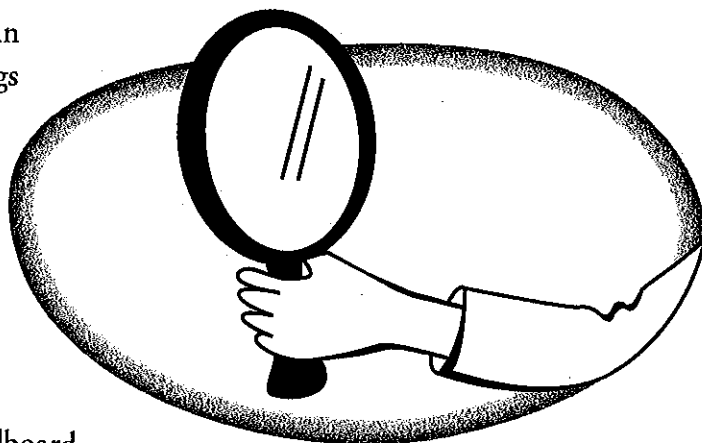


Can It Reflect Light?

What types of objects or materials can reflect light? Put an X next to the things you think can reflect light.

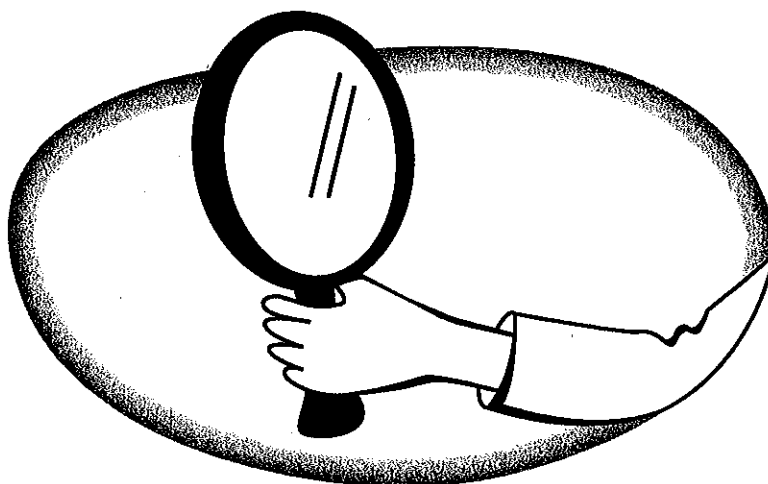


- | | | |
|---|--|--|
| <input type="checkbox"/> water | <input type="checkbox"/> dull metal | <input type="checkbox"/> milk |
| <input type="checkbox"/> gray rock | <input type="checkbox"/> red apple | <input type="checkbox"/> bedsheet |
| <input type="checkbox"/> leaf | <input type="checkbox"/> rough cardboard | <input type="checkbox"/> brand new penny |
| <input type="checkbox"/> mirror | <input type="checkbox"/> the Moon | <input type="checkbox"/> old tarnished penny |
| <input type="checkbox"/> glass | <input type="checkbox"/> rusty nail | <input type="checkbox"/> smooth sheet of aluminum foil |
| <input type="checkbox"/> sand | <input type="checkbox"/> clouds | |
| <input type="checkbox"/> potato skin | <input type="checkbox"/> soil | |
| <input type="checkbox"/> wax paper | <input type="checkbox"/> wood | |
| <input type="checkbox"/> tomato soup | | |
| <input type="checkbox"/> crumpled paper | | |
| <input type="checkbox"/> shiny metal | | |

Explain your thinking. Describe the "rule" or the reasoning you used to decide if something can reflect light.

Can It Reflect Light?

Teacher Notes



Purpose

The purpose of this assessment probe is to elicit students' ideas about light reflection off ordinary objects and materials. The probe is designed to find out if students recognize that all non-light-emitting objects that we can see reflect some light or if they believe that only certain types of objects reflect light.

Related Concepts

light, reflection

Explanation

Assuming all of the objects on the list are visible to an observer, the best response is "All of the objects on the list can reflect light." The objects and materials on this list can be seen when light is reflected from the object or material and enters the eye. When we can see a

nonluminous object, we know that some or all of the light striking the object is reflected to our eye. Otherwise we would not be able to see it. Most materials will absorb some wavelengths of light and reflect the rest. This accounts for why we see different colors. When we see white, all colors have been reflected back. Materials that absorb all light and reflect no light appear black. Black is the absence of light. Black objects whose features you can actually see do not absorb all the light that falls on them. With these objects, some reflection at the surface allows you to see their features. Some materials clearly reflect light better than others. Ordinary mirrors and light, shiny, smooth objects reflect light to the observer because the light bounces off the surface at a definite angle. When light hits rough surfaces, such as paper or rock, it is scattered and bounc-

es back in many different directions. This scattering makes some objects appear dull.

Curricular and Instructional Considerations

Elementary Students

Knowing that light can be reflected, refracted, or absorbed when it comes in contact with an object or material is a grade-level expectation in the national standards. Students at this age engage in learning opportunities that involve examining the properties of a variety of objects and materials. The probe is useful at this grade level for examining how students connect their ideas about certain observable properties of objects and materials to ideas about reflection of light. It is important for students to develop the generalization that all visible objects reflect some amount of light, an important prerequisite to understanding how vision works (a topic that is traditionally studied in middle school).

