NATIONAL CONSERVATION LANDS

Eastern States

Jupiter Inlet Lighthouse

Outstanding Natural Area

Hands on the Land Lesson Plan

Energy & Waves at the Jupiter Lighthouse

5th Grade

Bureau of Land Management
Jupiter Inlet Lighthouse Outstanding Natural Area
600 State Road 707, Jupiter, FL 33469
561-295-5953
www.BLM.gov/jupiterONA

Lesson Plan

Course: Grade 5 – Science (Energy)

Course Number: Benchmark – Big Idea 10: Forms of Energy

Lesson Plan Date: January 2017

Lesson Title: Energy & Waves at the Jupiter Lighthouse

Time: 1 hour in class and 3 hours on Lighthouse site

Instructor Preparation: (Prior to site visit)
Review Safety Precautions for the ONA
Review Pre-Trip preparations
Pre-view field trip activities
Prepare students with vocabulary and general energy types knowledge prior to site visit.

Site Prep and Equipment:

a. For all field trips please check the Lighthouse and ONA websites at:
http://www.jupiterlighthouse.org/plan/school-field-trips/
www.BLM.gov/jupiterONA
b. **Activity overview:** Students will make observations and inferences regarding the types of energy used for various tasks at the Lighthouse site both historically and currently. Additionally, students will observe several "wave' demonstrations then work in pairs to measure wave frequency and estimate amplitude of surface water waves. Students will need to do a division calculation, dividing the number of water waves they observe by 20 (the number of seconds they will count the waves) and record the answer in Hertz.
c. Students should **define the Vocabulary** and have some knowledge of energy types and waves prior to the site visit. The following web sites may be helpful with this preparation:
Forms of EnergyExplain Powerpoint.pptx – Energy PowerPoint on CPalms.org
http://scienceprimer.com/wave-features - Features of waves
d. **Discuss** with students that electrical energy is typically generated and is **transformed** into other types of energy to perform many tasks.
e. **Make copies** of Energy and Wave sheets for each student, printing should be front and back. The Energy sheet will be done individually and the Wave sheet will be done with a partner. Be prepared to select student partners to work on the Wave measuring activity.

f. **Preview** Energy and Wave sheets with students and explain what they will be doing on the site.

Main Objective:

Students will identify and compare historical and current uses of various energy types on and around the Jupiter Inlet Lighthouse Outstanding Natural Area. Students will also observe, measure and calculate wave frequency.

Est. Time	Visuals and Notes	Content
15 min.	**Pre-Trip Introduction:** Energy Types PowerPoint Forms of EnergyExplain Powerpoint.pptx –	**Show** Forms of Energy PowerPoint from CPalms.org lessons. **Question:** How has the use of the various types of energy changed over time? Anticipated Responses: *Moved from direct use of chemical and mechanical energy by individuals to chemical energy being transformed into electrical energy then back into other forms such as sound, light, heat, and mechanical energy on a larger regional scale.*
15 Min.	**Warm-up:** **Define Vocabulary**	**Vocabulary:** Have students define vocabulary words and discuss. **Amplitude** – maximum amount of displacement from rest to crest (height of wave). **Chemical energy** – energy stored in chemical compounds and released when the chemical bonds are broken. **Crest** – maximum amount of upward or positive displacement. **Electrical energy** – energy caused by the movement of charged particles in an electrical field. **Electromagnetic wave** – waves that can travel through a vacuum or empty space. (examples: light, microwaves, radio waves, and x-rays) **Energy** – The capacity or ability to do work. Can be transferred or converted from one form to another. **Frequency** – number of cycles per second

		Heat or Thermal energy – a form of energy which transfers among particles in a substance (or system) by means of kinetic energy of those particles. **Hertz** – unit of measurement for wave frequency (abbreviated as Hz). 1 Hz = 1 cycle per second **Light energy** – energy carried by waves in the visible region of the electromagnetic spectrum. **Mechanical energy** – energy in an object due to its position or motion. **Mechanical wave** – waves that require a medium or some sort of matter to travel trough. (examples: water waves, seismic waves, and waves moving through a spring or other object) **Sound energy** – the movement of energy through compressional waves that travel in a medium such as water, air or solids. **Troughs** – maximum amount of downward or negative displacement **Wave** – a traveling disturbance that travels through space and matter transferring energy from one place to another. **Wave length** – length of one complete cycle crest to crest or trough to trough. **Work** – the displacement of an object by a force acting upon that object.
10 Min.	**Hook 1:** **Wave Animations** http://scienceprimer.com/types-of-waves	**Visit websites** on waves and show animations explaining to students that on the field trip they will be asked to measure and calculate wave frequency. **Types of Waves –** Mechanical & Electromagnetic
10 Min.	**Hook 2:** **Wave Animations** http://scienceprimer.com/wave-features -	**Features of waves** – Crest, Trough, Amplitude, Explain to students that they will be observing waves and calculating frequency.

