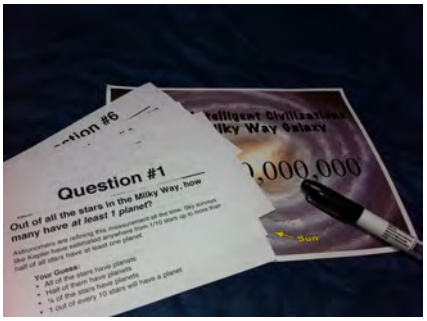
Anyone Out There?

What's this activity about?



Big Questions:

- What are the chances that there are other intelligent civilizations in our Milky Way Galaxy?
- What are the factors to consider when we think about finding other intelligent civilizations?

Big Activities:

Participants form groups around 6 questions about the likelihood of life in the Universe. Starting with all of the stars in the Milky Way, the presenter uses the participants' answers to come up with an estimate of the potential number of intelligent civilizations in the galaxy.

Participants:

From the club: A minimum of one person. With large groups, it is good to have at least two presenters.

Visitors: 25 or more visitors at a time may actively participate. It is best to have at least a dozen participants so that discussions emerge. "Anyone Out There?" is best used with ages 12 through adult, as the discussions can be elaborate.

Duration:

20 minutes to an hour, depending on the discussions and extensions.

Topics Covered:

- How scientists are searching for intelligent life on our galaxy
- Planets being discovered around other stars
- Why water is important for life
- When life developed on Earth
- How life evolved on Earth
- The fraction of Earth's life that humans have been here
- Humans' ability to communicate across interstellar distances

Where could I use this activity?

ACTIVITY	Star Party	Pre-Star Party – Outdoors	Pre-Star Party – Indoors	Girl Scouts / Youth Group Meeting	Classroom			Club Mtg	Public Presentation (Seated)	Gen Public Presentation (Interactive)
					K-4	5-8	9-12			
Anyone Out There?		√	√			√	√	√	√	√

What do I need to do before I use this activity?

What materials from the ToolKit are needed for this activity?	What do I need to supply to run this activity that is not included in the kit?	Preparation and Set-Up
Six Question cards Presenter's Cue Card/Tally Sheet Dry-erase marker	(Optional) This activity can be used with the *Anyone Out There PowerPoint*. If so, you would need a computer and projector.	None

Background Information

The Drake Equation

This activity is a simplified version of the Drake Equation, a very useful tool for examining the factors that determine the likelihood of other intelligent civilizations existing right now in our galaxy. It should be emphasized that **this is not an equation with an answer** that we know.

Frank Drake proposed these factors in 1961, when there were few scientists thinking seriously about life on other worlds. Since that time, astrobiology (sometimes referred to as exobiology) has become a mainstream science studying of the origin, evolution, distribution, and future of life in the universe. You can learn more about the Drake Equation from the SETI institute: http://www.seti.org/drakeequation

If you would like to see what other values of the variables could mean, PBS hosts this clever interactive site: http://www.pbs.org/wgbh/nova/origins/drake.html

To watch Carl Sagan's eloquent description of the Drake Equation, see this video on YouTube: http://www.youtube.com/watch?v=0Ztl8CG3Sys

The Universe in the Classroom issue #77 provides an excellent background to the Drake equation: http://www.astrosociety.org/education/publications/tnl/77/77.html

The Factors

Adapted from an article by Anna Lee Strachan, NASA Astrobiology Institute

Many people falsely believe that The Drake Equation "proves" the existence of intelligent life elsewhere in the universe. On the contrary, the Drake Equation simply expresses how many civilized worlds there would be in our galaxy given certain assumptions and known mathematical relationships. The equation is expressed as follows:

$N = R * F_p * N_e * F_l * F_i * F_c * L$

Where N = The number of communicating civilizations in the Milky Way, and where:

R = The rate of formation of suitable stars in the galaxy

F_p = The fraction of those stars with planets

N_e = The number of habitable planets (planets with liquid water) per planetary system

F_l = The fraction of those planets where life develops

F_i = The fraction of planets that ever develop life where intelligence develops

F_c = The fraction of planets with intelligent civilizations where technology develops

L = The "lifetime" of such technological civilizations releasing detectable signals into space

While the first three factors (R*, F_p, and N_e) can be estimated by scientists to some degree of certainty, the latter factors can only be reasonably guessed. For example, many scientists believe that where life can evolve it will (F_l = 100%), while others believe that the development of life is far more rare (F_l < 10% or even < .01%). Changes in each of the latter four factors of the Drake Equation can cause the solution, N, to equal anything from zero to the hundreds of thousands! Clearly, the Drake Equation is only a theoretical tool at this point; it has no unique solution. Estimates change as new discoveries bring us more information. For current estimations of the parameters, see this site:

http://en.wikipedia.org/wiki/Drake_equation#Current_estimates_of_the_parameters

Note: For this activity, we have made some assumptions and changed the equation slightly for simplification.

The first factor, the rate of star formation (R), has been changed to the number of stars in our galaxy. That is generously estimated as 400 billion, as shown on the Presenter's Cue Card. We make up for that by changing the last factor, the lifetime of intelligent communicating civilizations (L). We make this instead, the fraction of a planet's lifetime that an intelligent, communicating civilization will survive. This is a common change for clarity's sake.

The number of stars in our galaxy is probably between 200-400 billion. However, this number is not very much fun for the layperson to debate. In this activity, we have made an estimate of 400 billion stars that begins the presentation. This is where the number on the Presenter's Cue Card originates.

Detailed Activity Description

Anyone Out There?

Presentation Tip:
You can use this activity alone, or in conjunction with the included PowerPoint of the same name. To use this activity with the PowerPoint, follow the PowerPoint script that accompanies the presentation. It includes prompts for passing out the cards and soliciting answers from an audience. The following description is for use with the cards alone.

Leader's Role	**Participants' Role (Anticipated)**
To Do: Have the Presenter's Cue Card with the image of the Milky Way galaxy facing the audience. *To Say:* Does anyone here think there are aliens somewhere out there, looking to make contact with us? Well, we don't have any evidence of creatures from other worlds, but we are looking. Some of you may have heard of Area 51 and claims of UFO invasions. These are extra-ordinary claims. Science investigates these claims, and so far hasn't found any of them to hold up. Until we have evidence, let's take a look at what we think the chances are that there are other intelligent civilizations in our galaxy. A famous astronomer named Frank Drake broke down some of the factors we should consider. Let's look at them together and see what value we come up with. *To Do:* Pass out the 6 factor cards to 6 people in the audience. Ask your visitors to get in groups around the cards and discuss their factor. *To Say:* I want to emphasize that **there are no right or wrong answers** to these questions. At least not that we know. We are going to examine what factors might make a difference in whether or not there are other intelligent civilizations out there.	Usually "yes!"

Leader's Role	**Participants' Role (Anticipated)**
To Say: Let's start with the number of stars in the Milky Way galaxy. There may be as many as 400 billion stars in our galaxy. That's a huge potential for aliens! But not all of those stars have planets. First, we have to see which of those stars have planets. Question #1 -- Will you read us your question and give us your best guess? *To Do:* (These instructions are also written on the Cue Card) If the group guesses: • *All of them* (make no changes) • ***Half of them*** **(cross off the 4 and write "2")** • *¼ of the stars* (cross out the 4 and write "1") • *1 out of every 10 stars* (keep the 4 and cross off the last zero on the right)	"What fraction of all stars in the Milky Way have at least one planet orbiting them?" …We think half of them do
To Say: Okay, so, half of 400 billion is still 200 billion. Let's start to narrow that down a bit. Who has Question #2? Could one of you please read us the question and give us your guess?  Okay, that gets rid of two of our zeros. Now we're down to 2 billion places that might have aliens. Now for Question #3… *To Do:* Continue with each question in order, crossing off the appropriate number of zeros at each step. The chart on the back of the Presenter's Cue card tells you how many to cross off, depending on your audience's answer.	"How many worlds have the right environment to support life?" …we think 1 in 100

