GRIFFITH OBSERVATORY ONLINE SCHOOL PROGRAM

MODULE 5: EARTH IS OUR HOME

TEACHER GUIDE

Dear Teacher,

Welcome to Griffith Observatory's Online School Program teacher resources!

It is our mission to inspire everyone to observe, ponder, and understand the sky. With this program, we intend to be your partner in education, providing you access to experts and unique activities that bring science to life in your classroom.

Our Fifth-grade Online School Program modules are

- Entirely free to participate
- Aligned with current fifth-grade education Next Generation Science Standards (NGSS)
- Interactive and presented live by Griffith Observatory's knowledgeable staff
- Intended to inspire students' curiosity for space exploration and S.T.E.M. (Science, Technology, Engineering, and Mathematics) subjects and to expose them to the latest astronomical science and technology

If we learn how to observe and do so carefully, we are rewarded with profound discoveries about the universe and ourselves. This is the unifying theme of our Online School Program modules and what we hope your students will take away from the program.

Thank you for teaching the next generation of critical thinkers and observers!

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Griffith Observatory Online School Program

Overview

Griffith Observatory's online school program is a live, interactive, virtual school program for fifth-grade students. The program offers live and prepared elements that feature Griffith Observatory's knowledgeable Museum Guides and Telescope Demonstrators. Like the in-person school program, this online program is offered to interested schools on a first-come, first-served basis, and we encourage participation by schools in communities that have limited access to special science-outreach initiatives. The online program enables students to have a meaningful, virtual Observatory experience without transportation and geographic barriers to participation. The operation of both programs is funded by Griffith Observatory and Griffith Observatory Foundation.

Griffith Observatory's online school program is hosted entirely through Zoom, is delivered live from Griffith Observatory, and meets current fifth-grade standards (NGSS 2015).

Structure

The program is a series of modules that each address a different aspect of observation. Each module contains live, recorded, and animated elements, lasts about 30 minutes, and is followed immediately with a question-and-answer session. The modules are intended to be experienced in order, though not necessarily within a particular time-frame.

Goals

The modules are designed to accomplish three goals:

- inspire students to be observers
- encourage students to appreciate their place in and relationship to the universe
- expose students to the latest astronomical science and technology

The Modules

MODULE 1: EVERYONE IS AN OBSERVER

"Everyone Is an Observer" examines the observational skills everyone uses to navigate life. Through virtual daytime and night observation with Griffith Observatory's historic coelostat and Zeiss telescope, participants learn how astronomers observe, use scientific instruments, and record data to expand their knowledge of the universe. How has systematic observation changed our understanding of objects in space, and how have our findings helped us understand Earth's relationship to them?

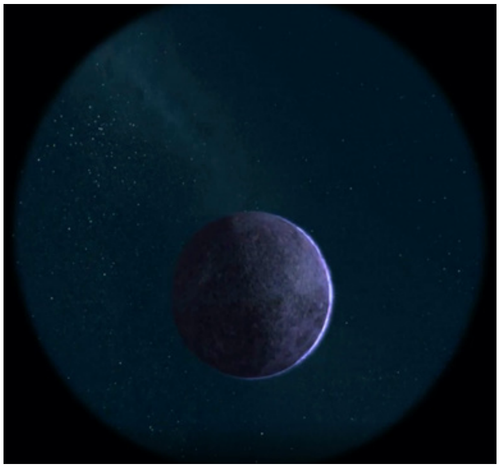
MODULE 2: CLUES FROM COMETS

"Clues from Comets" investigates the process of using observations to understand cause-and-effect relationships between events, exemplified by our understanding of comets over time. Presented live from Griffith Observatory's Leonard Nimoy Event Horizon theater, the program guides students through centuries of records kept on the appearances of comets as people gradually learned about their nature. Midway into the presentation, participants witness the manufacture of a life-ingredient-bearing comet from household supplies. Finally, participants embark on a journey to a real comet in space fashioned from actual photographs from the *Rosetta* mission. What can comets tell us about the solar system and about ourselves?

MODULE 3: THE SEARCH FOR WATER

"The Search for Water" emphasizes that liquid water is essential for life, looks inward at our own planet with thriving life forms, and then outward for other water-lush worlds. Griffith Observatory's *Our Earth*, *Our Moon*, *Elements*, and *Solar System Worlds* exhibits are explored to identify conditions and materials present on our world versus others. The unique properties of water are examined with a variety of demonstrations, and the resilience of life is explored with footage from Earth's extreme places. Students are then guided through the solar system in search of environments that sustain liquid water. The program includes animated elements from Griffith Observatory's planetarium show *Water Is Life* that have been converted to 2-D and enhanced for on-line learning.

Modules continued



MODULE 4: EXOPLANETS ARE EVERYWHERE

"Exoplanets Are Everywhere" outlines the structure of our solar system and shows how a planet's distance from its star, among other circumstances, is essential for making it a habitat for life. Students encounter exoplanet discoveries and what they mean. In this exhibit-based experience with interactive components, participants visit simulated alien worlds and solar systems in search of habitable planets. Students will visit The Gunther Depths of Space, experience the solar system models, see the current exoplanet count, take a tour of The Big Picture, see *Our Sun Is a Star*, and get acquainted with modern exoplanet-hunting technology.

