength:** 10-12 to 10-7 m
* **Frequency:** 3 x 1020 to 3 x 1015 Hz
* **Uses:** medical imagery, \_\_\_\_\_\_\_\_\_\_\_\_\_
* **Dangers:** cancer
* We can use x-rays to look \_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_ instead of cutting it open.

How do x-rays work? When x-rays hit your body, most go straight through you. When an x-ray hits a bone, the bone \_\_\_\_\_\_\_\_\_\_ it so the x-rays do not get to the film. This makes the bone look \_\_\_\_\_\_\_\_ on the x-ray photograph.

Are x-rays safe? In small doses, yes. Big doses of x-rays can damage your body, causing \_\_\_\_\_\_\_\_\_. People who use x-rays have to protect themselves. X-rays can damage \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_, so pregnant women have to protect themselves too.

**GAMMA RAYS**

* **Wavelength: 10-16 to 10-9 m**
* **Frequency: 3 x 1024 to 3 x 1017 Hz**
* **Uses: \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, observing the universe**
* **Dangers: cancer**

Gamma radiation is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ type of radiation. It causes \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It can also cause cancer. The more radiation you are exposed to, the more ill you will be.

Is it ever useful? Yes – because it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to cells, it can be used to kill \_\_\_\_\_\_\_\_\_\_\_ cells. This is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It is important that the gamma radiation hits the cancer without hitting too many of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells. To do this, more than one beam of radiation is used. This means that less of the healthy cells are damaged by the radiation.

**The Dangers of the EM Spectrum**

As the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** gets **smaller.** Eventually the waves are so small that they can interact with \_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_, and atoms.

**What is the link?**

They all travel as electromagnetic waves!

**FOR EXTRA CREDIT: Create a mnemonic to remember the order of the EM spectrum and display it on a poster.**