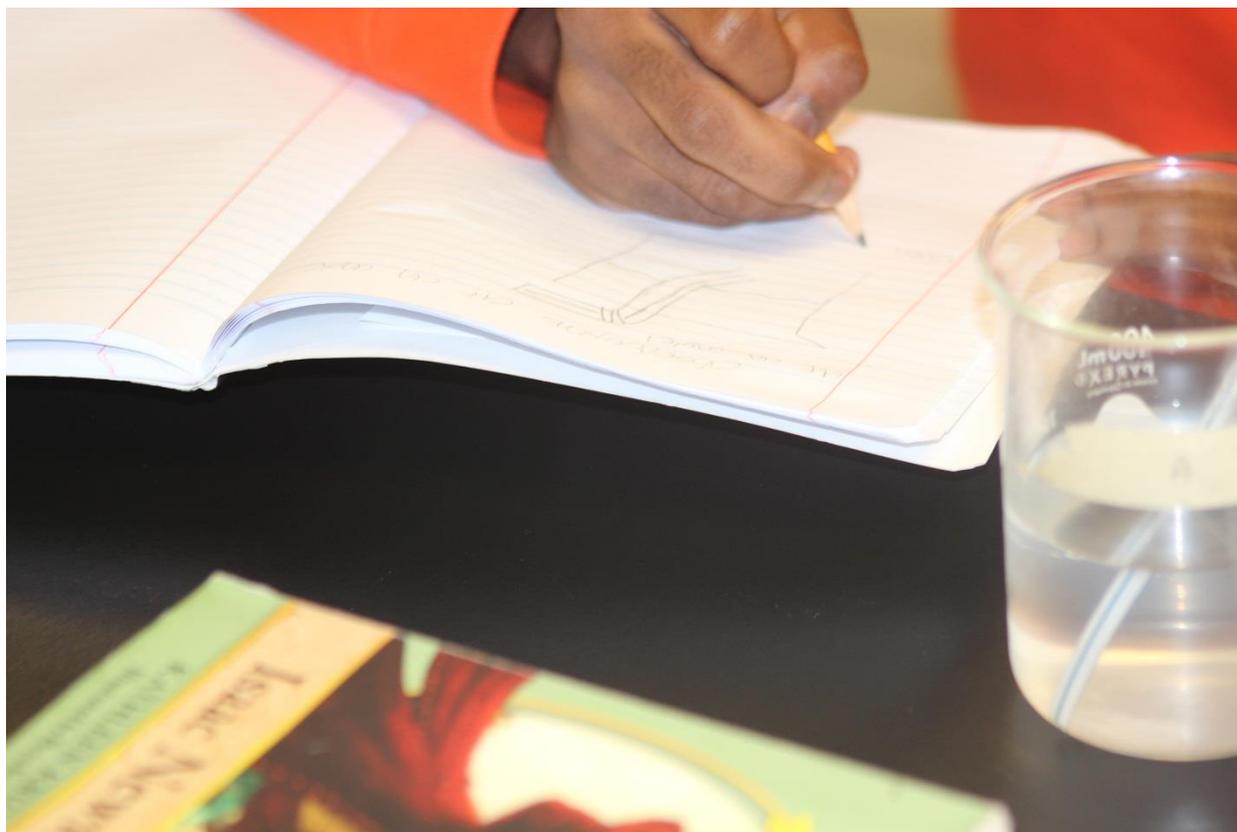


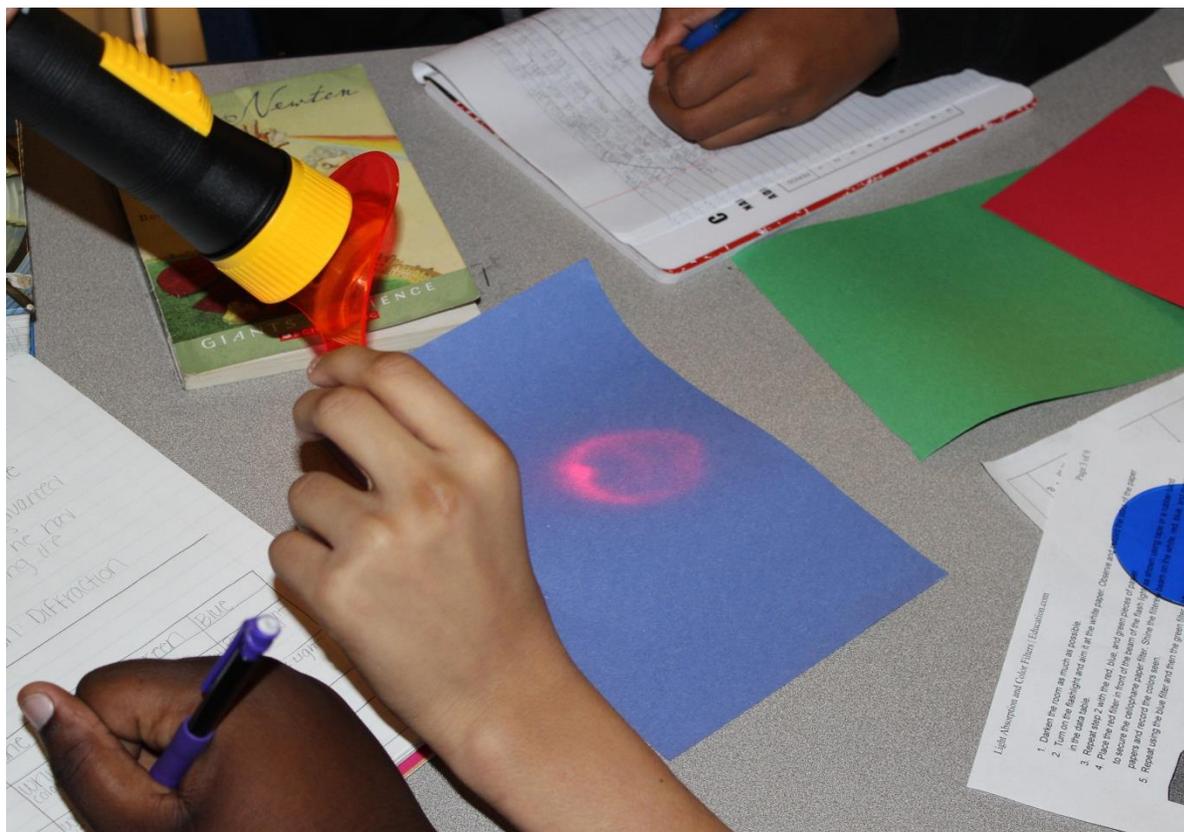
Exploration station for diffraction



<p>Exploration:</p> <p>A Straw's Journey from Air to Water</p>	<p>Place a striped straw in a beaker half-filled with water. Do you observe anything unexpected? Pay particularly close attention to the straw at the point where it hits the water. Describe what you observe.</p> <p><b>Checkpoint</b></p> <p>Reflect 1: Reobserve the situation from a new angle. Again, pay particularly close attention to the straw as it transitions from air to water. Draw and label your observations with the following identifiers: <i>air</i>, <i>water</i>, <i>straw in air</i>, and <i>straw in water</i>. (Accurately draw and label the amount of air and water in the beaker.)</p> <p><b>Checkpoint</b></p> <p>Observe the journey of the straw from air to water from two additional (different) perspectives. For example, consider examining it at eye level with the water, bird's eye view, or at a 45° angle. Use the same kinds of labels as requested in the first reflection. If you recognize a need for additional labels, use them.</p>
<p>Materials</p>	<p>Beaker (half-filled with water) Striped straws (though any solid object will work)</p>
<p>Teacher instructions</p>	<p>Make beakers and straws accessible to students. As with all of the exploration checkpoints, there is also an opportunity to make CCGPS and NGSS an explicit</p>

	part of the instruction. A suggested framework for this exploration is outlined below.
<i>CCSS</i> connections: <i>CCSS.ELA-Literacy.RST.6-8.3</i> and <i>CCSS.ELA-Literacy.WHST.6-8.2.d</i>	To trace the straw’s journey from air to water, students must follow the multistep procedures, recording measurements and labels that require precise language in the explanations they create in their drawings. During the checkpoints, ask questions such as, “Have you included enough information in your drawings for someone else to be able to read them accurately?” or “Would someone else be able to read and understand what you are describing in your drawings?”