MODULE 5: EARTH IS OUR HOME

"Earth Is Our Home" guides participants on an immersive, 13.8 billion-year journey through Griffith Observatory's *Cosmic Connection* timeline. Environmental change can be caused by cosmic events or by living things. When ecosystems change, life also changes. Real-life stories demonstrate that studying Earth from an astronomical perspective sheds light on how people are changing Earth's ecosystems. Two core messages are emphasized: The evolution of Earth and life are intertwined, and observation and scientific thinking are key for protecting Earth's resources and environment.

Program Rundown

Module 5 Strategies

- Show that Earth and life are natural products of cosmic evolution by diving deep into Griffith Observatory's *Cosmic Connection* exhibit.
- Demonstrate how the evolution of Earth and of life are intertwined by focusing our perspective on big-picture patterns.
- Inspire students to care about the health of our planet by using real-life evidence of how observation and scientific thinking can make tangible differences.
- Empower students to observe more and make real-world contributions with materials—for the classroom and at home—to be used before and after participating in the module.

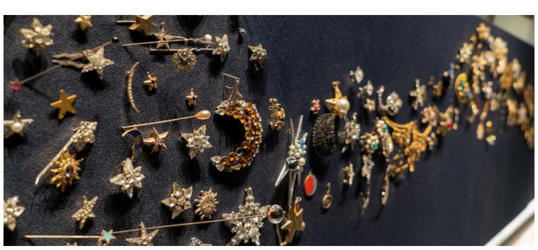
Module 5 Breakdown

PRE-PROGRAM WAITING ROOM
When logged on early, you encounter a waiting room animation indicating that the program has not yet begun.

ARRIVAL TO GRIFFITH OBSERVATORY ANIMATION
An animation designed and produced by Griffith Observatory's Satellite Studio brings you from the far reaches of the universe to Griffith Observatory.

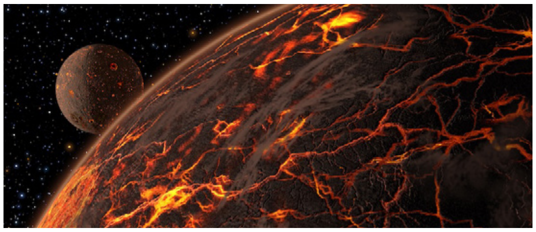
LIVE INTRODUCTION TO YOUR MUSEUM GUIDE
A Museum Guide joins you live from Griffith Observatory's Gunther Depths of Space. The Guide introduces the worlds in our solar system models and has students vote to guess which one is the most studied by scientists. The answer is revealed to be Earth, which provides everything we need.

PICTURING EARTH IN THE UNIVERSE
The Museum Guide uses Griffith Observatory exhibits to show Earth from an astronomical perspective. Earth has particular relationships with the Sun and Moon that make Earth habitable and cause familiar cycles. Earth's location is shown to be in the Milky Way Galaxy, which is just one of billions in the universe. Earth also has life. The Guide asks, was it always this way and how did it get this way?



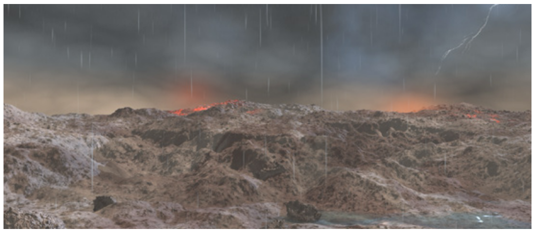
THE COSMIC CONNECTION PROVIDES AN ANSWER
A video on Griffith Observatory's *Cosmic Connection* exhibit places Earth, and the steps needed to make it, into perspective. The exhibit's ribbon of 2,200 pieces of jewelry is blended with exciting, original animations in a mission to connect students to the origin of everything.

Program breakdown continued



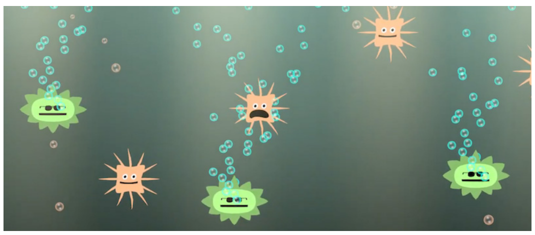
EARTH COOLS DOWN AND GETS A MOON

Animations and videos by Griffith Observatory artists demonstrate how Earth was not at first hospitable to life. We use in-house animations and scientist-created supercomputer simulations to show the Moon's catastrophic creation.



OCEANS AND LIFE

Earth's timeline continues. Students are asked from where they believe Earth's water came. Water is revealed to have come from asteroid impacts, comet impacts, and volcanic eruptions that released water vapor from below. Once Earth had everything life needed, it appeared rapidly in the oceans.



