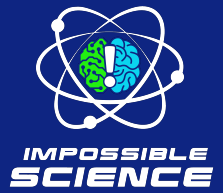


De-Aging Toys With Electromagnetic Radiation



Objective: After reviewing the electromagnetic spectrum and electromagnetic waves, students will apply their knowledge of electromagnetic waves and the electromagnetic spectrum to create a device to de-age their old toys.



Engagement

1. **Prep:** Prep: Display old plastic toys, an x-ray, a PET scan picture, sunscreen, a cell phone, a radio, a T.V. remote, and a prism on a table.
2. **Say:** Take a look at the items on the table and write a list of all of your guesses about what the items might have in common.
3. Have students **share** responses and lists.
4. **Fill** the waterproof clear box halfway with water. Have one student tap the short side of the box lightly while other students observe the waves in the water.
5. Have the student hit the side of the box with more force while students observe the waves in the water.
6. As students observe, **ask:** How big are the waves? How

Materials:

- Waterproof box with lid-a clear shoe box or bin works well if it fits the toy
- Tape
- UV light string (large enough to wrap the box several times)
- Hydrogen peroxide
- Safety goggles
- Rubber gloves
- Pencil and paper
- Old plastic toys (video game consoles work well)
- Small screwdrivers as needed to disassemble toys
- example items: x-ray, sunscreen, cell phone, radio, picture of a PET scan, television remote, prism
- Post-it notes
- Electromagnetic waves and the electromagnetic spectrum worksheet (below)

fast are they? How frequent/close together are they?

7. **Explain:** Today we will be learning about electromagnetic waves and the electromagnetic spectrum. All of these items use or are affected by electromagnetic waves.

Mini Lesson

8. **Show** students [Impossible Science video](#) to the two minute mark, pausing for students to take notes.
9. **Hand out** the electromagnetic spectrum worksheet (see below) and **review** the concepts as a class.

Procedure

1. **Show** students remainder of [Impossible Science video](#) and explain that they will be de-aging toys in class.
2. **Break** students into groups (size according to the number of toys you have gathered) and hand out/display instructions below- moving from group to group to supervise as needed.

De-aging Instructions

1. **Disassemble** a toy that has turned yellow over time. It is helpful to sketch the toy and tape parts/screws on the **sketch** to show where to reassemble them. Optional: take a before photo of the toy to compare at the end.
2. **Build** a UV light chamber by covering the clear waterproof box with UV light string as shown in the video.
3. **Wash** plastic parts with dish detergent and water.
4. With adult supervision, put on gloves and safety goggles and **fill** box with strong hydrogen peroxide, avoiding skin. The higher the concentration, the better it will work- 12% works well.

5. **Submerge** toys for a minimum of 24 hours with lid and UV lights on- stir peroxide occasionally.
6. With gloves on, **rinse** the pieces off with water.
7. **Reassemble** the toy.
8. **Compare** the cleaned toy to the original photo.

On-going assessment:

Students will **recreate the experiment** at home (alone or with a partner/small group), **film it**, and **submit their video**.

1. Have students label the items on the table with post-it notes saying which part of the electromagnetic spectrum they demonstrate.
2. Students should independently fill in the blanks and then review as a class.
3. Ask: *Why do old plastic toys turn yellow over time?*
4. Remind students that the video explained that old plastic toys tend to turn yellow over time because of UV light which happens to be the right wavelength to break up chemical bonds, causing it to damage many things.

Vocabulary

Electromagnetic waves transmit energy and are capable of traveling through the vacuum of outer space. The energy in electromagnetic radiation is created by the motion of particles creating a field that is both magnetic and electric.

The energy in electromagnetic waves is carried by **photons**- massless units that make up all light and electromagnetic energy.

Photons travel at the speed of light in space and they are described by:

-**Wavelength**- the distance from wave crest to wave crest. Wavelengths have crests (high points) and troughs (low points).

-The number of crests that can travel through a given point in a single second is referred to as the **frequency**.

-**Volts**- the energy in each photon

-**Hertz**- the number of cycles per second

Electromagnetic spectrum- The electromagnetic spectrum represents different forms of electromagnetic radiation. Wavelengths vary from meters to nanometers (billionths of meters). The electromagnetic spectrum ranges from radio waves to gamma rays.

Safety Note:

Adult Supervision Recommended

Watch the companion video here:



Lesson Plan by Whitney Gallagher based on the “Impossible Science” series.

Find more at impossiblescience.com



Electromagnetic Waves and The Electromagnetic Spectrum

Radio waves	Longest wavelengths with lowest frequencies and least energy. 1000s of meters to .001 meter	Broadcast radio and television
Microwaves	Second longest wavelength and frequency	Cell phones, microwave ovens
Infrared waves	Third longest wavelength and frequency	T.V. remotes send out infrared waves
Visible light	400-700 nanometers	The light we see (ROYGBIV)- t.v. and cell phone screens
Ultraviolet light X-rays	Second shortest wavelengths 400-10 nanometers	UV lamps used to sterilize equipment, UV light from the sun
Gamma rays	The shortest wavelengths with the highest frequency and most energy	Used by doctors to kill cancer cells in radiation treatment.

Radio waves have the lowest _____ and lowest energy. They are used in broadcast radio and television.

Gamma waves have the _____ frequency and energy and are the most damaging to tissue. They are used in cancer treatment because they are strong enough to kill cancer cells.

_____ rays are used in television remote controls to communicate with the television.

Visible light is the light we _____.

The energy in electromagnetic waves is carried by _____.

_____ transmit energy and are capable of traveling through the vacuum of space.