Next Gen PET

Teaching and Learning Extension K

Explanations and Solutions – Preparation for Lesson 7

Purpose

This extension activity has the following sections.

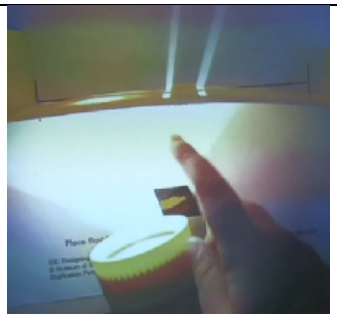
1. Video Analysis Guide. This includes instructions for how to access the video and questions to guide your observations.
2. Transcript of video
3. Reading about NGSS Practice 6: Constructing explanations (for science) and designing solutions (for engineering).

Video Analysis Guide

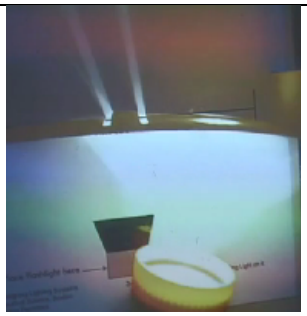
Watch the video *Shedding Light on It (1), grade 3*. This video can be found at http://www.eie.org/eie-curriculum/resources/shedding-light-it-1-grade-3-fairfax-vt

In the video the children made several observations in small groups (from time 1:30-3:55). First they observed that the light from the flashlight went out "like a fan."

The second set of observations were that when they pointed the flashlight at a notecard with a slit and moved the flashlight, the light that goes through the slit appears to move in the opposite direction.



When flashlight pointed to the left, light transmitted through slits angled to right.



When flashlight pointed to the right, light transmitted through slits angled to left.

Use what you have learned in Next Gen PET, to explain the second set of observations (observations in the box above). You may want to draw a diagram to help explain your ideas.

While you watch this section of the video, make notes of what kinds of activities the students are doing and what the teacher is doing to facilitate the students' development of explanations. Pay particular attention to how the teacher brings the attention of the whole class to the second set of observations described above.

Note for video section: time 1:30-4:00

Time	Students Actions	Teacher Actions


How might children use the second set of observations (depicted in the box on page TLk-1) to support the claim that light travels in a straight line?

Later in the video, the children conduct some explorations and determine that the angle of incidence was equal to the angle of reflection when light strikes a mirror (time 5:29-10:10).


While you watch this section of video, make notes of what kinds of activities the students are doing and what the teacher is doing.

Note for video section: time 5:29-10:10

Time	Students Actions	Teacher Actions

 Look at the chart for student expectations for Practice 6 at the end of this extension activity. Which expectations for Practice 6 did you notice students engaged in?

EiE Light Lesson 3 (part 1) Transcript

EiE Light Lesson 3 (1): Shedding Light on It
Transcript

This transcript is for a video that is part of the online resources for the Engineering is Elementary (EiE) curriculum. The video can be found online at

http://www.eie.org/eie-curriculum/resources/shedding-light-it-1-grade-3-fairfax-vt

[00:23.06] Teacher: You are going to take a box and a flashlight. Now the box isn't important to you right now, but what is inside the box are two mirrors, two small mirrors. So I'm going to give you a few minutes to play with the light from the flashlight and the two mirrors.

[00:40.25] Student: Let's see if we can aim it here and make it bounce off here and come over here. Let's see if that will happen. Wait, no. It should be like this.

[00:55.19] Student: So then if it's against the mirror. If the mirror is straight like this, it's not going to be able to. But if the mirror is angled, it's gonna bounce off and hit somewhere else.

[01:07.26] Teacher: What did you notice about the materials you were using this time? The properties of the materials you were using this time?

[01:15.13] Student: We had to angle it a different way and it had to um. It was shining on the ceiling.