LIFE AND EARTH ARE INTERTWINED

Animations created at Griffith Observatory show how Earth and life are interconnected. Early bacteria thrived in their environment. Once this environment was changed by a new form of life, the life on Earth had to change. Neither Earth nor life can change without affecting the other.

MUSEUM GUIDE INTRODUCES EARTH'S SPHERES

The live Museum Guide hosts another poll about Earth's systems, which are connected to Earth's many ecosystems. A Griffith Observatory-produced video demonstrates how the dinosaurs' environment changed too quickly and led both to mass extinction and an opportunity for new life forms to evolve into the life that exists today.

LIVING WITH THE EARTH

The Guide shows how people have altered the environment and made life easier. Art, culture, and science have flourished because we use technology to change the Earth. These changes are shown to have consequences. The peppered moth is used as an example. Changes in the environment lead to changes in life.

OBSERVING HOW PEOPLE CHANGE THE EARTH

A Griffith Observatory-produced video highlights how "the mother of Landsat," Virginia Norwood, made crucial decisions in the design and development of the longest-running Earth-observation program. Satellite images provide us a birds-eye view of Earth and help us monitor how we are changing it.

EARTH IS OUR SPACE

The Guide brings us home to Earth and today at Griffith Observatory and explains that observation, science, and community effort can guide us toward sustaining our world.

2015 Next Generation Science Standards Reflected in the Program

Module 5: Earth Is Our Home

GRADE	STANDARD	NGSS DESCRIPTION	HOW THE STANDARD IS ADDRESSED
5	5-PS2-1 PS2-B	The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	We show pictures and animated simulations of how Earth's Moon was created and how gravity is a key component of how many other astronomical objects form and work.
5	5-ESS2-2	Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	We talk about the hydrosphere and frequently zoom out visually to show the Earth over time. With a zoomed-out perspective, students will notice how Earth has changed and how water levels and distributions have fluctuated over millions of years.
5	5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	We describe Earth's systems and provide examples of how changes to one affect the others. Then, Earth-observing programs like Landsat are explored to show how big-picture observations help us understand Earth's systems and how they interact.
3-5	Principle I (CA)	The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.	Throughout the program, we support the argument that Earth and life are cosmically intertwined—that a change to one always results in a change to the other. We assert the importance of balance and why a stable environment and care toward Earth's resources are necessary for survival.
3	3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	We present a video element about the Great Oxygenation Event, in which some microorganisms had the necessary traits to survive the changing conditions while others either adapted or died out.
5	5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	We explore the demise of the dinosaurs—how a sudden change in the environment affected the plants, which then affected the animals.
5	5-PS3-1	Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the Sun.	We mention that the Sun provides energy and note specifically that a reduction in sunlight during the K-T extinction affected plants, which affected animals.
3	3-LS3-2	Use evidence to support the explanation that traits can be influenced by the environment.	We present the story of the peppered moth in England, in which a human-caused change in the moths' habitat resulted in a certain mutation becoming the dominant trait.

Standards continued

GRADE	STANDARD	NGSS DESCRIPTION	HOW THE STANDARD IS ADDRESSED
3	3-LS4-2	Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	In the peppered moth story, we demonstrate that the moths with better camouflage coloration were more likely to survive a change in their environment and so became the dominant peppered moth.
3-5	3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	We share the story of how an aerospace engineer, Virginia Norwood, designed, tested, and completed an instrument that exceeded expectation and led to one of the most successful and important Earth observation programs ever.
3	3-LS4-4	Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.	A story is presented about the time people discovered that the chemicals we were using were creating a hole in our atmosphere's ozone layer. All the countries of the world worked together to change laws, and this combined effort has enabled the ozone layer to heal gradually.
4	4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.	We describe some examples of how we use Earth's natural resources and transform our planet to fit our needs. Then, we present ideas (and resources in the program guides) to guide anyone's participation in keeping our planet healthy.
5	5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	We include stories, images, and program resources to show some of the many ways that individuals and communities make an impact in protecting Earth's resources and environment.

Connecting to the Program

Overview

This section contains all of the information you and your students will need in order to join your online school program webinar session and ensure a successful virtual visit to Griffith Observatory. It is essential that you read and follow these instructions carefully.

Within 24 hours of completing the registration process for our program, you should have received a confirmation email from online.sp@griffithmedia.org. The message includes a **Zoom webinar link**, the **date and time** of your session, and other important information and links. You are responsible for forwarding the necessary information, according to the instructions in the message, to your students and all included teachers. Shortly before your scheduled Griffith Observatory Online School Program webinar session, you will receive a reminder message.

