



TED Connection:

Far, far away galaxies and why they matter

Overview

Mensa for Kids' TED Connections are short, easy to use guides that help teachers, parents and youth use TED talks in a classroom or home setting. Rather than a lesson plan format, they have a list of discussion questions, all at higher levels of thinking.



Harvard student scientist Henry Lin explores the beauty and potential of giant cluster galaxies and what the universe's most massive laboratories have to teach us.

WATCH THE TED TALK AT:

ted.com/talks/henry_lin_what_we_can_learn_from_galaxies_far_far_away#



Think about it

1. Cluster galaxies have three components to them:

- Hundreds of galaxies (stars, gas, dust)
- Hot gas clouds (up to 100 million degrees Celsius)
- Dark matter

Of the three components, only the first one can be seen with optical telescopes. How can you tell something is there that you cannot see?

2. Henry Lin describes the clusters of galaxies as “mysterious, surprising, and useful.” Can you think of three other things that meet these criteria?

- 1) _____
- 2) _____
- 3) _____



Photo : NASA, ESA/
Ming Sun (UAH)
and Serge Meunier

3. The Hubble telescope caught an image of spiral galaxy ESO 137-001 being torn apart by gravity cluster Abell 3627. Does this seem like a positive thing to you, a negative thing, or neutral? How can naming inanimate objects change how we feel about the object? What would be the effect be different if a gravity cluster named Frank tore apart a galaxy cluster named Wendy? Would it sound more or less sinister?



Photo: NASA

4. Lin argues that these galaxy clusters have four main uses, the first being to probe the very big. He shows an image of Abell 1689, a galaxy cluster with a trillion stars that is 2 million light years wide. The size of this cluster enables it to bend light and magnify the light of galaxies behind it, a process called “gravitational lensing.” In the image above, find some examples of bent (curved) light. Think of something on Earth that is enormous and describe a trait that its size gives it that something similar yet smaller does not have.

5. The second reason for the usefulness of the cluster galaxies according to Lin is that they allow us to probe the very hot. He says that when you take out star light, you are left with hot gas, really million-degree plasma. What do you see as the value of studying extremes of heat, cold, or size?

6. This is El Gordo, the largest galaxy cluster that we know of in the Universe, 7 billion light years away from Earth. Its mass is 1% from its stars, and the rest is in the hot gas in the space between those stars. Lin says in his talk that great speed creates great temperatures. Can you think of ways in which this is true? What can you think of that gets hot when it moves quickly? In what way is this true of emotions as well?



Photo: NASA



7. The third use Lin describes is probing the very small. He says that most of the universe is made up not of atoms, but rather of dark matter. What is one way that this seems odd or counter-intuitive?



Image credit:
X-ray: NASA/CXC/CfA/
M.Markevitch et al.;
Lensing Map: NASA/
STScI; ESO WFI;
Magellan/U.Arizona/
D.Clowe et al.
Optical: NASA/STScI;
Magellan/U.Arizona/D.
Clowe et al.;

8. This is a composite image of galaxy cluster 1E 0657-56, also known as the Bullet Cluster. It was instrumental in the development of the idea of proving the existence of dark matter. It took three different groups to get this shot. What other things can you think of that benefit from multiple viewpoints?

9. Henry Lin says that studying what happens when these big galaxies smash together is like seeing a huge particle collider in action. Why do you think this might be valuable to see? What can we learn from this?



10. The last use of the galaxy clusters mentioned is that they allow us to see the physics of the very strange. He discusses that the Universe is expanding faster and faster, and how that can seem odd. Arguing that we can tell best what happened by looking at the biggest pieces rather than the smallest, he makes the case the we can determine what's happening in the Universe by looking at these galaxy clusters. Do you agree that that's the best way to tell? Do you think it matters why the Universe is expanding so quickly? What uses do you think the study of the very strange has?

11. He ends by saying that we don't always want to rely on focus and concentration, but also look at the broad picture, step back, and zoom out and recognize the place that innovation, inspiration, and ingenuity have in science. Do you agree? When do you think the best time is for narrow focus? For the broad picture? Do you think science is a creative process like art?



Do it

- Research to discover the highest point on earth, the deepest sea, the largest land mass, the hottest place on earth, and at least two other extremes. Use mapfab.com/editor/new to create a map of your discoveries.
- Take a free online course about dark matter at bit.ly/darkmatterclass.
- The galaxy cluster we live in is called the Local Group. It includes our galaxy, the Milky Way, as well as Andromeda and others. It is part of the Virgo supercluster, a collection of at least 100 galaxy clusters about 110 million light years wide. Thinking about what you know about space, rename our galaxy cluster with purposeful intent and meaning.
- Create an advertisement for our galaxy cluster using the new name you created above, pointing out at least three distinguishing features of it.
- Create a playlist of songs for our galaxy cluster that contains at least five songs, one that is instrumental only.

Read about it

- Read about the spiral galaxy being torn apart by the galaxy cluster at bit.ly/torngalaxy
- Read about million-degree plasma flowing through the universe at bit.ly/hotplasma
- Read about plasma in space at bit.ly/spaceplasma
- Read more about the millennium simulation Henry Lin mentions at bit.ly/milsim
- *Dark Side of the Universe: Dark Matter, Dark Energy, and the Fate of the Cosmos* by Iain Nicolson (older readers)
- *Space: A Visual Encyclopedia* by DK Publishing (ages 7-12)

Watch it

- bit.ly/abell1689 Watch this one-minute video of images panning across Abell 1689
- bit.ly/spacedocs Watch lots of free documentary films on space

Surf it

- Visit the Hubble website (spacetelescope.org)
- Visit Cornell's Ask an Astronomer website (curious.astro.cornell.edu) where you can read more about all things astrophysics, as well as listen to their podcast.
- Visit How Stuff Works (bit.ly/hsw-darkmatter) or NASA pages (bit.ly/nasa-de) to learn more about dark matter and dark energy.