CaSTL

Apples in the Dark

Boys and Girls Club After School Science
NSF Center for Chemical Innovation
Chemistry at the Space Time Limit (CaSTL)
https://www.castl.uci.edu/

Standard(s) Addressed: Physical Science

Light has a source and travels in a direction. As a basis for understanding this concept:
a. Students know sunlight can be blocked to create shadows.
b. Students know light is reflected from mirrors and other surfaces.
c. Students know the color of light striking an object affects the way the object is seen.
d. Students know an object is seen when light traveling from the object enters the eye.
e. Students know that for an object to be seen, light emitted by or scattered from it must be detected by the eye.
f. Students know light travels in straight lines if the medium it travels through does not change.
g. Students know that white light is a mixture of many wavelengths (colors) and that retinal cells react differently to different wavelengths.
h. Students know light can be reflected, refracted, transmitted, and absorbed by matter.

Lesson Objective: The purpose of this probe is to elicit student's ideas about how we see objects. The probe will assist the teacher in finding out if students know that light must be reflected off an object and enter the eye in order for a non-light-emitting object to be visible. This probe will help teachers identify various conceptual models students use to link the role of light to vision.

Materials: You will need to have access to a totally dark room, an electrical outlet, different colored light bulbs, light fixture, colored markers, a red apple or various different colored objects, probe 2 taken from Keeley book (see reference below)

Student Talk Strategies: (Descriptions at end of lesson)

- Numbered Heads
- Report to a Partner
- Think-Pair-Share

Classroom Management: Discuss the appropriate behavior in the room when the lights go out. Children need to keep their hands to themselves. It is best if space is available to have children sit on the floor. You may have to do this activity in small groups therefore teaming with another teacher to allow both groups sufficient supervision.

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ENGAGE: ***Connect to Prior Knowledge and Experience, Create Emotionally Safe Learning Environment, Preview New Vocabulary*** **Estimated time: 10 minutes**		
Teacher's Role	**Teacher Questions**	**Students' Role**
1) Teacher passes out the probe, instructing students to work independently.	1) Teacher reads the probe and asks students to write their explanation on the paper. How would you see an apple in the dark?	1) Students listen to the probe, read choices, select one statement and write their explanation.
2) Teacher asks students to number off 1-4 to use the Numbered Heads student talk strategy. Teacher will begin by instructing the students to take turns sharing and listening. Students know that one of them will randomly be selected to share their group's thoughts.	2) Numbered Heads: Students count from 1 to 4 and discuss the question. Teacher calls a number from each group to share ideas. Students are prepared to share out to the class about group's thoughts.	2) Students number off to form their groups. Each student takes a turn sharing out while others in the group listen using Numbered Heads.
3) Teacher sets a 4 minute timer. Each student gets a minute to explain their choice. Teacher will inform them when each minute passes to switch to the next student. When timer goes off teacher calls out a number and the student that has that number will share out.	3) You have 4 minutes to share out therefore each of you will get 1 minute. I will say, "time" after each minute which will be the signal to switch to the next student."	3) The student whose number is called will stand up and share the group's thoughts.

EXPLORE: ***Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding*** **Estimated time: 20 minutes**		
Teacher's Role	**Teacher Questions**	**Students' Role**
1) Teacher describes the investigation to the students.	1) Let's find out if your choice is correct. We will go into a	1) Students will go into a room with the teacher and

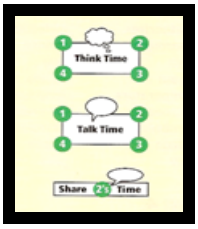
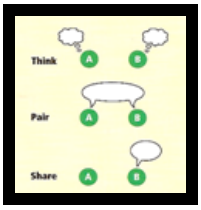
Teacher takes students into a room that will be totally dark when the lights are turned out. If it is in a small space teacher will take students in small groups. Students will be instructed to go back to their group and report their findings using Numbered Heads. Teacher will repeat the timer to keep students focused.	room that will be totally dark when we turn out the light. Make your observation about seeing the apple and be prepared to discuss it with your group when you return.	report their findings about their ability to see the apple.
2) Encourage students to think about their observations, and discuss reasons that could explain why their experience did not match their prediction.	2) Go back into your groups using Numbered Heads and discuss what you saw. If you would like to change your answer, share why.	2) Students will return to their groups, using Numbered Heads to share their observations.
3) Teacher will call out a number 1 to 4 and that student will share the findings of the group. **This is a good place to stop the lesson. Continue lesson the following day or as soon as possible.**	3) Number 2 will you share the findings of your group. Were there any "Ahas?"	3) Student 2 will share if the group made any changes to the original choice and why.
EXPLAIN: ***Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding***		**Estimated time: 20 minutes**
Teacher's Role	**Teacher Questions**	**Students' Role**
1) Teacher opens the discussion with a question.	1) What must be present for us to see? What did we learn from the experiment yesterday?	1) Student's responses will vary. Desired response is: *Light must be present in order for us to see*.
2) Teacher asks students to name all the light sources they can think of and records them on the board or chart.	2) What light sources can you think of? Report to a partner- Each student reports his/her own answer to a peer. The students then listen to their partner's response. Both will report what partner shared when prompted.	2) *the sun, light bulbs, lamps, fire, street lights, car headlights*