What You Need to Know

- Please be as punctual as possible. Your session includes a window for arrivals before the actual program begins, but the program will begin regardless of whether every registered classroom shows up or not.
- A Griffith Observatory staff member will be in the Zoom room to assist you if needed, relay some reminders, and will then act as your main point of contact for any questions you may have during the program. Use the chat feature to message the "Host and Panelists."
- The school program now uses Zoom's "webinar" model. Teachers and students are encouraged enter the webinar all at once. Although you will be muted with your video turned off, you may still use the chat function to message Griffith Observatory staff.
- Students that join the webinar from their individual devices are also not able to unmute themselves or share their video streams. They may not chat with each other. They may, however, use the chat feature to ask for help and use the Q&A feature to submit astronomical questions to staff. Questions submitted in the Q&A feature are not visible to everyone unless a staff member chooses to answer it live.
- You may also choose to project the program to your class. Note: This means you will need to answer the interactive polls and ask questions for the Q&A on behalf of your class.
- In the unlikely event that the Griffith Observatory video stream drops out of the webinar, please instruct your students to wait patiently and remain in the call.

Essential Information for Students

It is your responsibility to make sure your students receive and understand the following information. You may easily copy it and paste it into a message to your students. Make sure you insert your class's registered session **time**, **date**, and unique **Zoom webinar link** into the **orange** areas below. This information may be found in your confirmation email.

Dear Students,

Your class's Griffith Observatory Online School Program webinar time:
[**INSERT YOUR REGISTERED WEBINAR TIME AND DATE**]

Please log on at the time of your scheduled session. Make sure you set your "Zoom name" to contain your first and last name.

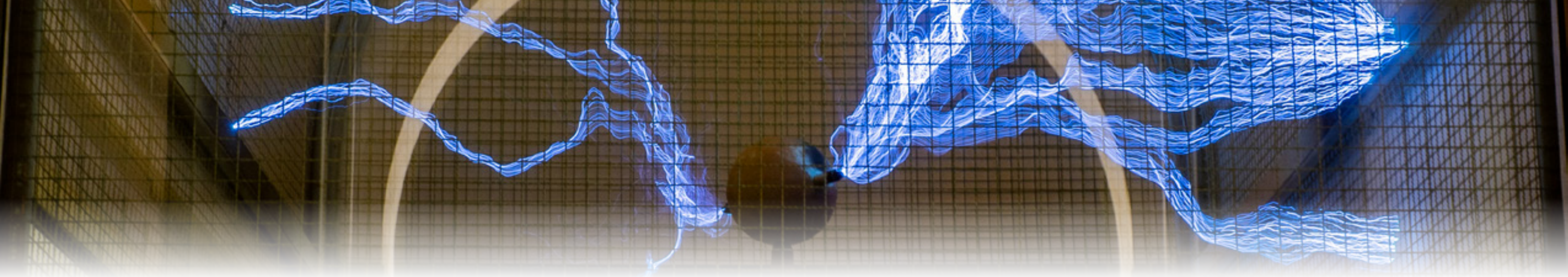
Once you enter the webinar, you will be muted with your video off. You will see a video of Griffith Observatory against a sky that cycles between day and night, and you will hear music. If you do not see the video or hear the music, use this time to work with a grown-up to check your internet connection and sound. You may also use Zoom's chat feature to ask one of the Griffith Observatory hosts for help. Once everything is working perfectly, pay attention to the instructions, and have a great online visit to Griffith Observatory!

Click the link below or copy and paste it into an Internet browser to join the meeting.

YOUR CLASS'S ZOOM WEBINAR LINK:
[**INSERT YOUR GRIFFITH OBSERVATORY ZOOM WEBINAR LINK**]

THIS WEBINAR LINK IS YOURS AND YOURS ONLY. DO NOT SHARE IT WITH ANYONE NOT PART OF YOUR CLASS.

Before the program, please make sure you have reviewed your **Student Guide**.



Frequently Asked Questions

How safe are the online school program's meeting rooms?

Your meeting room has a unique **Zoom webinar link** that will only be issued to the teacher/adult contact(s) you indicated during the registration process and to other teachers and students that have registered for that particular session. The email message with the Zoom webinar link also contains necessary information to relay to your students. This information includes a prohibition on sharing the Zoom webinar link, as keeping the webinar session link private guarantees security. At the beginning of the program, staff will state that any inappropriate, rude, or harassing language or spam sent to staff in the chat or Q&A is not tolerated and may result in being dropped from the Zoom session.

Do my students and I need to download the Zoom app to view the program?

No. You may click the Zoom webinar link or copy and paste it into an internet browser. If you do not have the Zoom app, your browser will present you with an option to "join from your browser." If you do have the Zoom app, you will be redirected to the webinar in your Zoom app after searching the link in your internet browser.

Can I access my registration form to make changes?

There is a link in your confirmation email to make any registration corrections or to reschedule.

What happens if a participant has poor connection, loses connection, or needs help?

Students will be told early in the Zoom webinar what they should do if they need help or if a connection issue occurs. They may use Zoom's chat feature to talk to Griffith Observatory staff members to report or receive help with technical issues. If a participant's call fails, the participant will be able to use the same Zoom webinar link to rejoin the session.

May I or my students record the program?

No. Like the Observatory's in-person school program, the live webinar is designed and intended to be experienced in the moment. We also need to safeguard the program content, quality, and integrity. In the future, we may consider producing recorded versions of the program, but they would be optimized for that format (vs. a live program.)