<i>NGSS SEP</i> connections: Practice 2 – Developing and Using Models	Students are guided through creating conceptual models that focus on the behavior of light when it encounters a new medium. Since students are in the Explore phase, they do not have the language of light behavior (diffraction) to attach to this model. Emphasizing the unexpected outcomes of students’ observations presents an opportunity to highlight one purpose of models in science: as means for gaining understanding of things that are abstract in one’s mind. With this emphasis, the labels and descriptions students use at each perspective are critical. Discussing with students limitations in this focus and reassuring them that an overarching label will be researched in the next phase supports their continued engagement and interest in the task.
<i>NGSS DCI</i> connections: PS4.B: Electromagnetic Radiation	The purpose of these explorations is to provide direct experience and observations associated with the DCI, behaviors of light waves (reflection, absorption, and transmission). This will be made explicit during the Explain phase of the learning cycle. In encouraging students to begin thinking about these behaviors, you may want to ask questions such as, “What could be happening to make the straw seem like it breaks in the water?” or “How might the outcomes be different if we used a different kind of liquid, such as Kool-Aid, milk, or tea?”
<i>NGSS CC</i> connections: Structure and Function	Interplay between DCI and CC also occur with this exploration. For example, when asking students, “How might this experience be different if we used Kool-Aid, milk, or tea?” you will be asking them to consider how the properties of the materials relate to the way the light interacts.