[01:21.25] Teacher: The flashlight wasn't, but because of the angle you had the mirror

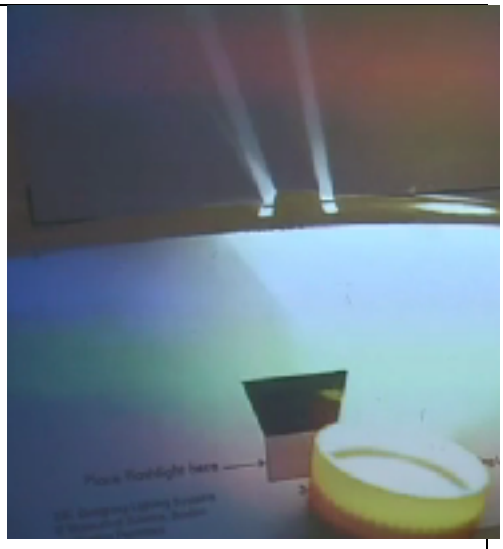
[01:29.26] Student: It bounced off.

[01:30.25] Teacher: It bounced off. It reflected. Yes. All right take a look up front. In your boxes you have this card that looks like mine and you are going to take Card A - that's the card that has the two slits. You're going to want to place it at Card A - the line for Card A right here. You're going to want to see what the light does when you shine it on the card.

[02:10.11] Student: It looks like a fan. So Now let/s

[02:14.25] Student: It looks like a sunset.

[02:17.05] Student: Card A
[02:21.07] Teacher: If you can hear me, clap once.
[02:23.01] Teacher: you are going to add card B which has one slit. I want to hear your predictions.
[02:33.05] Student: It will stop right. It will stop and it won't go through the little slot because the little line's in the middle and that's in the middle. So I don't think it's going to go through
[02:45.29] Teacher: so try it.
[02:50.00] Student: Can we put it in this way
[02:54.16] Student: Oh right
[02:54.16] Student: I knew it.
[02:56.26] Teacher: Is it coming through both these slits in to this one or is it one slit going into one.
[03:02.20] Student: I think it's one.
[03:04.16] Student: I think it's both.
[03:06.02]Teacher: Flashlights off. I heard some very interesting things happening here. And what happened. I didn't get to talk to all the groups. What did happen?
[03:22.25] Student: The light is shining here and depending on where I'm moving it, that's where these two holes are coming. They're going the opposite direction I move it.
[03:31.05] Teacher: Did you notice that. If you move the flashlight, then it was where those light

			
		When flashlight pointed to the left, light transmitted through slits angles to right.	**When flashlight pointed to the right, light transmitted through slits angles to left.**

[03:39.13] Teacher: I need you to think about everything that you did today. Because, when you come back, when I see you again tomorrow, I am going to ask you, "Which one of the things that we know about light fit what we did today?"

The Following Day

[03:55.04] Teacher: Remember what we did when you were shining the flashlight through card A with one slit and card B with two slits. The question we were trying to answer is "How does light travel?"

[04:09.10] Student: light travels in a straight line.

[04:12.27] Teacher: okay, which we saw on our what do we know. You're going to work a little bit with mirrors today, to just further our knowledge about how light travels. So you each have your box. or each group of three will have your box with a mirror on it. And you will have, and I'll put this up here for you to see. And you're going to get it - An Angle of Reflection Test 1. Make sure you keep track of those, because you are also going to get an Angle of Reflection Test 2.

[04:51.09] Teacher: Now what you need to do down here is predict, kind of an educated guess, what letter do you think the reflected light will hit?

[05:03.16]Student: What do you think? I think it's going to bounce - I'm pretty sure you know it's not going to bounce off here so it can only bounce off C, B, or A.

[05:17.00] Student: C

[05:29.11] Teacher: now I have a challenge for you within this challenge. And this is optional. This is not a "have to have" but are any of you protractor trained? Usually that's not something that happens in third grade. It's not until like 4th or 5th that you become trained in using these. This is mine. And the purpose of this is to measure angles. So, I would encourage you just to try it.

[06:01.04] Student: I think that that lines up.

[06:10.03] Student: what went like

[06:12.21] Student: Well I kind of agree it kind of went

[06:14.04] Student: Yeah me too

[06:14.28] Student: Because the first time we did that, it's actually true because it went here.

[06:20.14] Student: Yeah but I think it's B.