10 Min.	**Overview of Field Trip** • Safety • Energy Sheet • Wave Activity	**Main objective**: Students will gain a basic knowledge of Energy Types and Waves, and to be prepared to safely complete the fieldtrip activities.

	http://www.jupiterlighthouse.org/wp-content/uploads/2016/11/School_Tour_Info_Inquiry_2016.pdf https://www.blm.gov/es/st/en/fo/Jackson_Home_Page/jupiter_ONA.html	View Lighthouse and ONA websites for field trip information. Safety Requirements and considerations: a. Chaperones, 1 per 10 students. b. Closed-toe shoes are required for all activities. (old tennis shoes work best for water shoes) c. Bring water, each student should have a water bottle! d. A floppy hat for shade may be helpful. e. Stay with partners/team/group (use the buddy system) f. Be careful of your surroundings: some plants are poisonous or have sharp thorns and some animals may be venomous. g. Don't touch anything you haven't been told to touch. h. Wading only, no swimming. i. Only use the two-way radio for project related communications. j. Follow your groups protocol for emergencies. Call 911 for emergencies k. Report any injury or concern to site staff.
	See Energy and waves Data Sheet See Wave Frequency Activity Sheet	Discuss with students that electrical energy is typically generated and is transformed into other types of energy. Make copies of Energy and Wave sheets for each student, front and back. The Energy sheet will be done individually and the Wave sheet will be done with a partner. Preview Energy and Wave sheets with students and explain what they will be doing on the site.

	Wave Activity (http://scienceprimer.com/types-of-waves - Good moving illustrations)	**Equipment:** a. Data sheets - Energy and Waves. Print one for each student prior to visit. (can be front and back) b. 1 - 25 feet of ½ inch nylon rope for demo (provided on site) c. 1 metal "slinky" toy for demo (provided on site) d. Stop watches one per pair of students (provided on site) e. 1 set - Walkie talkies for demo (provided on site) f. 1 – flashlight for demo (provided on site) g. Binoculars – one per pair of students for wave observation **optional if observing waves from the Lighthouse**.

2 Hrs.	**Field Trip Activities** 1. Energy Types 2. Three Wave **D**emonstrations (D1, D2, &D3) with Follow-up discussion questions. 3. Wave Frequency Activity	1. The Energy data sheet will be completed individually by students as they tour the facility. **Group demonstrations** - instructor demonstrates with student assistance. **D1 Rope waves** – Transverse mechanical wave - wave moves perpendicular to the force placed on the rope. ***Demonstration:*** Select two students for this demonstration. Have students hold each end of the rope and lightly stretch the rope between them at about waist height. With the light stretch on the rope Hit/tap the rope downward at one end and observe the "wave" move across the rope. Hit/tap the rope sideways and again, observe the "wave" move across the rope. The rope can be shaken up and down and observe the "wave" move across the rope in a similar circular fashion to that of a surface wave. **Discuss wave motion observations.** **D2. Slinky waves** – Longitudinal mechanical wave - wave moves parallel to the force applied to the slinky. ***Demonstration:*** Again, select two different students to hold the slinky at each end. ***Gently*** stretch the slinky and have one student push & pull gently from one end and observe the "wave" move across the slinky length wise in the direction of the force. It may work better if the slinky is supported on a table. **Discuss wave motion observations.** **D3. Visible Light, Radio waves** – Electromagnetic waves, can travel through a vacuum and space. Although we can see visible light, we cannot see the waves created by the light. **It is IMPORTANT** to explain to the students that the visible light and radio waves in the case of our demonstrations, are **transformed from electrical energy**, in this case batteries. Electrical energy is created by **charged particles moving** in an electrical field. Also, in the case of the radio waves, students are **not hearing radio waves**, they are **hearing sounds waves (mechanical longitudinal waves) created by the radio device.** ***Demonstration:*** *Prior to this demonstration, two locations meeting the criteria below, will need to be predetermined.*

