

Grade Seven Sample Test Item—Reading

Achievement Level: Standard Met

Now You See It, Soon You Won't

Engineers are developing technology to makes things—POOF—seem to disappear.

Could we soon make objects, even ourselves, invisible? The answer is yes, invisibility is possible. Engineers and researchers are working on it. But before researchers can make something invisible, they have to know why we can see things in the first place. We see things because of light.

What Is Light?

Light is a type of energy wave. For the Earth, the biggest source is the Sun. When light from the Sun travels to us, it is white. And what about colors? Isaac Newton's experiments proved that white light is made up of many different kinds of waves. Colors are simply different wavelengths of light.

The longest waves, or wavelengths, that humans can see are red. The shortest are violet. Red wavelengths bounce off of red things, like tomatoes, so that is what our eyes see. All the other colored wavelengths soak into the tomato. Because of this, we see only red.

The same is true with green. All the light waves—except the green ones—say, in grass, soak into the grass. We see green.

When all the light waves soak into an object, our eyes see the color black. Almost no waves bounce off of a black cat.

The human eye can see something only if a light hits it. Once light hits an object, one of two things needs to happen for us to see something.

One: Some light waves bounce back.

Two: Some light waves soak in.

If neither of these things happens, anything would be invisible.

Grade Seven Sample Test Item—Reading
Achievement Level: Standard Met (continued)**How to Make Things Invisible**

For our tomato, or any other object, to be invisible, engineers need to do two things. They need to stop all the light waves from bouncing back. And they need to stop all the light waves from soaking in. If light could bend around an object, the light would not bounce off the object or soak into it. Remember that the human eye cannot see something unless a light wave bounces back or soaks into the object. Engineers wondered what they could do to manipulate the light waves away from objects so they were invisible.

To solve this problem, researchers thought about properties of light. Put a straw in a glass of water. From the side, it looks like the straw is bent. This means that light can bend. What is really happening is that the water slows the light down. If you tried to race someone while you were in water and they were on dry land, the water would slow you down. You would probably lose the race.

When the light waves pass through a prism, the wavelengths change speeds, or bend, too. But prisms do even more. They bend the different wavelengths of light differently. We see rainbows because red is not bent as much as green, which is not bent as much as violet. The way light bends in water and prisms proves that manipulation of light is possible.

Not Magic, But Metamaterials

Researchers are working with a material they've designed, called a metamaterial. In Greek, meta means "changed or altered." Metamaterials are ordinary materials, such as fiberglass and copper, arranged in intricate patterns on a molecular level, like a fabric woven with microscopic threads. Objects made from metamaterials, known as cloaks, help guide light waves around an object. Metamaterials make light curve like a river streams around a rock. The light splits and travels around the cloak, combining again on the other side. Because the light doesn't bounce off the object or soak into it, the object can't be seen.

The science is not quite there for light waves humans can see. To date, it has only worked with one type of wavelength, such as microwaves, which are very long waves. The best way to think of seeing microwaves is like seeing ripples in a pond.

Grade Seven Sample Test Item—Reading
Achievement Level: Standard Met (continued)

So if we were aliens with microwave vision, current metamaterial cloaks could hide any object from our alien sight.

To make any object vanish for our human eyes, a metamaterial cloak would need to manipulate all the light waves, or colors, that we can see. Visible light waves are very short, so the cloak needs to have very small features, which are hard to make. This is one of the biggest challenges researchers face. With current metamaterials, a cloak could make a human disappear, but only if you shined one type of light wave at the cloak at a time. That could work by putting red cellophane over a flashlight, for example, but it would be impossible to wrap the Sun with red cellophane! Curving one type of wavelength around an object is a start, though, toward the goal of invisibility.

Invisibility Ideas

The possibilities for using metamaterials are endless. Ashwin Atre, a materials science engineer, thinks that invisibility would be amazing, but he'd love to work on manipulating light waves for something else. He'd like to create super-fast computers fueled by and made from light.

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**Grade Seven Sample Test Item—Reading
Achievement Level: Standard Met (continued)**

Grade Seven

Which sentence from the text best supports the conclusion that researchers are learning to control light?

- A. “When all the light waves soak into an object, our eyes see the color black.”
- B. “The human eye can see something only if a light hits it.”
- C. “In Greek, meta means ‘changed or altered.’”
- D. “Objects made from metamaterials...help guide light around an object.”

Area**Reading**

Demonstrating understanding of literary and nonfiction texts

Standard(s)

Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Answer

D