EVALUATE: ***Thinking Maps, Summarize Lesson and Review Vocabulary, Variety of Assessment Tools, Games to Show Understanding***		**Estimated time: 15 minutes**
Teacher's Role	**Teacher Questions**	**Students' Role**
1) Teacher will ask students to draw directional diagrams that include a light source, an object, and the eye to show how the eye sees an object. Students will then share their diagrams with a partner.	1) Using a blank piece of paper, draw a diagram of how our eye sees that includes a light source, an object, and the eye. Don't worry about your ability to draw. Do the best you can and the direction the light is traveling using arrows. Once students are finished with their diagrams have them Report to a Partner**.** Share your diagram with a partner.	1) Students will draw a diagram of how the eye sees. Report to a Partner –share your diagram and explain the process of how we see.
2) Teacher gives the students the probe from the Engage one more time to check for understanding after the investigation.	2) Look at your response in the probe. Do you agree with your answer? If you do not agree, then change your answer to fit your new understanding.	2) Students work independently to show what they now understand about how we see. If they want to change their explanation, then they can cross out their first answer (DO NOT ERASE!) and write their new answer below the original.
EXTEND: ***Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas***		**Estimated time:30 minutes**
Teacher's Role	**Teacher Questions**	**Students' Role**
1) Teacher opens a discussion: How do we see color?	1) If we went back into the small dark room and added a minimal amount of light would you be able to see color? Why? or Why not? Turn to your partner: Think, Pair Share: Share with the person next to you what you think and report to class.	1) Students will write their prediction and **Think, Pair, Share** with a partner.
2) Teacher takes the students to a dark room, turns out the lights and passes a bag of colored markers around. Each	2) While the lights are out, teacher will pass a bag of markers around. Students will take one and hold onto it. The	2) Students will take a marker from the bag. They will look at it with minimal amount of light. Then write what color

student takes one. Students will be asked to name the color of their marker. Then they should write the color name on their hand as proof they guessed correctly. Teacher then turns on the overhead light. Students compare their guess to the color they have. 3) Teacher probes to check for student understanding.	teacher will turn on a small light and ask "I want you to see if you can tell what color your marker is now that I have turned on the light. Write on your hand the color you think it is as proof to others. Report to a Partner your observations. 3) Close your eyes and think about a time you got up at night to walk to the bathroom with only a night light on or a time you went on a night hike. Were you able to see the colors of the rug or the color of the leaves?	they think they have on their hand. After teacher turns on the light, students will Report to a Partner their findings. 3) Students will Think, Pair Share *No, everything looked gray*.

Student Talk Strategies

Adapted from *Avenues* (1997). Hampton Brown.

Numbered Heads 	• Students number off within each roup. • Teacher prompts or gives a irective. • Students think individually about The topic. • Groups discuss the topic so that Any member of the group can report for the group. • Teacher calls a number and the Student from each group with that number reports for the group.	• Group discussion of topics provides each Student with language and concept understanding. • Random recitation provides an opportunity for evaluation of both individual and group progress.
Think, Pair, Share 	• Students think about a topic suggested by the teacher. • Pairs discuss the topic. • Students individually share information from their discussion with the class.	• The opportunity for self-talk during the individual think time allows for the student to formulate thoughts before speaking. • Think time allows students to think about the concepts and the language before producing. • Discussion with a partner reduces performance anxiety and enhances understanding.
Report to a Partner 	• Each student reports his/her own answer to a peer. • The students listen to their partner's response. ("Turn to a partner on your left." "Now turn to a partner on your right" etc.)	• This allows students to talk to different students in the class and gives each student an opportunity to share and listen to various answers and language structures. • Talking one-on-one with a variety of partners gives risk free fluency practice. • Students practice speaking and listening.

Teacher Background Knowledge

We cannot see without light. In order for us to see, light rays hit an object and reflect into our eye. Once the light travels through the lens of the eye, it bends or refracts then forms an upside down image on the retina.

White light contains wavelengths of electromagnetic energy that correspond to the colors: red, orange, yellow, green, blue, indigo, and violet. We can see color because, when white light hits an object, the object absorbs all the wavelengths of color except the color that reaches our eye. When light is limited to a night light in a dark room or moonlight at night, there isn't enough light to reach the cones in our eyes. These structures in the back of our eye detect color. Therefore, we see objects as shadows, shapes or outlines. The rods in our eyes allow us to detect these in low light.