This resource is a compilation of text, videos, and other elements to create a scaffolded 5E learning experience for students. This is meant for Tier I instruction under the Response to Intervention (RtI) model for grade 5 science TEKS (6)(C). The resource incorporates three levels of learning from how light travels in a straight line, to what materials can light travel through and which it cannot, to culminating in the concepts of reflection and refraction.

Be sure to check for prerequisite knowledge and skills as well as differentiation needs by reviewing the entire resource and the related items before assigning it to or working through it with your students.

This resource can be used for instruction in a variety of ways.

- Use with a single computer and projector; this can be delivered in a traditional classroom.
- Use with a combination of individual student computers and teacher computer and projector (in either a computer lab or other 1:1 environment).
- Assign the resource to students as work to do outside of the school day as part of a "flipped classroom" to allow application, practice, and additional support during the school day.
- Use with students as tutorials.
- Share with parents to inform them about what their child is learning in school.
- Use with students who are unable to participate in the traditional classroom environment.

Engage

Students observe images involving reflection and refraction. This gets students thinking about why distortion occurs.

Classroom Options

- Have students look at the images and do a think-pair-share. Have students record their thoughts in their science notebooks.
- Provide students with additional images that involve reflection and refraction. Have them sort the images into categories based on what they believe is causing the distortion of the image. Have students paste these images onto chart paper or sort electronically using the image files. Revisit these after the Explore/Explain III cycle to check for understanding and allow students to revise their initial thoughts.

Explore I

Students have the opportunity to experience light traveling in a straight line. Students start by thinking about a lunch line and how students travel in a lunch line. They transfer this thinking to watching a video of the three-hole investigation to test whether light travels in a straight line. A student narrates this video.

Classroom Options

- Have students conduct the investigation themselves before watching the video. Putting a Styrofoam cup upside down, cutting a slit in it, and inserting an index card will produce a setup similar to that in the video at minimal cost. Punch holes in the index cards to allow the light rays to travel. You will need to use a laser pointer for this investigation, so be sure to check your district policy on using laser pointers in the classroom and never allow students to aim the light at other students or look directly into the laser beam.

Explain I

The Explain makes the connection of light rays traveling in a straight line unless they are acted upon by something else. This *something else* is called a medium. Medium is specifically mentioned in the student expectation and is critical to students' later understanding of the essential difference between reflection and refraction. Air is the medium that most students forget because it cannot be seen. It is important to remind students that air is one of the major mediums that light travels through on Earth.

Classroom Options

- Allow students to work in pairs or small groups to complete their comparison document. This could also be done electronically using an interactive white board or an online bulletin board program.
- Do a knowledge check using a cloze passage and have students complete it as an exit ticket. Here's an example
    - Light travels in a _____ line. A _____ can allow light rays to travel or not allow them to travel. ____ is an example of a medium we cannot see that allows light to travel.

Explore/Explain II

The word *media* is used here as the plural form of medium. While students will likely not be tested on this specific vocabulary, it is still important to expose them to the vocabulary of the discipline. Students investigate different media they find around their home and test how much light travels through each type of medium. Students should understand the three major types of media: opaque, translucent, and transparent.

This investigation and discussion relate back to 5(5)(A) because students are classifying matter based on physical properties. Students cannot understand the next phase of the resource, dealing with reflection and refraction, unless they understand that there are media through which light can travel and media through which light cannot travel.

Classroom Options

- Create a “buffet” of materials for students to test. Allow groups to select up to six materials. When they have completed the investigation, allow students to have

small-group conversations (2–3 students) with other students who tested the same material but were not in their investigational group. Do this instead of the traditional investigational-group sharing. This mimics what scientists do in the real world and allows students to process their findings.

- Consider creating a realia wall with samples of these media and the categories into which they fit. It is a great visual for students to refer to as they continue the study of reflection and refraction.
- Take students on a scavenger hunt around the school with sticky notes and label things around the building that are transparent, translucent, and opaque. Bring black or dark-blue tablecloths that students can use as a tent in order to darken the location as they test with the flashlight.

Explore III

In the third and final Explore, students will observe in the first video how light behaves when it travels through one medium and, in the second video, how light behaves when it travels through more than one medium. If possible, pull up the resource side by side in two browser windows (not tabs) so that the teacher can pause each of the videos and allow students to see the difference in the behavior of the light rays.

Classroom Options

- Allow students to do these investigations themselves rather than watching the video, if possible. It also is possible to insert another investigation here that is hands-on and illustrates the difference between how light rays behave during reflection versus refraction. Again, if using laser pointers, ensure that the district/campus policy allows student use of these tools.
- Encourage students to draw in their science notebooks what is happening and to label the media involved. This will create yet another visual for students to connect with during Explain III.

Explain III

This is where the words *reflection* and *refraction* come in. At this point in this scaffolded student experience, students now understand light travels in a straight line unless acted upon by a medium; those mediums can be opaque, translucent, or transparent; and this property of matter affects whether the light rays can travel through the medium. Using this knowledge, students can understand that in the process of reflection, light rays traveling through only one medium can reflect off another medium. Students can now understand that in the process of refraction, light rays travel through one medium and through another medium, where the bending occurs. For fifth-grade students, this is the critical understanding, rather than reflection is bouncing and refraction is bending. Students should be able to look at any scenario and ask themselves if the light ray is traveling through one medium or more than one medium.

It is true that reflection and refraction occur at the same time. When we see the image of the duck, refraction **and** reflection are happening. We could not see the duck without the process of reflection. While many advanced fifth-graders may understand this and should be allowed to express that understanding, this duality is likely to be better understood by students with more mature cognitive ability in middle school and later in physics.

Elaborate

Here the students have an opportunity to engage in a hands-on experience with refraction. Students explore the great-billed heron and the archer fish. There are examples of how physical science applies to life science, increasing the relevance of 5(6)(C). What is important here is the application of a physical science concept to life science and understanding that science is not clearly defined disciplines but an interconnected web of concepts.