[06:22.08] Student: that's what I'm saying
[06:30.17] Teacher: So on the green line, here, there it goes. There you got it.
[06:38.11] Student: ours hit C
[06:39.13] Student: Ours hit C but it was in front. The mirror was
[06:44.13] I Student: It's on A.
[06:45.01] Teacher: What's your final conclusion?
[06:45.25] Student: A
[06:47.04]Teacher: A? What do you guys think?
[06:47.26] Student: A
[06:49.12] Teacher: Okay
[06:50.18] Teacher: In your notebook, you have a perfect picture of a light ray beaming into a mirror, reflecting off and beaming out, but there's special names that they've attached to the names of those angles. So where the flashlight is going into the mirror, that angle inside called there is called what?
[07:20.21] Student: incidence
[07:23.03] Teacher: It's called the angle of incidence. And the angle that's inside there right here is called
[07:32.23] Student: Angle of reflection.
[07:34.02] Teacher: Yes, Angle of reflection. So now we have new language to use.
[07:34.02] Student: We have a second test to do now. Okay predict first. Go to that page where you predict and then do the test.
[07:45.24] Student: I'm just going to write.
[08:02.08] Student: We all guess B
[08:02.08] Student: I think A because it's closer and it will go like farther away.
[08:05.28] Student: It's B.
[08:09.21] Student: B. Okay
[08:14.21] Student: Do you want me to tell you why it was B?
[08:21.02] Student: Because look, because when it goes right there, no matter how far away, it goes like that far away it (draws), that far away it (draws).
[08:33.02] Student: So 40 degrees.
[08:36.13] Student: And 40 degrees
[08:36.13] Student: And 40 degrees!
[08:38.03] Student: 40, 40
[08:38.03]Teacher: There it goes. It goes right - did you see that? It went right on B. B is 40 and you said B coming out is
[08:48.23] Student: It's right there. It's 40, 40.
[08:51.14] Teacher: Okay nice.
[08:54.09] Student. Yes.

[08:54.25] Teacher: That's a nice beam you have going there

[08:57.00] Student: We got

[09:00.20] Student: Yep, our answer is B.

[09:05.14] Teacher: You did a nice job. Now it's time to reflect. Our brains reflect too, just like light. What did I just see happen with the angle of incidence and the angle of reflection? Yes?

[09:15.20] Student: Um, it that - the angle of incidence and the angle of reflection - they kept matching up.

[09:29.01] Teacher: Okay, did you hear that? What she noticed was the angle of incidence and the angle of reflection are matching up. This is when she then says, she uses her data and says, "for example"

[09:43.17] Student: For example, we got 40.

[09:51.05] Teacher: For example, the angle of incidence in test 2 was 40 degrees and the angle of reflection was 40 degrees.

[09:57.06] Student: Well they have their own lines of symmetry down the middle.

[10:07.01] Student. If you split it in half where the C is, it's a line of symmetry.

[10:10.16] Teacher: That is another way. If we did not want to use our protractor - but you were all brave souls and you all did it anyway, we could have folded the paper at line C and did they match up? Yeah. Excellent

Teacher reflection interview

[10:30.06] What amazed me about the angle of incidence and reflection was that it was the students themselves that brought up the symmetry. We were using a protractor, but they could see that if they fold up the paper, the light - it is symmetrical, the way the angle in and the angle out. So that was really exciting to me. And they were able to pull up some of that knowledge that they had about their math. They were able to identify the angles as acute or obtuse. And very easily with the protractors that were provided in the kit, they could read the protractor. For 3rd grade, that is to me, that is fantastic.

Next Gen PETLC

Teaching and Learning Extension K

Practice 6 Expectations

Constructing Explanations and Designing Solutions

*"The **goal of science is the construction of theories that provide explanatory** accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories" (NRC Framework, 2012, p. 52).*

*"In **engineering the goal is a design** rather than an explanation. The process of developing a design is iterative and systematic, as is the process of developing an explanation or a theory in science" (NRC Framework, 2012, p. 68).*

Grades K-2 Expectations	Grades 3-5 Expectations
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence- based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. • Generate and/or compare multiple solutions to a problem.	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.