		Location #1 must in view but beyond speaking voice distance (approx. 50 yards) and location #2 will need to be out of view and out of normal speaking distance (beyond a hill or behind bushes) further than 50 yards. The ***chaperon*** *needs to know the two locations and* ***must accompany students to those spots.*** Select two new students and **one chaperon** for this demonstration. Give a walkie-talkie to one of the students and show them how to transmit then ask them not to do anything with that radio until asked to do so. Have the selected students and chaperone stand within 15-20 feet from the group facing the group and teacher. The teacher will then shine the flashlight towards the students and chaperon and ask them if they can see the light. After their response (*yes*), **ask the group what kind of energy did they see (*light*) what kind of energy produced the light (*electrical*) and what other energy was needed for their response (*sound – not electromagnetic energy*).** Next have the two students and the chaperon move to the first location #1, about 50 yards away and in view of the group. When they are set, the teacher shines the flashlight in the students' direction and in a normal speaking voice asks if they can see the light. There should be no response because they will not have heard the question (*discussion point about sound vs radio waves*). Now, shine the light again and ask on the walkie-talkie if they see the flashlight. The response through the radio should be (*yes*). Now have the students move to the second location #2. Again, shine the flashlight and ask on the walkie-talkie if they can see the light. The response should be (*no*), they cannot see the light. Through the walkie talkie ask the students and chaperon to return to the group. Collect the walkie-talkie from the student and turn them off.

	3. Wave Frequency Measurement Activity See Wave Frequency Activity Sheet	**Demonstration follow-up discussion questions:** What energy made the light and radio waves possible? *Electrical* Which energy source reached the group when they were out of sight? *Radio waves* What three forms of energy di the walkie-talkie use to do its job? *Electrical to radio waves out to the other walkie-talkie, back to electrical energy and out of the second walkie-talkie in the form of sound energy.* Students work with a partner to complete this activity. In this activity, students will be paired and work together to measure the frequency of water wave crests and record the frequency you calculate in Hertz (Hz) or cycles per second. **Each pair of students will need a way to measure 20 seconds.** Students observe water waves, either ocean waves from the top of the Lighthouse or waves from the shoreline of the Intracoastal and follow the methodology on the Wave Frequency sheet also shown below. (wave observation location will need to be determined with Lighthouse staff prior to visit. **Method for wave frequency measurement activity:** 1. Find a mark or point (the beach, pole, marker, buoy, rock) that you can see where the Crest of each wave reaches or hits. 2. As one partner watches the waves and counts the number of crests that hit your mark, the other partner will time twenty (20) seconds.

		3. Complete the items on their sheet (also listed on below): **Number of cycles (crests) counted in 20 seconds = _____** Divide the number of cycles above by 20 to get cycles per second = _____ 1 Hertz = 1 cycle per second. What is your water wave frequency in Hertz? _____ Where did you observe water waves? (check one) Ocean _____ Intracoastal _____ What was the force that caused the water waves you observed? *Either wind of boats* What is the estimated Amplitude of the waves you observed today? *Ocean may be feet and Intracoastal waves in inches*. (don't forget to put the unit of measurement - inches, feet, meters…) **Follow-up questions for both the Energy Types and Wave Frequency activities:** 1. Considering the six forms of energy presented in this lesson, identify the energy types that had played a large role in the history and function of the Lighthouse. *(heat energy & chemical energy – steam energy for transportation, chemical(oil) for the light for the Lighthouse, mechanical for the rotation of the Lighthouse light)* 2. What forms of energy currently have the largest impact on the workings of the Lighthouse? *(electrical energy for the light and rotation of the lenses)* 3. Regarding the Jupiter Lighthouse, two forms of electromagnetic wave energy play critical roles both historically and today. Identify these two forms of electromagnetic waves. *(Light and radio waves)*

		Finish with a review and discussion of answers on both the Energy types and Wave Frequency sheets. **Teacher Resources to follow: Benchmarks, Activity sheets, Helpful websites.** http://www.physicsclassroom.com/class/circuits/Lesson-1/Electric-Field-and-the-Movement-of-Charge The above site discusses electricity http://www.physicsclassroom.com/class/light/Lesson-2/The-Electromagnetic-and-Visible-Spectra The above site discusses electromagnetic spectra and visible light http://www.physicsclassroom.com/Class/waves - Interactive Physics web site waves http://scienceprimer.com/types-of-waves - Types of waves http://scienceprimer.com/wave-features - Features of waves http://www.jupiterlighthouse.org/explore/history/our-pioneers/ - Jupiter Lighthouse web site http://www.ducksters.com/science/physics/waves.php - Physics web site Forms of EnergyExplain Powerpoint.pptx – Energy PowerPoint on CPalms.org http://www.cpalms.org/Public/ - Cpalms web site (Teacher resources) http://www.cpalms.org/Public/PreviewResourceLesson/Preview/46550 - Exploring Forms of Energy lesson plan http://uslhs.org/history/lighthouse-technology - Lighthouse technologies (lenses, lamps and clockworks)