Presentation Tip:
You can easily connect questions #4 and #6 to the Earth Timeline activity. Show how long it took for intelligent life to develop on Earth. For #6, mention that the Earth will likely be around another 5 billion years, about the same amount of time as it has existed so far. How much of that time does your audience think intelligent life will survive?

It's okay to say, "I don't know." Most importantly, never make up an answer. Many presenters find that they learn the most by talking with the public. You can always send visitors to the NASA website Ask an Astrobiologist: http://astrobiology.nasa.gov/ask-an-astrobiologist/

Misconception Tip:
Remember to let your audience know that these are all just guesses. Scientists don't know the answers to these questions.

Leader's Role	**Participants' Role (Anticipated)**
To Do: When you finish all 6 of the cards, you'll have a number left. This is the number of intelligent, communicating civilizations that this group predicts are currently active in the Milky Way. If you cross off all of the zeros and still have more to cross off, then that tells you that their prediction is that we are likely alone in the galaxy. Cross off all of the numbers, including the one you wrote for Question #1 and instead write a big "1" underneath, indicating that they predict we are all alone. *To Say:* So, what does this number tell us? Well, it's our guess of how many intelligent, communicating civilizations might exist in our galaxy right now.	

Wrap-Up

(If this number is 1 or less) You predict that we are alone in our galaxy! Unfortunately, the closest big galaxy is Andromeda and any signals we might receive from them would be 2 million years old. Plus, we would have no way to send back such a strong signal.

(If the number is less than 10) With this few civilizations in our Milky Way, we will be very lucky indeed to find them. Right now, most of the planets we are monitoring are in our corner of the Milky Way.

To Do:
Draw a circle of about 1" diameter around the Sun in the picture.
To Say:
It's unlikely that any of these few civilizations will be in there. Here's hoping they contact us first.

(If the number is 10 or greater) Wow, IF it turns out there really are that many intelligent civilizations in our galaxy, we can hope to hear from at least one of them. We may even detect their presence in sky surveys that are looking for planets around nearby stars.

Common Questions and Answers

Can we search other galaxies?
Not presently. Even our own galaxy is hard to see in its entirety. Even the closest galaxies are much too far away to imagine communicating with another civilization. The energy required to send a signal to another galaxy is more than our Sun produces, for starters. And we can't even see individual stars very well in other galaxies; much less detect planets or life. We are confined to the Milky Way for now.

Why haven't we heard from anyone?
This is called the Fermi Paradox. The short answer is that we don't know. But there are many possible reasons.
You can find more information and a debate on that question here:
http://www.astrobio.net/debate/242/fermi%E2%80%99s-paradox-where-are-they
There is also an overview in this podcast:
http://www.astronomycast.com/astronomy/episode-24the-fermi-paradox-where-are-all-the-aliens/

Isn't it possible that…
Yes, it is entirely possible that we are being observed by aliens (the Zoo Hypothesis), or that Earth has very special features that make it the only hospitable place in the galaxy (the Rare Earth hypothesis), or that many other wild things are possible. We simply don't know. And science requires extraordinary evidence to back up extraordinary claims. So until then, they are fun to think about, but we cannot debate them scientifically.

Materials

What do I need to prepare?

- Just wipe off the Presenter's Cue Card with a tissue if you have used it before.

Where do I get additional materials?

1. Print additional copies of the presenter sheet and audience cards. You can find these on the Manual and resources CD in the folder labeled "Masters."
2. These can be laminated at a copy center.
3. If you are using laminated version, dry erase pens can be purchased at any office supply store.