Contact

For any concerns or questions, contact online.sp@griffithmedia.org.

Program Materials

To get the most out of Module 5: Earth Is Our Home, explore these materials before and after your visit.

Module 5 Glossary

The glossary identifies and defines important words that are useful for students before they attend “Earth Is Our Home.”

Listen to the Glossary

This helps students become familiar with the terms we shall use in the program. This is recommended as an accessibility resource for students with physical and/or language-related challenges. The audio file includes pronunciations and definitions of important terms used in our program (same as in the Glossary above).

Intergalactic Pen Pals and Grading Version

This glossary-review activity has students use glossary terms to fill in the blanks in correspondence with a pretend alien from a different galaxy.

Making Cosmic Connections and Grading Version

In this cut-and-paste activity, students piece together the timeline of the universe and learn about some notable scientists and discoveries along the way.

Exploring Environment Evolution

This short-answer handout helps students to notice how people change environments to meet their needs. By examining local, historical, and space-based images, students are introduced to the concept of sustainability and the importance of observation.

The Roll of a Lifetime

In this hands-on activity that results in delicious dinner rolls, participants witness an organism changing its environment and the environment changing the organism, too.

Coloring the Cosmos

We have included two coloring book activities for a quiet moment.

A-Z Responsible Disposal

This resource may help you dispose of common household items more responsibly.

Program Materials continued...

Imagining Jobs in Space

In this short-answer handout, students learn about eco-friendly jobs on Earth that make our environment more livable. Then, they employ their creativity and reasoning skills to imagine jobs needed in space to create and sustain livable environments.

Citizen Science: Help Power Real Research

This resource features two websites that contain Citizen Science projects. Citizen Science is a way for anyone, no matter age or level of experience, to help scientists change the world and have fun doing it, too!

Surf the Earth-observing Web

This resource lists some trusted NASA websites for students to extend their Earth-observing journey and stay informed about the latest climate science.

Internet Resources

The Internet may be helpful. This variety of websites will help students expand their astronomical knowledge and have fun doing it.

Glossary

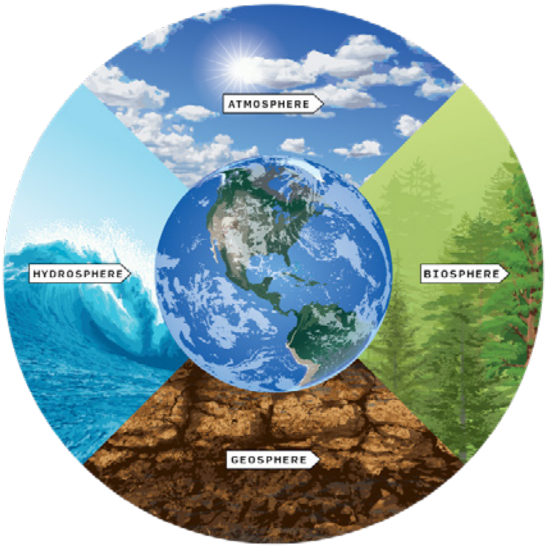
MODULE 5: EARTH IS OUR HOME

asteroid – a rocky, airless remnant left over from the early formation of our solar system about 4.6 billion years ago. Most asteroids orbit the Sun between Mars and Jupiter within the main asteroid belt.

atmosphere – the layer of gas that surrounds Earth. It is often called air. Other planets, and some of their larger moons, also have atmospheres.

big bang – a theory that describes how the universe we know began expanding rapidly from a very dense and incredibly hot state approximately 13.8 billion years ago.

biosphere – the zone of Earth that includes all living things; the part of the world in which life can and does exist.



climate – the long-term weather pattern in a region or globally. The state of and the interactions between the atmosphere, hydrosphere, geosphere, and biosphere determine climate.

data – factual information (such as measurements or statistics) used as a basis for reasoning, discussion, or calculation.

element – in chemistry, a pure substance containing only one type of atom.

energy – in space, energy is the capacity to cause change or movement within the universe (expressed as light, heat, radiation, motion, and more). Energy is needed for life to carry out essential functions and is gained through consuming food. It originated from the Sun.

galaxy – a massive collection of stars, gas, dust, and other celestial objects bound together into a single system by gravity. A galaxy may contain from ten million stars to one trillion stars. The Sun and Earth are in the Milky Way Galaxy.