Big Idea 10: Forms of Energy

A. Energy is involved in all physical processes and is a unifying concept in many areas of science.

B. Energy exists in many forms and has the ability to do work or cause a change.

BENCHMARK CODE	BENCHMARK
SC.5.P.10.1	Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical. *Remarks/Examples*: Annually assessed on Grade 5 Science FCAT 2.0. Also assesses SC.3.P.10.1, SC.3.P.10.3, SC.3.P.10.4, SC.3.P.11.1, SC.3.P.11.2, SC.4.P.10.1, and SC.4.P.10.3. *Cognitive Complexity:* Level 2: Basic Application of Skills & Concepts
SC.5.P.10.2	Investigate and explain that energy has the ability to cause motion or create change. *Remarks/Examples*: Annually assessed on Grade 5 Science FCAT 2.0. Also assesses SC.3.P.10.2, SC.4.P.10.2, and SC.4.P.10.4. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
SC.5.P.10.3	Investigate and explain that an electrically-charged object can attract an uncharged object and can either attract or repel another charged object without any contact between the objects. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning
SC.5.P.10.4	Investigate and explain that electrical energy can be transformed into heat, light, and sound energy, as well as the energy of motion. *Remarks/Examples*: Annually assessed on Grade 5 Science FCAT 2.0. Also assesses SC.3.E.6.1, SC.4.P.11.1, SC.4.P.11.2, SC.5.P.10.3, SC.5.P.11.1, and SC.5.P.11.2. *Cognitive Complexity:* Level 3: Strategic Thinking & Complex Reasoning

Access Point for Students with Significant Cognitive Disabilities		
Independent	***Supported***	***Participatory***
SC.5.P.10.In.1 Identify forms of energy, including heat, light, sound, electrical, and mechanical. *Date Adopted or Revised*: 02/08 SC.5.P.10.In.2 Identify ways energy can cause things to move or create changes. *Date Adopted or Revised*: 02/08 SC.5.P.10.In.4 Demonstrate that electricity can produce heat, light, and sound. *Date Adopted or Revised*: 02/08	SC.5.P.10.Su.1 Recognize uses of electrical energy (popcorn popper, vacuum cleaner), heat energy (grill, heater), light energy (sunlight, flashlight), and mechanical energy (bicycle). *Date Adopted or Revised*: 02/08 SC.5.P.10.Su.2 Recognize that energy is required to cause motion. *Date Adopted or Revised*: 02/08 SC.5.P.10.Su.4 Recognize examples of electricity as a producer of heat, light, and sound. *Date Adopted or Revised*: 02/08	SC.5.P.10.Pa.1 Recognize a source of light energy (Sun, light bulb). *Date Adopted or Revised*: 02/08 SC.5.P.10.Pa.2 Initiate a change in the motion of an object. *Date Adopted or Revised*: 02/08 SC.5.P.10.Pa.4 Identify one source of sound, heat, or light that uses electricity. *Date Adopted or Revised*: 02/08

Additional benchmarks:

LAFS.5.RI.2.4 : Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

LAFS.5.SL.1.1 : Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
b. Follow agreed-upon rules for discussions and carry out assigned roles.
c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.
d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

Belongs to: Comprehension and Collaboration

LAFS.5.RI.2.4 : Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
Belongs to: Craft and Structure

Energy & Waves Data Sheet

ENERGY& Waves at the Jupiter Inlet Lighthouse **Name:** _____ **Date:** _____

Using the chart below, identify 2 or 3 places or objects at or around the Lighthouse that exhibit the use, **or have used in the past** for each form of energy and what work that energy is doing.

Heat or Thermal Energy	Chemical Energy	Mechanical Energy

Sound Energy	Light Energy	Electrical Energy

Electromagnetic energy can travel through space and includes visible light. Below, identify two types of electromagnetic energy you observed or learned about in this lesson that have been major parts of the Lighthouse history and purpose.

