



ENGAGING READING!

**GRAPHING,
WORD
PROBLEMS &
MEASUREMENT!**

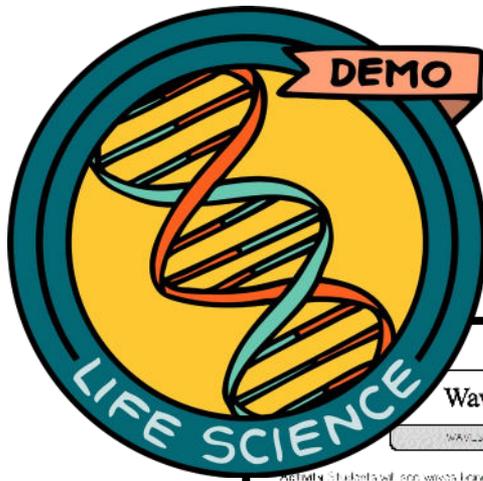
**INQUIRY
SKILLS &
PROCESSES!**

**HANDS-ON
INVESTIGATIONS!**

STEM CHALLENGES!

ALL Station Signage Included!!

Color & Black and White



Teacher guide and answer key offered for every lab!

Easy-to-get materials!



Waves and Energy

WAVES & ELECTROMAGNETIC SPECTRUM

Activity: Students will see waves being created and that they carry energy forward without matter.

Materials:

- nuclear duck
- wide pan of water
- small rock or object to ripple water

Procedure:

Part A: Before the demo

- Draw this image on the board.

Part B: During class

- Ask students to predict where the duck will end up if a rock is dropped at Point X.
- Place the nuclear duck on the surface of the calm water.
- When the water is still, drop the small rock into the pan.
- Have students observe what happened once the rock was dropped and ask if the prediction was correct.

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Discussion questions and teacher set-up included!

Name _____ Date _____

Lab

Build a Spectroscope

WAVES & ELECTROMAGNETIC SPECTRUM

A spectroscope is similar to a prism because it can break light into its component. At one end of the spectroscope is a square film of material that acts like a prism. The film is called a diffraction grating. It is made by putting thousands of grooves on a plastic film. This bends the light coming through it and, in essence, causes the light to spread out into its different wavelengths of light (colors). The diffraction grating sorts light by frequency, with violet light at one end of the spectrum and red light at the other.

Safety: NEVER use your spectroscope to look directly at the Sun.

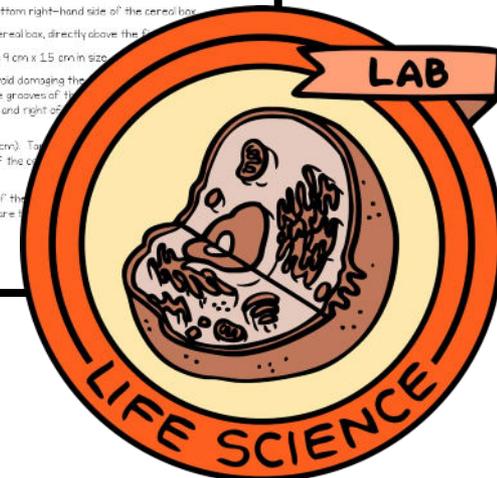
Materials:

- empty cereal box (1.5-1.5 oz)
- diffraction grating (3 cm x 3 cm)
- ruler
- scissors
- aluminum foil
- spectroscope black ruler (cut out)
- colored pencils
- light source(s)

Procedure:

Part I: Build a Spectroscope

- Measure and cut a 2 x 2 cm window from the bottom right-hand side of the cereal box.
- Repeat step 1, but this time on the top of the cereal box, directly above the first window.
- To the left of the upper window, cut a rectangle 9 cm x 1.5 cm in size.
- Pick up the diffraction grating by the edges to avoid damaging the grating. Turn the film so that the grooves of the grating are vertical. The rainbow colors you see should appear to the left and right of the bottom window of the cereal box.
- Cut two rectangles of aluminum foil (2.5 cm x 4 cm). Tape one rectangle over half of the small window on the upper lid of the cereal box.
- Tape the other aluminum foil on the other half of the small window on the upper lid of the cereal box. Make a VERY thin slit (see diagram).





Group members will read a passage and then complete a task to help increase science literacy and deepen their understanding of the science concept.



Gravitational Waves

Have you ever thought about the possibility of traveling in time? Numerous books, movies, and television shows help to fuel our curiosity about being time travelers, but it was difficult to think time travel was possible. Now, thanks to Einstein's theory of relativity, stating that space and time are intertwined (known as space-time), and the discovery of gravitational waves, time travel is mathematically possible.