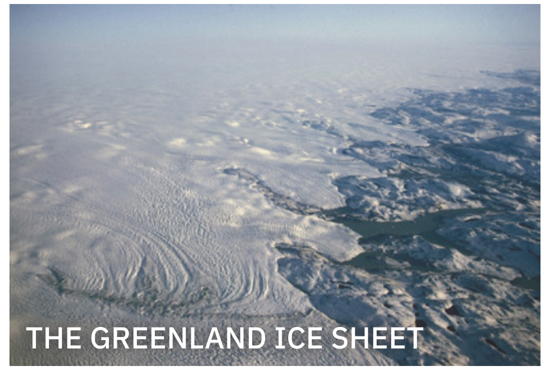
geosphere – the solid part of Earth, including rocks and minerals and towering mountains and grains of sand. It also includes the oceanic crust, Earth's molten rock interior, fossils, and skeletons of once-living organisms.

habitable – capable of being lived in or on (as a house, environment, or planet).

hydrosphere – all of the water on Earth, including water on Earth's surface, underground, in the air, and frozen as solid ice or snow.

ice sheet – a mass of glacial land ice that extends more than 20,000 square miles. Ice sheets are constantly in motion as ice flows outward from the sheet's edges.

Industrial Revolution – starting in the eighteenth century, the period of change from farm-based economy to one dominated by industry and machine manufacturing. Industrialization continues today.


THE GREENLAND ICE SHEET

mammal – warm-blooded animals with fur or hair, backbones, and three middle ear bones. They nourish their young with milk-producing mammary glands. You are a mammal!

matter – any substance that has mass and takes up space by having volume. Matter is made of atoms. You are made of matter!

methane – a chemical compound with the chemical formula CH_4 (one carbon atom bonded to four hydrogen atoms). Methane can be an indication of living things, but it can also be produced by processes that do not involve life.

methanogen – a microscopic life form (microorganism) that produces methane.

nebulae – plural form of nebula. Known as "star nurseries," nebulae are made of large clouds of interstellar gas and dust that look similar to clouds when viewed from far away. Over time, stars and planets can form within some nebulae.

physicist – a scientist who studies the fundamentals of nature, including matter, energy, forces, space and time, and their interactions.


ROSETTE NEBULA

planet – a planet is an object that (a) orbits the Sun, (b) is massive enough to be spherical in shape, and (c) has cleared away its neighboring region of other objects. There are eight planets in our solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

satellite – an object in space that orbits another object. Natural satellites already exist in space (planets, moons, asteroids, and such), and artificial satellites are made by people.

solar system – a system of planets, moons, asteroids, comets, and other small objects that orbit a star. The Sun is the star in our solar system.

star – a celestial body of hot, dense gas that generates light and other energy and is held together by its own gravity. The Sun is a star. Although stars look like tiny pinpoints of light to us, many are larger than the Sun. They look tiny because they are so far away.

supernova – the dramatic explosion that takes place during the final stages of the death of a super-massive star.

sustainability – the meeting of the needs of the present without compromising the ability of future generations to meet their own needs.

universe – all of space and time and all its contents, including the solar system and all stars and galaxies.

Intergalactic Pen Pals

A GLOSSARY-REVIEW ACTIVITY

INSTRUCTIONS

Fill in the orange-colored blanks in the story with Module 5 glossary terms from the word bank below. Use each glossary term only once and only in ways that make sense.

WORD BANK

Tip: Use a pencil! It might help to cross out the terms as you use them up.

star	methane	physicists	energy	ice sheets	satellites
elements	solar system	hydrosphere	galaxy	mammal	geosphere
biosphere	methanogens	Industrial Revolution	asteroids	Data	
atmosphere	~~habitable~~	sustainable	planet	universe	climate

THE STORY BEGINS...

It's the year 2251, and miraculous advances in science have allowed you to live for hundreds of years and send postcards to possibly *habitable* planets in the Andromeda galaxy! Maybe one of these planets has intelligent life. Maybe you'll get a postcard back. But wait—you accidentally left your postcard in the sanitation chamber for too long and some of your words faded! You better fill them in again using the word bank.

POWERED BY INTER-SPECIES TRANSLATION TECHNOLOGY

WRITE IN THIS AREA

Hello, life in the Andromeda Galaxy!

I am a human from Earth, in the Milky Way Galaxy, where our stable ____________ is maintained mostly by the Sun's ____________. Our climate system contains a diverse ____________, a solid and shifting ____________, a watery ____________ with liquid and solid parts, and an oxygen-rich ____________. Our large ____________ contains our star (Sun), eight planets and many moons, ____________ that orbit Earth, dwarf planets, comets, and ____________! What's your planet like?

Humans usually have four limbs, two-eye vision, big brains, and a developed vocal tract. We have no fur, antennae, or tails. What are you like?

Ever since our planet's ____________, people have been using our natural ____________ at a rate that is not ____________. Do you have any tips?

With astronomical awe,

Your Name:

NAM

TO WHOMEVER THIS REACHES

PLANET VAR

STAR SYSTEM G4-8071

ANDROMEDA GALAXY

LOCAL GROUP

UNIVERSE

THE STORY CONTINUES...

Great news, an intergalactic postcard arrived at your mailbox! Inter-species translation is a new science, however, and some words on the postcard could use some extra help with translation. Can you figure out what your alien pen pal is trying to say?

POWERED BY INTER-SPECIES TRANSLATION TECHNOLOGY

Greetings Earthling! I am from planet Var. It is a joy to share this vast __________ with you. We Vee-LuLus are warm-blooded, covered in bioluminescent fur, and highly intelligent. You too sound like an intelligent __________, but without fur...? Shocking.

