Grades K-5
Mini-Lesson: “What is a black hole?”

VIDEO TRANSCRIPT

VIDEO 1

Hi, it's Doug! This is the first-ever real photograph of a *black hole*. Now, seeing this makes me think of all kinds of questions, like why haven't we been able to take a photograph of this before?

Someone named Sammy has a question about this, too. Let's give her a call now.

[Video Call]
- Hi, Doug!
- Hey, Sammy!
- I have a question for you. What is a black hole?
- That is a great question.

Well, I've got to tell you, this is one of the most surprising questions in science because a black hole sounds like it might be a simple thing to explain. It's some kind of hole, right? But the idea of a black hole is one of the most advanced—and maybe one of the weirdest—ideas in all of science.

For starters, a black hole is not actually a hole at all. It's an object—a thing. So what kind of thing is a black hole? Well, at first, it was just something that scientists imagined could exist. It was just an idea—a what-if.

So what's the idea of a black hole? Well, you know how the Earth has gravity, right? We think of gravity as the invisible force that keeps everything pulled down. You can jump up and get off the Earth's surface, but only for a second or two. Gravity pulls you back down.

It's not that we can't escape the Earth's gravity—you know we can send things to space. But to do that, we have to go really fast. A rocket has to travel at a speed of nearly 25,000 miles an hour in order to get to outer space. We call this escape speed.

Earth isn't the only thing in space that has gravity. Mars has gravity. The Moon has gravity, too. Now, because the Moon is smaller than the Earth—or less massive—it turns out the Moon has less gravity than the Earth. If you jump while standing on the Moon, you go a bit higher before the Moon's gravity pulls you all the way back down to the surface.

This also means that the Moon's escape speed is much less than the Earth's. Rockets don't have to fly as fast to escape the Moon. The Moon's escape speed is only about 5,000 miles an hour.

Okay, that's the Moon, though. What about an object more massive than the Earth? If you could stand on a planet bigger than the Earth, the gravity would be stronger. You wouldn't be able to jump as high as you can on Earth, and the escape speed would be even more than the Earth's escape speed.

This is where the idea of a black hole comes in. Scientists ask themselves, "What if there were an object so massive, an object that had such strong gravity, that not even the fastest thing in the universe would have enough speed to escape it?"

Let's think about what this might be like. What even is the fastest thing in the universe?

VIDEO 2

The fastest known thing in the universe is light. Maybe not too surprising, right? When you turn on a light switch, the time it takes for light to go from the light bulb to your eyes seems like it happens instantly.

What if there were an object with such strong gravity that its escape speed was even higher than the speed of light? Would that mean even light itself wouldn't be fast enough to escape this object?

If you think about it, you can start to imagine why the name *black hole* makes a pretty good name for this idea. It would be like a hole because an object like this would have such strong gravity that anything that got anywhere near it would get sucked in toward it. A passing spaceship, nearby planets, entire stars, maybe even light itself.

If light couldn't escape an object like this, think of just how weird that would be. Imagine if you could stand on this object with a flashlight. You go to point the flashlight up to shine it into space, but the gravity of the object would be so strong that the light wouldn't even be able to go up. It would bend back and fall toward the ground beneath you. So the object itself would have to look black. It would suck in any light that got near it.

Now, like I said at first, all of this was just an idea—a what-if. If such a thing existed, would it really do that to light? Can light really be bent?

But around the middle of the 1900s, scientists discovered some reasons for thinking that black holes might actually exist in real life. They started looking for them using telescopes. But, as you might expect, one reason why it'd be hard to see a black hole is because they're black—and so is outer space.

But it should be possible, especially if there's a black hole sucking in material from some nearby objects, like a star. Maybe we'd see a bunch of light getting sucked into a kind of black spot and disappearing.

Using telescopes, scientists started finding places in the universe where they think some black holes might exist. None of these places are anywhere near us, which is good news. We wouldn't want to get pulled into one. But this is also the main reason why it's been so hard to actually get a photograph of one.

Even though a black hole is a massive object, they're all so far away from us that scientists realized we would need a telescope the size of the Earth itself just to be able to see one.

That is what's most amazing about this, the first-ever actual image of a black hole. A team of 200 astronomers worked together all around the globe and used eight different telescopes to basically act like one giant Earth-sized telescope.

It was not an easy thing to do. Not only did the telescopes all have to point at the exact same place in space, but to combine the view from each telescope involved really advanced computer skills, used by scientists like Katie Bouman.

Now, we have photographic proof. Black holes aren't just an idea. They're a real thing.

What other kinds of strange things will we be able to discover by combining telescopes like this? Will we be able to actually see other planets like Earth, going around faraway stars? Will we be able to find other things we've only imagined could be real in movies and stories—things like *wormholes,* passageways that take us to other parts of the galaxy?

One thing's for sure: it's an exciting time to be alive!

That's all for this week's question. Thanks, Sammy, for asking it!