Almost a century ago, Albert Einstein predicted that space wasn't as rigid as it seemed. Instead, he predicted that space was flexible and influenced by objects and events within it. He suggested that energy from large, violent events in space, such as colliding stars, create ripples in the fabric of space. These ripples cause space to stretch and squeeze back again. Think of space as being a smooth pond. What happens when you throw a rock into the middle of the pond? It creates ripples in the water. This was all a hypothesis until February 11, 2016. After decades of trying to find these ripples or waves, scientists discovered them.

These waves were discovered by the Laser Interferometer Gravitational-Wave Observatory, known as LIGO. A collision of two black holes in light years away emitted more energy than the rest of the fabric of space-time, like a mallet striking a drum, causing LIGO detectors on Earth. LIGO used special mirrors, two in Washington state, that could pick up a small but measurable waves. A statement from Northwestern University claims waves has "launched a new era in astronomy".

Before the discovery, every telescope and observatory in the universe. Now imagine gaining another of your senses. Well, because we cannot only see but also now "hear," gives us another way to see the universe in different wavelengths can show us things that

<p>A</p> <p>What did Einstein mean when he predicted space was "flexible"?</p>	<p>B</p> <p>What event occurred in space allowing LIGO to detect gravitational waves?</p>
<p>C</p> <p>LIGO detected?</p>	<p>D</p> <p>What does the article mean that we can now "hear" the universe?</p>

A. _____

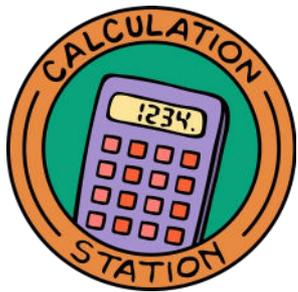
B. _____

C. _____

D. _____

<p>A</p>	
<p>B</p> <p>1. Looking at the image above, what color of light passes through the prism? The least?</p> <p>2. What type of waves is shown above? Why?</p>	<p>C</p> <p>_____ is a satellite used for GPS. What does GPS stand for? What does it do?</p> <p>_____ GPS is used.</p>
<p>Name: _____ Date: _____</p> <p>A1. _____</p> <p>A2. _____</p> <p>B1. _____</p> <p>B2. _____</p> <p>C1. _____</p> <p>C2. _____</p>	

Group members will have images, illustrations, or actual samples at this station that show applications or processes of the science topic.



Group members use their math skills to complete the station challenge. Skills may include graphing, analyzing data, using models, measurement, and calculating formulas or word problems.

Wave Properties

Waves transfer energy from one place to another. Each wave starts at the distance between a point on a wave and the next identical point. For all the waves that travel in the same medium, the number of waves that pass a fixed point in a second times the wave's wavelength is equal to the velocity of the wave. This relationship is expressed by the equation: $\text{velocity (m/s)} = \text{frequency (Hz)} \times \text{wavelength (m)}$

Each square on the graph represents 1 unit.

Answer the following questions on your answer sheet.

1. According to the graph, how many units is the amplitude of the wave?
2. Which letter represents the crest of the wave?
3. Which letter shows the amplitude of the wave?
4. On the graph, draw your answer based on the wave length of 4 units and an amplitude of 2 units.
5. Again, on the graph, draw your answer based on a wavelength of 4 units and an amplitude of 3 units.

Complete the following calculations and write the answers on your answer sheet.

6. An ocean wave has a frequency of 70 Hz, with a wavelength of 10 meters. Calculate the velocity of the wave? Show your work.
7. A tuning fork has a frequency of 250 Hz and the wavelength of the sound produced is 1.3 meters. Calculate the velocity of the wave. Show your work.

Use graphing paper to answer 1-5.



Change That Channel

Challenge: Construct a system to turn on a television that is around the corner.

You use infrared waves everyday. Infrared waves have a wavelength longer than visible light, but shorter than radio waves. Most of today's technology incorporates infrared wave use in equipment. Examples are weather satellites that use infrared data to look for clouds, fire detectors that use infrared signals to sense fires, and remote controls that use infrared signals to turn on a television. Infrared waves are also used in motion sensor devices such as remote controls that emit a narrow beam of infrared radiation to reach a device.