Exploration station for seeing color



<p>Exploration (modified from <i>Light Absorption and Color Filters</i> at <a href="http://www.education.com">www.education.com</a>)</p>	<ol style="list-style-type: none"> <li>1. Darken the room as much as possible.</li> <li>2. Turn on the flashlight and aim it at the white paper.</li> <li>3. Observe. Record the outcome in the data table.</li> <li>4. Repeat step 2 but aim the light at the red, blue, and green pieces of paper.</li> <li>5. Observe and record the outcomes.</li> </ol> <p><b>Checkpoint</b></p> <ol style="list-style-type: none"> <li>6. Now position the red filter in front of the beam of the flashlight. Aim the red-filtered light at the white paper.</li> <li>7. Observe. Record the outcome in the data table.</li> <li>8. Repeat step 6 but aim the filtered light at the red, blue, and green pieces of paper.</li> <li>9. Observe and record the outcomes.</li> <li>10. Repeat with the blue filter. Repeat with the green filter.</li> </ol> <p><b>Checkpoint</b></p>
<p>Materials needed</p>	<p>Red, blue, and green Filters White, red, blue, and green pieces of construction paper Flashlight Composition books</p>
<p>Teacher instructions</p>	<p>Make filters, paper, and flashlights accessible to students. As with all of the exploration checkpoints, there is an opportunity to make CCGPSand</p>

	<p><i>NGSS</i> an explicit part of the instruction. A suggested framework for this exploration is outlined below. As an instructional side note, the way we see color encompasses absorption <i>and</i> reflection. As you read in the article, this had to be distinguished in follow-up conversations during the Explain phase.</p>
<p><i>CCSS</i> connections: <i>CCSS.ELA-Literacy.RST.6-8.3</i></p>	<p>To explore filtering colors, students must follow the multistep procedures and record the outcomes. During the initial checkpoints, ask questions such as, “Is this what you expected to occur?” At the end of students’ explorations ask, “Does this make you curious about anything else?” or “If you could design your own investigation with filters, what would you want to find out about?”</p>
<p><i>NGSS</i> SEP connections: Practice 1 – Asking Questions and Defining Problems, Practice 3 – Planning and Carrying Out Investigations, and Practice 4 – Analyzing and Interpreting Data</p>	<p>While this particular investigation is very structured, there is great potential for students to plan and carry out an investigation that could answer some of their own questions, especially as time permits toward the end of the time allocated for the Explore phase. (Please see <i>NGSS</i> DCI connections and article for further explanation.) During students’ exploration, it is important to ask questions such as, “What is the (in)dependent variable in this investigation?”; “How is this exploration like a controlled experiment?”; and “What patterns do you see in the outcomes?”</p>
<p><i>NGSS</i> DCI connections: PS4.B: Electromagnetic Radiation</p>	<p>The purpose of these explorations is to provide direct experience and observations associated with the DCI, behaviors of light waves (reflection and absorption). This will be made explicit during the Explain phase of the learning cycle. In encouraging students to begin thinking about these behaviors, you may want to ask questions such as, “What might happen if there were black paper?”; “What might happen if we used something besides solids?”; or “If you have extra time, I want you to plan an investigation for this.”</p>
<p><i>NGSS</i> CC connections: Structure and Function</p>	<p>Interplay between DCI and CC also occur with this exploration. For example, when asking students, “How might this experience be different if we used liquids instead of solids?” you will be asking them to consider how the properties of the materials relate to the way the light interacts.</p>