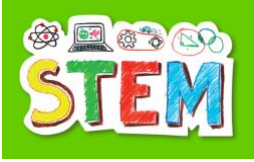


## GRAVITATIONAL WAVES

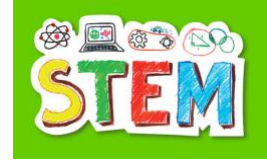
What is a gravitational wave? It's a **1.** \_\_\_\_\_ in the **2.** \_\_\_\_\_ of space and time.

Imagine that space is a giant **3.** \_\_\_\_\_ of **4.** \_\_\_\_\_: things that have mass cause that **5.** \_\_\_\_\_ **6.** \_\_\_\_\_ to bend, like a bowling ball on a trampoline. The more mass, the more that space gets **7.** \_\_\_\_\_ and distorted by gravity. For example, the reason the earth goes around the sun is that the sun is very **8.** \_\_\_\_\_, causing a big **9.** \_\_\_\_\_ of the space around it. If you just try to move in a **10.** \_\_\_\_\_ line around such a big **11.** \_\_\_\_\_, you will find yourself actually moving in a **12.** \_\_\_\_\_.

That's how **13.** \_\_\_\_\_ work: there's not an actual force pulling the planets around, just a **14.** \_\_\_\_\_ of the space. Gravitational waves are produced whenever masses accelerate, changing the **15.** \_\_\_\_\_ of space. Everything with mass and/or energy can make gravitational waves. If you and I started to dance around each other, we would also cause **16.** \_\_\_\_\_ in the **17.** \_\_\_\_\_ of space and time. But these would be extremely small. Practically **18.** \_\_\_\_\_. Now gravity is very weak in the scale of the other forces in the Universe, so you need something really really **19.** \_\_\_\_\_ moving very, very fast, to make the big **20.** \_\_\_\_\_ that we can **21.** \_\_\_\_\_. How would you observe a **22.** \_\_\_\_\_ in the space? If the space between you and me **23.** \_\_\_\_\_ or **24.** \_\_\_\_\_, we wouldn't have noticed if we had made marks on our metaphorical **25.** \_\_\_\_\_ **26.** \_\_\_\_\_, for example, using equally spaced rocks. Because these marks would also get **27.** \_\_\_\_\_ further apart. But there is one ruler that doesn't get **28.** \_\_\_\_\_, one made using the speed of light. If the space between two points get **29.** \_\_\_\_\_, then light will take longer to go from one point to the other. And if the space gets **30.** \_\_\_\_\_, light takes less time to cross the two points. This is where the **31.** \_\_\_\_\_ experiment comes in. It has 4 kilometer long **32.** \_\_\_\_\_ and uses **33.** \_\_\_\_\_ to measure the changes in the distance between the ends of the **34.** \_\_\_\_\_. When a gravitational wave comes through, it **35.** \_\_\_\_\_ space in one direction and **36.** \_\_\_\_\_ space in the other direction. By measuring the interference of the **37.** \_\_\_\_\_ as they bounce between the different points, physicists can measure very precisely whether the space in between has **38.** \_\_\_\_\_ or **39.** \_\_\_\_\_. And the precision needed is incredible. To **40.** \_\_\_\_\_ a gravitational wave, you need to be able to tell when something changes in length by a few parts in 10 to the 23. It is like being able



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to tell that a stick one **41.**\_\_\_\_\_ meters long has **42.**\_\_\_\_\_ by 5 mm. The effect of a gravitational wave is so minuscule and easily confused with random noise you need a smart data analysis technique. Scientists hope to identify the patterns of gravitational waves by comparing the **43.**\_\_\_\_\_ they measure in the experiment to the **44.**\_\_\_\_\_ they expect from the gravitational waves. That's like trying to identify a song being **45.**\_\_\_\_\_ at a noisy party. A very, very noisy party. Imagine that your whole life you had been **46.**\_\_\_\_\_ until one day your hearing was restored. You'd be able to explore the Universe in this whole new way. That's why **47.**\_\_\_\_\_ gravitational waves are so significant. It's a completely new way of studying the Universe. Anytime there's a new way to investigate the Universe we discover things that we didn't expect. It's really about looking for new things that we didn't know existed, examining the extreme edges of our knowledge of physics and testing our theories about how the Universe works.