Type of electromagnetic energy	**Work being done by that energy**

Electromagnetic energy waves can travel through a vacuum and space. Below, identify two types of electromagnetic energy you observed or learned about in this lesson that have been major parts of the Lighthouse history and purpose.

Transformed Energy type	**Work being done by transformed energy**

Some forms of energy perform work through wave energy. Waves that require a medium through which to travel and are often generated by another form of energy are **mechanical waves**. At the Lighthouse site there are mechanical waves every day, some large and some small. Identify this very common mechanical wave and indicate the force that created these mechanical waves.

Mechanical wave name/type	**source of energy that caused this mechanical wave**

Energy & Waves Data Sheet Answers

ENERGY& Waves at the Jupiter Inlet Lighthouse **ANSWER SHEET (answers may vary)**

Using the chart below, identify 2 or 3 places or objects at or around the Lighthouse that exhibit the use, **or have used in the past** for each form of energy and what work that energy is doing.

Heat or Thermal Energy	Chemical Energy	Mechanical Energy
steam transportation	Cooking -burn wood for heat	Weights pulled by gravity to turn light
	burn oil for lighthouse light	Getting water of well bucket & hand pump
		Rowing boats

Sound Energy	Light Energy	Electrical Energy
whistles from boats and train	lighthouse light beam	Lighthouse beam
warning bells on bridge		motor to rotate Lighthouse
		general lighting

Electromagnetic energy waves can travel through a vacuum and space. Below, identify two types of electromagnetic energy you observed or learned about in this lesson that have been major parts of the Lighthouse history and purpose.

Type of electromagnetic energy	Work being done by that energy
Light waves	Light Beam of the Lighthouse
Radio waves	Radio communications

Today, electrical energy is transformed into other forms of energy for many tasks. On the chart below, indicate the type of energy the electricity is being transformed into and the work that energy is doing in or around the Lighthouse.

Transformed Energy type	Work being done by transformed energy
Electric to Light	Lighthouse light beam
Electric to Mechanical	Run motor to rotate Lighthouse lenses
Electric to Sound	Warning bells
Electric to Electromagnetic	Radio and other communications and navigation.

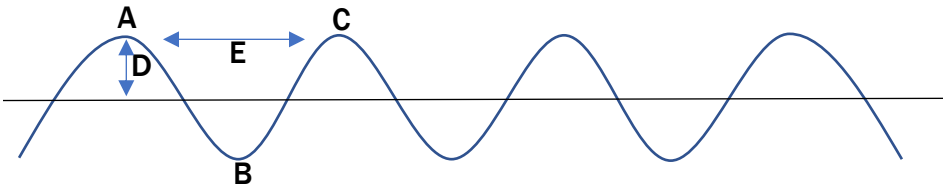
Some forms of energy perform work through wave energy. Waves that require a medium through which to travel and are often generated by another form of energy are **mechanical waves**. At the Lighthouse site, there are mechanical waves every day, some large and some small. Identify this very common mechanical wave and indicate the force that created these mechanical waves.

Mechanical wave name/type	source of energy that caused this mechanical wave
Water Waves	Water waves for this activity are most likely caused by wind or boats.

Wave Frequency Activity Sheet

ENERGY & Waves at the Jupiter Inlet Lighthouse **Names:** _____ **Date:** _____

Wave Frequency: **Partner:** _____



Equilibrium or middle of wave

The above diagram shows a basic (transverse) wave with the center line showing the equilibrium or middle of the wave. The wave parts are as follows:

A & C - labels the ***Crest*** or highest upward or positive displacement.

B - labels the ***Though*** or lowest downward or negative displacement.

D - labels the ***Amplitude*** or wave height which is the highest or most positive displacement.

E – labels the ***Wave Length*** or one complete cycle (A to C).

Frequency is the number of cycles that occur in a period of time, measured in cycles per second. In other words, how often something happens.

Wave demonstration questions:

1. In the Light & radio demonstration, electrical energy was transformed into _____ energy?

2. There are two main kinds of energy waves; one can transmit through a vacuum and one must have a medium through which to move, name the two main types of energy waves:

_____ and _____ .

3. What energy type allows us to control and generate other forms of energy: _____ .

<u>Wave measurement activity:</u> In this activity, you and your partner will measure the ***frequency*** of water wave crests and record the frequency you calculate in Hertz (Hz) or cycles per second. Remember, water waves are **mechanical** energy waves.

Method:

Observe water waves, either ocean waves or waves in the Intracoastal.

