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A constructivist approach to teaching 'Light'

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A. Constructivism in science education

Constructivism: A theory which says that people construct their own understanding and knowledge through experiences of the physical, biological and social world, and through reflection on those experiences.

Constructivist teaching practices: Students use active techniques – like experiments, real-world problem solving and reasoning – to construct understanding. They reflect on observations, raise questions and talk about what they are doing and how their understanding is changing. The teacher tries to ascertain the students' preconceptions and ways of thinking, then guides the activities to address and build on these, towards a robust understanding of science.

Below are some simple real-world observations and problem situations related to 'light'. Reflect (!) on them, notice the preconceptions they may reveal, and think of how you and the students together could use such situations to co-construct your understanding of light.

B. Naive ideas about 'light' and 'vision'

1. When playing hide-and-seek, young children sometimes "hide" by covering their eyes with their hands. Why do you think they do this?
2. We say, "the sun peeped out of the clouds" or, "the stars looked down from the sky" or, "her eyes lit up". Think of such idioms in your own language.

C. Light and dark

1. You are in a lighted room and your friend is on a dark street outside. Can you see the friend better or can the friend see you? Explain why.
2. How will you explain to a child the difference between 'light' and 'dark'?

D. What are 'rays'?

Do simple, no-equipment demos to check the following statements. Use diagrams to analyse and reflect on your experiences.

1. You are watching a football match through a hole in the compound wall. Will you see better with your eye close to the hole or away from it? Explain with a diagram.
2. Why can we not see "around the corner" of an obstacle? Explain with a diagram.
3. A lighted bulb may be behind an obstacle but you can guess that it is there. How could that be so? Under what conditions would it be easy or difficult to guess if the light bulb is there?
4. My elder sister told me that a beam of sunlight emerging from a hole is as wide as the hole. (Is this correct? Does it hold true if the source is a light bulb?) As the hole is made smaller the light beam will get narrower. Ultimately will we get a 'ray' of light? Why or why not? What does this experience tell us about the nature of light?

E. Light and shadows

1. Two point sources of light are kept in front of a ball. There is a screen behind the ball. Show with a diagram the shadow of the ball on the screen.
2. Now change the point source to an extended source, and again draw the shadow. How is it different from the first situation?
3. Try to experimentally confirm your diagrammatic inferences. Explain any differences between your actual and expected shadows.

F. Plane mirrors

1. A small rectangular plane mirror is given to each of you. Tape over its sharp edges. Play with the mirrors; place different objects in front of them and write down as many observations as you can.
2. Draw a schematic of the plane mirror. Indicate the region where an object can be placed in order that its image is formed. As a challenge - in this and the next questions **(F.3 - F.5)** imagine the 3-D shape of the region with a rectangular or a circular mirror. Does it matter how far away is the object from the mirror?
3. In the next schematic show a point object in front of the mirror. Indicate the region from where the image of an object will be seen.
4. In the next schematic draw an eye in front of the mirror. Indicate the region where a point object can be placed so that the eye can see its image.

5. In the next schematic indicate the region where an eye can be placed so that it can see its own image.

6. Try two mirrors placed at different angles with an object between them. How many images do you see? Predict the number of images with the help of diagrams (try 90°, 60°, 45°, 30°, 15° and 0° angles between the mirrors). Find a formula to predict the number of images as a function of the angle. Under what conditions does the formula hold? Try it for the angle 120° and comment on the results.

7. Hold a plane mirror in your hand and let sunlight (or any bright light) fall on it, so that a patch of reflected light is seen on a nearby wall. Try to keep the patch steady. Why is it so difficult to do this? Check your guess with the help of a diagram.

Did you enjoy these 'constructivist' learning situations? Do you think they could lead to effective science learning? Where in the process does the teacher need to exercise judgement? Estimate the time, material and information resources that you would need to follow through with this approach. What implications do you see for pre and inservice teacher education?

G. References

http://www.thirteen.org/edonline/concept2class/constructivism/

J. Ramadas: **Curriculum Development in Science Relevant to the Indian School System**, Ph.D. Thesis, Universiy of Poona, July 1981.

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