Our sphere is cloaked in cold, like the __________ in your Earth's hydrosphere. Our skies weep the chemical compound __________, a life-giving nectar to the __________ that live beneath our ice. We live peacefully with these ancient microorganisms as they influence stable temperatures beneath the surface.

We are intrigued by your planet! It is concerning that your natural resources are declining at an unsuitable rate. Here are some "thinkings" from us Vartians:

Try to reuse what exists. Plant green friends. Conserve your drinking liquids. Trust your science humans and stay current on science. __________ is your greatest ally. Let your __________ probe the unseen forces binding your system together. Lastly, try to remain unified...you can accomplish more together, holding paws.

Galactically yours,
Vartian Vee-LuLu

YOUR NAME: __________

SCHOOL: __________

CITY: __________

STATE/REGION: __________

COUNTRY: __________

__________ : EARTH

__________ : SUN

__________ : MILKY WAY

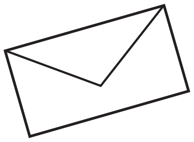
LOCAL GROUP

UNIVERSE

CONGRATULATIONS!

You became the first person to receive, and fully understand, a postcard from an extraterrestrial life form.

TEACHER VERSION



Intergalactic Pen Pals

A GLOSSARY-REVIEW ACTIVITY

INSTRUCTIONS

Fill in the orange-colored blanks in the story with Module 5 glossary terms from the word bank below. Use each glossary term only once and only in ways that make sense.

WORD BANK

Tip: Use a pencil! It might help to cross out the terms as you use them up.

~~star~~	~~methane~~	~~physicists~~	~~energy~~	~~ice sheets~~	~~satellites~~
~~elements~~	~~solar system~~	~~hydrosphere~~	~~galaxy~~	~~mammal~~	~~geosphere~~
~~biosphere~~	~~methanogens~~	~~Industrial Revolution~~	~~asteroids~~	~~Data~~	
~~atmosphere~~	~~habitable~~	~~sustainable~~	~~planet~~	~~universe~~	~~climate~~

THE STORY BEGINS...

It's the year 2251, and miraculous advances in science have allowed you to live for hundreds of years and send postcards to possibly *habitable* planets in the Andromeda galaxy! Maybe one of these planets has intelligent life. Maybe you'll get a postcard back. But wait—you accidentally left your postcard in the sanitation chamber for too long and some of your words faded! You better fill them in again using the word bank.

POWERED BY INTER-SPECIES TRANSLATION TECHNOLOGY

WRITE IN THIS AREA

Hello, life in the Andromeda Galaxy!

I am a human from Earth, in the Milky Way Galaxy, where our stable *climate* is maintained mostly by the Sun's *energy*. Our climate system contains a diverse *biosphere*, a solid and shifting *geosphere*, a watery *hydrosphere* with liquid and solid parts, and an oxygen-rich *atmosphere*. Our large *solar system* contains our star (Sun), eight planets and many moons, *satellites* that orbit Earth, dwarf planets, comets, and *asteroids*! What's your planet like?

Humans usually have four limbs, two-eye vision, big brains, and a developed vocal tract. We have no fur, antennae, or tails. What are you like?

Ever since our planet's *Industrial Revolution*, people have been using our natural *elements* at a rate that is not *sustainable*. Do you have any tips?

With astronomical awe,

Your Name:

NAM

TO WHOMEVER THIS REACHES

PLANET VAR

STAR SYSTEM G4-8071

ANDROMEDA GALAXY

LOCAL GROUP

UNIVERSE

TEACHER VERSION

THE STORY CONTINUES...

Great news, an intergalactic postcard arrived at your mailbox! Inter-species translation is a new science, however, and some words on the postcard could use some extra help with translation. Can you figure out what your alien pen pal is trying to say?

POWERED BY INTER-SPECIES TRANSLATION TECHNOLOGY

Greetings Earthling! I am from planet Var. It is a joy to share this vast *universe* with you. We Vee-LuLus are warm-blooded, covered in bioluminescent fur, and highly intelligent. You too sound like an intelligent *mammal*, but without fur...? Shocking.

Our sphere is cloaked in cold, like the *ice sheets* in your Earth's hydrosphere. Our skies weep the chemical compound *methane*, a life-giving nectar to the *methanogens* that live beneath our ice. We live peacefully with these ancient microorganisms as they influence stable temperatures beneath the surface.

We are intrigued by your planet! It is concerning that your natural resources are declining at an unsuitable rate. Here are some "thinkings" from us Vartians:

Try to reuse what exists. Plant green friends. Conserve your drinking liquids. Trust your science humans and stay current on science. *Data* is your greatest ally. Let your *physicists* probe the unseen forces binding your system together. Lastly, try to remain unified...you can accomplish more together, holding paws.

Galactically yours,
Vartian Vee-LuLu

YOUR NAME:

SCHOOL:

CITY:

STATE/REGION:

COUNTRY:

planet : EARTH

star : SUN

galaxy : MILKY WAY

LOCAL GROUP

UNIVERSE

CONGRATULATIONS!

