Measuring a Kid Minute

Activity G10

Grade Level: 3–9

What's This Activity About?

The concept that a light year is a unit of distance can be confusing to students since the name involves a unit of time. This activity gives students a concrete analogy for light years from their own experience.

What Will Students Do?

Students walk heel to toe for one minute and measure the distance they walked. They get a sense of how a kid-minute can be a unit of distance, just like a light year. A possible math extension can connect this idea to their mathematical skills.

Tips and Suggestions

- You may want to combine this activity with G9, Birthday Stars, which also addresses the concept of a light year.
- The activity requires a long straight space in which students can walk, either indoors or outdoors. It's useful to arrange in advance that the space you want to use will be clear and available.

What Will Students Learn?

Concepts

- Measuring distances in astronomy
- Light years

Inquiry Skills

- Measuring
- Comparing
- Observing
- Imagining

Big Ideas

- Scale
- Models and simulations

ASTRONOMY from the GROUND UP
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Activity Guide

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Type of Activity:	Facilitated
Set up Time:	0 - 15 minutes
Time to Do:	30 minutes
Audience age:	10 years and older
Group size:	variable, in pairs

What's This Activity About?

Astronomical distances are sometimes measured in light years. The concept that the light year is a unit of distance is sometimes confusing, since it involves a unit of time. In order to clarify this point, this activity has participants walk heel-to-toe for one minute, measure the distance they walked and then uses that as an analogy for the distance that light travels in a specified time. Though not necessary, this activity can be started and concluded with some mathematical calculations, which can be a good way to make connections between math and astronomy.

Materials

For each pair:

- Stop watch or watch with second hand
- Tape measure
- Calculator (optional)
- Clipboard with paper and pencil for recording data

Setting Up the Activity

You'll need a long, straight stretch of space for this activity. It should be at least 300 feet long, but need not be any larger than a football field. A long hallway or sidewalk will work fine. If you want to save time during the activity, you can pre-mark the course every meter or so using tape or sidewalk chalk. If you plan to go through the mathematical calculations, you'll need a blackboard, flip chart or overhead projector to go through the calculations as a group.

Suggestions for Introducing the Activity

How far is it to the Moon? To the Sun? To Saturn? To the nearest star? To the nearest galaxy? See if anyone uses the term "light year" and ask if they know what a light year is. Many may know that it is the distance light travels in one year, but others may think it is a unit of time. Once you've established the definition, ask them to consider the meaning of a light hour or light minute.

Why do we use light years (ly) to measure the distance to stars? Why not inches or kilometers or miles? We could use these units, but the numbers would be very large. For example, the distance to the star Sirius is 84,320 trillion km, a value that is difficult to grasp. But this becomes much more manageable when we say that Sirius is 9 ly away. Similarly, it is much easier to think of 15 years rather than 5,475 days.

The light year is also important because it tells us about the time lag involved in communicating across the large distances involved in astronomy. If we sent a television or radio signal (both of which are forms of light and therefore travel at the speed of light) to Sirius, it would arrive only after 9 years. In the same way, if Sirius were to stop shining right now, we would not find out about it for nine more years, when the last light the star produced finally reached the Earth. How old would you be then? How old were you when the light we see now from Sirius left the star?

At first, it may seem strange to talk about distance by using a measurement of time, but this is something we do all the time. For example, we might say, "I live five minutes from school" or "I'm just a two hour flight from New York". These distances are based on how fast we can drive or walk to school or how fast an airplane flies to New York, just as a light year is based on the speed of light.

If you want to include the mathematical component of this activity, you may want to calculate the distance, in kilometers, that light travels in one year:

The speed of light is 300,000 km/s.
In one year, there are 31,536,000 seconds (calculated as follows: 60s/min x 60 min/hour x 24 hours/day x 365 days/year = 31,536,000 s/year).
So, in one year light will travel

31,536,000 s x 300,000 km/s = 9,461 billion km (9,461,000,000,000 km)

If you'd prefer not to use the metric system, the calculation is as follows:
The speed of light is 186,000 miles / s.
So, in one year light will travel

31,526,000 s x 186,000 mi/s = 5,870 billion mi (5,870,000,000,000 mi)

For school groups, you may want to suggest to the teacher to go through this calculation with the class prior to the their visit. Whether or not you go through the calculation, it is recommended that you write down the value so that participants can see how large it is. To put this number in perspective, you can compare it to something a little more familiar. For example, 9,461 billion kilometers is the same as going around the Earth at the equator 236 million times or traveling to the Sun and back 32,000 times. Explain that in order to help us think about the idea of a light year, we will measure something called a kid minute. If a light year is the distance that light travels in one year, what is a kid minute? How many kid minutes do you think is the distance to Sirius?

Doing the Activity

Have one participant in each pair start at the end of the chosen space and walk heel-to-toe for one minute, which the other will time with the stopwatch. It is important to have them walk heel-to-toe, because otherwise they will go much too far. Remind them that it is not a race! Each pair then measures the distance walked (either from the beginning or from the nearest marked off distance) and repeats it with the other member of the team. Each pair can repeat this several times as time permits.

As an alternative to measuring the distance walked, each participant can measure his or her foot and count the number of steps taken. Partners can help with the counting. They then multiply the number of steps taken by the length of the foot to get the total distance walked.

Each participant will then have measured his or her own _____minute. You may want to refer to them by names, e.g. a "Jessica Minute" or a "Matthew Minute." Then, as an entire group you can take the average of all the heel-to-toe distances and call this the Kid Minute.

Wrap-up

Are all the Kid Minutes the same? How are they similar? How is the Kid Minute similar to a light year? How is it different? Here it is important to remind the participants that the speed of light is not based on an average – light always travels at the same speed through space. This is why it is a good tool for measuring distances.

If you'd like the participants to try out some more mathematical calculations, you could ask some of the following questions. For school groups, these could be sent with the teacher for follow-up.

- How many meters (or feet) are in 3 Kid Minutes?
- How many Kid Minutes are there in 5 km (5000m)?
- Listening to the radio one morning at 6:30, you hear that school has been cancelled because of damage in some parts of town by a windstorm. You start to climb back in bed and sleep the day away, but then you remember that your best friend lives in a part of town that was damaged and therefore has no telephone or electricity. Your friend leaves every morning at 7:00 and lives 900 m away from you. You'll have to deliver the news to your friend. If you're only allowed to walk heel-to-toe, can you make it to your friend's house in time based on your own Kid Minute?