Middle School Students

Students develop an understanding that non-luminous objects are seen as a result of light being reflected off the object and entering the eye. This idea is a grade-level expectation in the national standards. However, they often fail to recognize the closely linked idea that if you can see something, then it must be reflecting light. This notion explains why each of the visible objects on the list reflect some light. Middle school students typically engage

in learning activities that examine the directionality and angle of light as it passes through or reflects off objects. They frequently engage in activities that use mirrors. They use ideas about reflection and absorption to explain how colors are seen. At this level the probe is useful in determining whether students are “context-bound” in their thinking or if they are making the generalization that an object, regardless of the type of material or color, is reflecting some light if it is seen by the eye.

High School Students

Students develop more sophisticated ideas about light reflection and optics. They may, however, still be context-bound or persist in their intuitive notions that certain characteristics of objects, such as dull or bumpy surfaces, inhibit light reflection. The notion of light reflection by ordinary objects is fundamental to optics instruction and is used to understand image processes such as photography.

Administering the Probe

Be sure students are familiar with the objects on the list. Ask them to cross out any word or object they are unfamiliar with. You might consider explaining, or showing an example of, an object if students are not sure what it is. This probe can also be used as a card sort. In small groups, students can sort cards listing each item into two groups—those that reflect light and those that do not reflect light. Listening carefully to students’ discussions with each other as they sort can lend insight into their thinking. This probe can be combined with “Apple in

the Dark” to further examine students’ ideas about the role of light.

or material. Light can be absorbed, redirected, bounced back, or allowed to pass through.

Related Ideas in National Science Education Standards (NRC 1996)

K-4 Properties of Objects and Materials

- Objects have many observable properties.

K-4 Light, Heat, Electricity, and Magnetism

- ★ Light can be reflected by a mirror, refracted by a lens, or absorbed by an object.

5-8 Transfer of Energy

- ★ Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). For a person to see an object, light from that object—emitted by or scattered from it—must enter the eye.

Related Ideas in Benchmarks for Science Literacy (AAAS 1993)

K-2 Structure of Matter

- Objects can be described in terms of their physical properties (color, texture, etc.)

3-5 Motion (New benchmark from “Waves” map in Atlas of Science Literacy [AAAS 2001])

- ★ Light travels and tends to maintain its direction of motion until it interacts with an object

6-8 Motion

- Light from the Sun is made up of a mixture of many different colors of light, even though to the eye the light looks almost white. Other things that give off or reflect light have a different mix of colors.
- Something can be “seen” when light waves emitted or reflected by it enter the eye.

Related Research

- Studies by Guesne (1985) and Ramadas and Driver (1989) revealed that middle school students will accept the idea that mirrors reflect light but may not accept the idea that ordinary objects reflect light (AAAS 1993).
- Students’ ideas about reflection may be context-bound. Many students questioned in a study conducted by Anderson and Smith (1983) could describe light as bouncing off mirrors but not off other objects. A few students even lacked a conception of light bouncing or reflecting off any objects. The researchers also found that 61% of the children they sampled thought color to be a property of an object rather than reflected light off an object (Driver et al. 1994).

Suggestions for Instruction and Assessment

- By experimenting with light, K-4 students begin to understand that phenomena can be observed, measured, and controlled in various ways (NRC 1996).

★ Indicates a strong match between the ideas elicited by the probe and a national standard’s learning goal.

- “Light can be reflected by a mirror, refracted by a lens, or absorbed by an object” is a learning goal in the National Science Education Standards (NRC 1996). However, use caution when addressing this standard as it may imply to some students and teachers that only mirrors reflect light if other examples are not included. Provide students with a variety of materials to investigate reflection. There is a danger of students becoming context-bound if their experiences only include mirrors or shiny and smooth objects. Emphasize the generalization rather than focusing exclusively on one type of object.
- Explicitly link the idea that if we can see an object, regardless of its observable physical properties, it is reflecting or emitting some light in order for us to be able to see it.
- Have students use a flashlight to observe light reflecting off smooth aluminum foil and rough aluminum foil. Connect this experience with an analogy of a ball (representing the light) bouncing on a smooth floor versus a bumpy surface. Take students outside to bounce a ball on a smooth pavement and then compare how the ball bounces on gravel or some other rough surface. Connect the idea to what happens to light on smooth and rough surfaces (see Matkins and McDonnough [2004] under “Related NSTA Science Store Publications and NSTA Journal Articles,” below).
- Use real-life applications, such as remote-sensing images, to develop the idea that Earth materials such as water, vegetation, rocks, soil, sand, and clouds reflect light that is detected by satellites.
- Ask students to draw and explain ray diagrams that compare light reflecting off smooth versus rough objects.
- Identify various physical properties of materials and their associated vocabulary, such as *texture*, *luster*, *color*, *transparency*, *translucence*, and *opaqueness* and compare and contrast what happens when light interacts with these materials.
- Alert students to the ways our English language refers to reflection, such as *reflection pools* and *seeing our reflection* in a mirror or shiny object. Reflection is almost always spoken of in the context of mirrors, shiny objects, and water. Objects and materials like paper, wood, soil, and rocks are seldom referred to as reflective materials.
- Modify the assessment probe by having students come up with their own list of things they think reflect light and things that do not reflect light. Have them use their own list to explain their reasons for deciding whether an object or material reflects light.

Related NSTA Science Store Publications and NSTA Journal Articles

American Association for the Advancement of Science (AAAS). 1993. *Benchmarks for science literacy*. New York: Oxford University Press.

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Stepans, J. 2003. *Targeting students' science misconceptions: Physical science concepts using the conceptual change model*. (See section on light and color.) Tampa, FL: Showboard.

Related Curriculum Topic Study Guides

(Keeley 2005)

Visible Light, Color, and Vision

Senses

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