Materials

- cup
- water
- tape
- string
- string
- cardstock paper
- wire paper
- aluminum foil
- glue
- ruler/straight edge
- string
- small objects

Supplies/Equipment

1. Each team will be required to construct a system to turn on a television that is around the corner that meets the following:
 - ✓ Only uses materials listed below.
 - ✓ Must be made by hand.
 - ✓ Must be made by the group.
2. Draw and test your system.
3. Answer any questions.

Testing

All the lines of testing to be used in your design. You are able to test your plan. You are given a chance to test your plan.

Name _____ Date _____

Drawing with labels:

1. Did your plan work? Were adjustments needed during the testing portion? Explain.
2. What other technology do you use that requires the use of infrared waves?

Group members will work together to solve a STEM (Science, Technology, Engineering, Math) challenge by creating models or designs that demonstrate their understanding of the science topic being taught.



This station makes science concepts relevant for students by asking them to imagine scenarios that will bring about discussion and critical thinking.

USER-FRIENDLY PAGES:

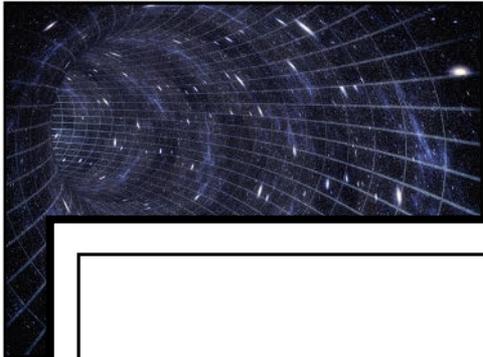
Students easily recognize which answer sheet to use at each station by matching station icons located on each page!



Time Traveler

Directions: Use your imagination to answer the statement below.

IMAGINE scientists were able to use information from gravitational waves to bend time and create time travel.





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Drip, Drop, Splat!

Problem: How do the density of a liquid and drop height affect the size and shape of splatter patterns?

Materials:

- colored water (graduated cylinder A)
- colored syrup (graduated cylinder B)
- eye dropper
- paper
- metric ruler
- meter stick

Procedure:

1. Make a hypothesis of how density of a liquid will affect splatter size on your lab sheet.
2. Place the piece of paper down on the lab table in order to catch splatters.
3. Measure the heights listed in the data table using a meter stick. Place meter stick with end starting at zero on paper and move up stick when increasing height of drop.
4. Use the eye dropper to drop ONE drop of colored water and ONE drop of colored syrup. Make sure to drop on different places on paper.
5. Measure the size of the splatter in MILLIMETERS. Round in data table on answer sheet.
6. Repeat for each height.
7. Use the collected data to graph the splatter size versus drop height for each liquid.

Analyze and Conclude

1. Was your hypothesis correct? Explain.
2. What were two controls in your experiment that helped you collect the most accurate data possible?

Date: _____



Hypothesis

	Drop Height (cm)			
	3	25	50	100
Eye-dropper Water				
Graduated Syringe				

Height of Drop vs Splatter Size

Height of Drop (cm)	Water	Syringe
3		
4		
5		
6		
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Analyze and Conclude:

1. _____
2. _____

TEACHERS SAVE TIME:
Laminate station pages and reuse for each class and for years to follow!

Inquiry and Process Skills

©NGS

Demo
 Guided Inquiry Lab
 Science Stations

Inquiry-Based Science Unit: Waves and the Electromagnetic Spectrum	Classifying	Communicating	Compare & Contrast	Creating Models	Gather/Organize Data	Generalizing	Identifying Variables	Inferring	Interpreting Data and Graphs	Making Decisions	Manipulating Materials	Measuring / Calculating	Observing	Predicting
Waves and Energy	X	X	X			X		X		X	X		X	
Remote Control Issues						X		X					X	
Build a Spectroscope		X	X	X	X		X		X		X	X		X
Information Station: Gravitational Waves					X	X		X						
Observation Station: Images & Questions	X		X		X	X		X					X	
Investigation Station: Wave Speed and Frequency	X		X		X		X		X		X		X	
Calculation Station: Wave Properties					X		X		X	X		X		
Communication Station: Questions	X	X				X				X				
Creation Station: Change That Channel		X		X	X				X	X	X	X	X	X
Imagination Station: Time Traveler		X		X						X				X

NGS Magnified promotes scientific inquiry throughout the curriculum. Students become more confident and effective learners while developing problem-solving and critical thinking skills.

Process skills, such as planning, organizing, and evaluating, help students to complete projects and assignments. These skills allow students to independently gather information, analyze it, and draw their own conclusions.

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