**Middle School STEM Science Lab/Activity Planner**

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| Name of Lab/Activity:Refraction | Grade: 7 |
| California Science Standard(s): 6. Physical principles underlie biological structures and functions. As a basis for understanding this concept:6a. Students know visible light is a small band within a very broad electromagnetic spectrum.6c. Students know light travels in straight lines if the medium it travels through does not change6e Students know that white light is a mixture of many wavelengths (colors) and that retinal cells react differently to different wavelengths.6f. Students know light can be reflected, refracted, transmitted, and absorbed by matter. |
| Common Core Science Reading and/or Writing Standard(s): *Reading:* 3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).9. Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic.*Writing:*4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| Learning Objective/Goal:1. Students will observe refraction using a mirror, water in a clear tub, and sunlight.
2. Students will observe refraction using an opaque bowl, glob of clay, water, and sunlight.
3. Students will observe and note refraction of light from different colored light bulbs using two different kinds of spectroscope.
4. Students will draw their observations and write summaries in their science notebook.
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| Language Objective/Goal: (based on California Common Core Standards)1. Students will follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. 2. Students will determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).9. Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic.*Writing:*4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| Next Generation Science Standards: (please copy and paste any of the 8 Science and Engineering standards taught during this lesson, as well as any Cross Cutting Concepts that apply) |
| Materials & Resources:Colored pencils or crayons, water, opaque bowl, glob of clay (1 to 1 ½” diameter), clear plastic tub, small mirror, piece of white card stock, tube spectroscopes, lamp base and socket, different colored light bulbs.i |
| Procedure:1. Demonstration:
	1. Teacher will demonstrate refraction in class using a clear glass cylinder filled 3/4th with water and adding a pencil to it. The children will notice that the pencil appears bent and offset.
	2. Students will draw a picture of the cylinder, water, and pencil.
	3. Teacher will ask students to explain why this happened.
2. Demonstration:
	1. Teacher will take students outdoors on a sunny day.
	2. Teacher will place a glob of clay in the center of the large opaque bowl. Clay is used because it will stick to the bowl and not move when the water is added.
	3. Several students at a time will stand still around the bowl at a position where they can just see the top of the clay
	4. Students take tiny baby steps backwards until the clay is no longer visible
	5. Teacher will add water to the container without allowing the clay to shift.
	6. Students will notice that the clay becomes visible to them even though they have not moved at all.
	7. Teacher will ask questions as to why this happened.
3. Demonstration:
	1. Teacher will take students outdoors on a sunny day and:
		1. Put water in a clear plastic tub.
		2. Place a mirror in one end at an angle facing the sun.
		3. Hold the white card stock outside the other end of the tub.
		4. Adjust the card until the refracted visible light spectrum is visible.
	2. Students will observe and make a quick draw in their science notebooks of the refracted visible light spectrum on the card.
	3. After returning to the classroom, students will improve and color their drawings.
	4. Groups will have an academic discussion of their observations and the reasoning behind it.
	5. Students will do a quick write in their science notebooks of their observations and the reasoning behind it.
4. Activity:
	1. Teacher will show students a tube spectroscope and discuss the process of its safe use without using the word “spectroscope”. Teacher could use the word “tube” to begin with and let students figure out the real word.
	2. Using white light from an incandescent bulb, students will look through the spectroscope and record the color patterns seen in their science notebooks.
	3. Teacher will change the white light bulb to a red bulb on the lamp. Students will again record their observations.
	4. Teacher and students will repeat the process with a green light bulb and an ultraviolet light bulb (black light).
	5. If the teacher has access to spectroscopes that measure the angstroms of the different colors seen in the spectrum, students will also record that information.
	6. Groups will have an academic discussion of their observations and the reasoning behind it.
	7. Students will do a quick write in their science notebooks of their observations and the reasoning behind it.
 | Teaching Notes: This can be done with either one cylinder/water/pencil for all the students to observe, or one for each group.Keep this simple and short.@ 10 minutesKeep this simple and short.@ 10 minutesKeep this simple and short.@ 10 minutesTube spectroscope kits are available from RAFT, which is near the Santa Clara County Office of Education (SCCOE)Instructions for making tube spectroscopes with CD’s are at:<http://www.youtube.com/watch?v=-cH_2mbsvBo><http://www.youtube.com/watch?v=YStZk2zANvk> |
| Math Connection (Including CCSS Math Practice(s):If the teacher has access to spectroscopes that measure the angstroms of the different colors seen in the spectrum, this is also a math measurement activity.  | Teaching Notes: |
| Technology Used to Extend Learning: 1. Students will use teacher selected websites to research the refraction of visible light and answer teacher generated questions.
2. Students will also generate at least one question that is different than the teacher’s questions.
3. Using GoAnimate.com, students will make a video to explain the refraction of visible light.
 | Teaching Notes: Websites and questions are attached to this lesson. |
| Formative Assessments: 1. Teacher will check drawings and quick writes in the science notebooks.
2. Teacher will check wavelength measurements (if done).
3. Teacher will monitor group academic discussions.
4. Teacher will do a quick scan of answers to the websites’ questions.
5. Teacher will cavelength measurements.eo uthe ollect the student generated questions. These can be used for further instruction or for review prior to summative assessment.
6. Goanimate.com videos will be viewed and peer-edited by groups. Finished videos will be viewed by teacher.
 | Teaching Notes:The websites and questions are at the end of this lesson. |
| Strategies for EL & Special Needs Students (ELD CCSS:1. Drawings
2. Connecting vocabulary with real world experiences.
3. Hands-on activity with the tube spectroscopes
 | Vocabulary:Reflection (of light by the mirror)RefractionBending of light raysWavelengthSpectroscopeSpectrumAngstrom |
| Alignment in science unit: Brief description of lessons taught **prior to** this lab/activity:6a. Students know visible light is a small band within a very broad electromagnetic spectrum.6c. Students know light travels in straight lines if the medium it travels through does not change. |
| Brief description of lessons taught **after** this lab/activity:1. Extend the understanding of the refraction of visible light to explain convex and concave lenses. (Helpful websites - <http://www.srh.noaa.gov/srh/jetstream/clouds/color.htm> and <http://www.physicsclassroom.com/Class/refrn/u14l1c.cfm> )
2. Continue with science standard 6f. *(Students know light can be reflected, refracted, transmitted, and absorbed by matter)* to teach how light is reflected, transmitted, and absorbed.
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| Lab/Activity adapted from: Sandra Yellenberg’s demonstration during STEM training - summer, 2013 | Formative Assessment adapted from: |
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| This lesson was developed by: |
| Kathy Phillips | 7th grade teacher in K-8 school |
| Smita Jayakar | Science Teacher-Middle School |

***Websites for the Formative Assessment***

* **YouTube video – explanation for the refraction of light**
* Stop the video at 3 minutes. The rest of the video goes into the more advanced geometric explanation of refraction.
* This video was made using British English.
	+ Torch = Flashlight
	+ Pronunciation is different for aluminum
	+ Elastic band = rubber band

<http://www.youtube.com/watch?v=kc2o73FyN3I>

Questions:

1. What happens to the speed of light when it enters water?
2. Refraction can make an object appear to be in a (adj) \_\_\_\_\_\_\_\_\_ (noun) \_\_\_\_\_\_\_\_\_.
* **YouTube video of refraction of several rays of lights in a water tank**

<http://www.youtube.com/watch?v=l_AfK4wyXeA>

1. What happens to a single light ray when it shines upwards through the air above the water tank?
2. What happens to a single light ray when it shines upwards through the water in the water tank?