1. Find a mark or point (the beach, pole, marker, buoy, rock) that you can see where the ***Crest*** of each wave reaches or hits.
2. As one partner watches the waves and counts the number of crests that hit your mark, the other partner will time twenty (20) seconds.
3. **Complete the items below:**

Number of cycles (crests) counted in 20 seconds = _____

Divide the number of cycles above by 20 to get cycles per second = _____

Hertz = 1 cycle per second. What is your water wave frequency in Hertz? _____ Hz

Where did you observe water waves? (check one) Ocean _____ Intracoastal _____

What was the force that caused the water waves you observed? _____

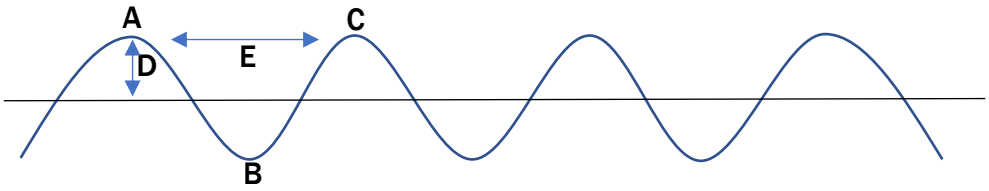
What is the estimated *Amplitude* of the waves you observed today? _____

(don't forget to put the unit of measurement - inches, feet, meters…)

Wave Frequency Activity Sheet Answers

ENERGY & Waves at the Jupiter Inlet Lighthouse **ANSWER KEY**

Wave Frequency:



The above diagram shows a basic (transverse) wave with the center line showing the equilibrium or middle of the wave. The wave parts are as follows:

A & C - labels the ***Crest*** or highest upward or positive displacement.

B - labels the ***Though*** or lowest downward or negative displacement.

D - labels the ***Amplitude*** or wave height which is the highest or most positive displacement.

E – labels the ***Wave Length*** or one complete cycle (A to C).

Frequency is the number of cycles that occur in a period of time, measured in cycles per second. In other words, how often something happens.

Wave demonstration questions:

1. In the Light & radio demonstration, electrical energy was transformed into Electromagnetic energy?

2. There are two main kinds of energy waves; one can transmit through a vacuum and one must have a medium through which to move, name the two main types of energy waves:

Electromagnetic and Mechanical.

3. What energy type allows us to control and generate other forms of energy: Electrical.

Wave measurement activity: In this activity, you and your partner will measure the ***frequency*** of water wave crests and record the frequency you calculate in Hertz (Hz) or cycles per second. Remember, water waves are **mechanical** energy waves.

Method: Observe water waves, either ocean waves or waves in the Intracoastal.

1. Find a mark or point (the beach, pole, marker, buoy, rock) that you can see where the ***Crest*** of each wave reaches or hits.
2. As one partner watches the waves and counts the number of crests that hit your mark, the other partner will time twenty (20) seconds.
3. **Complete the items below:**

Number of cycles (crests) counted in 20 seconds = varies

Divide the number of cycles above by 20 to get cycles per second = based on number above

1 Hertz = 1 cycle per second. What is your water wave frequency in Hertz? same as above Hz.

Where did you observe water waves? (check one) Ocean or Intracoastal may be either

What was the force that caused the water waves you observed? Wind or boats most likely

What is the estimated *Amplitude* of the waves you observed today? varies, may be inches to feet

(don't forget to put the unit of measurement - inches, feet, meters…)

Energy & Waves websites:

http://www.physicsclassroom.com/class/circuits/Lesson-1/Electric-Field-and-the-Movement-of-Charge - This site discusses electricity

http://www.physicsclassroom.com/class/light/Lesson-2/The-Electromagnetic-and-Visible-Spectra - This site discusses electromagnetic spectra and visible light

http://www.physicsclassroom.com/Class/waves - Interactive Physics web site waves

http://scienceprimer.com/types-of-waves - Types of waves

http://scienceprimer.com/wave-features - Features of waves

http://www.jupiterlighthouse.org/explore/history/our-pioneers/ - Jupiter Lighthouse web site

http://www.ducksters.com/science/physics/waves.php - Physics web site

Forms of EnergyExplain Powerpoint.pptx – Energy PowerPoint on CPalms.org

http://www.cpalms.org/Public/ - Cpalms web site (Teacher resources)

http://www.cpalms.org/Public/PreviewResourceLesson/Preview/46550 - Exploring Forms of Energy lesson plan

http://uslhs.org/history/lighthouse-technology - Lighthouse technologies (lenses, lamps and clockworks)