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Making Cosmic Connections

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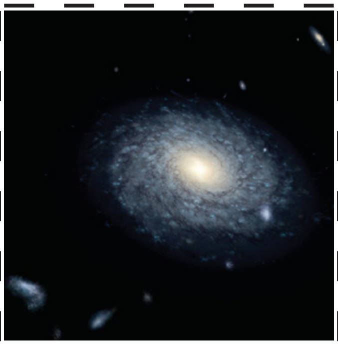
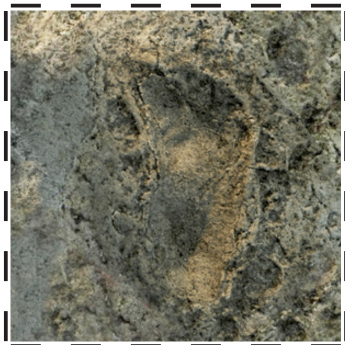
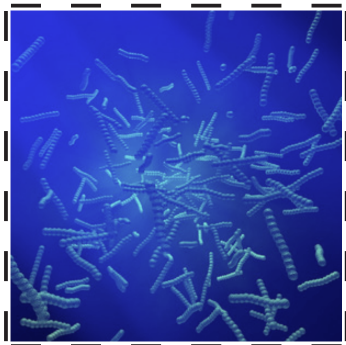
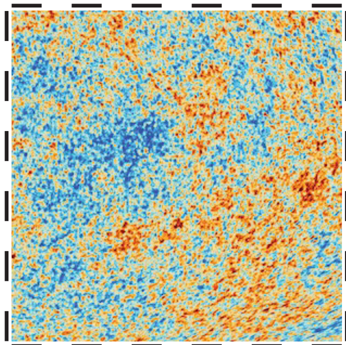
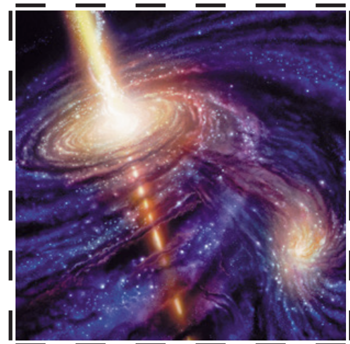
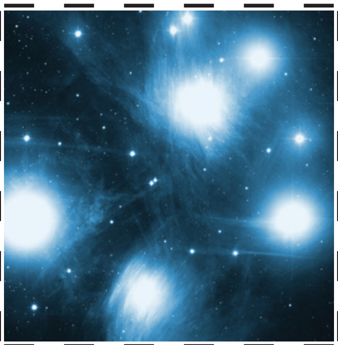
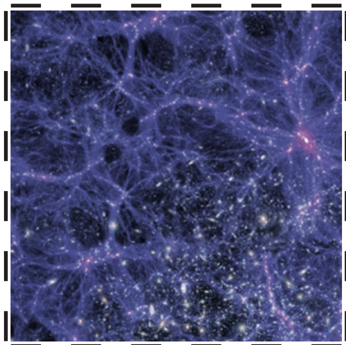
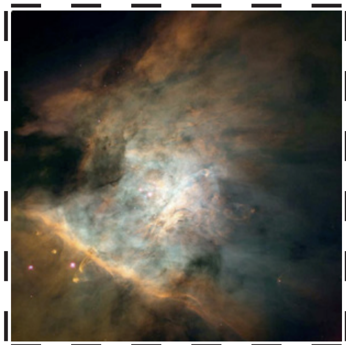


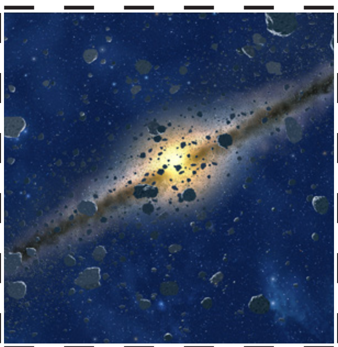
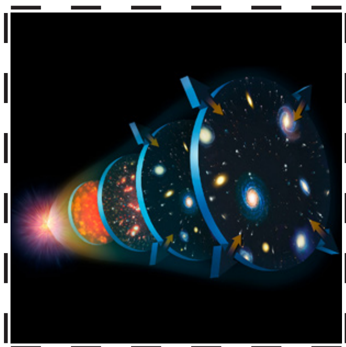

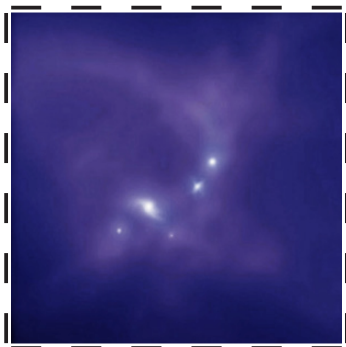


BILLIONS OF YEARS

0

The Beginning of Time

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400,000 years after the big bang

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1

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Vera Rubin and Kent Ford

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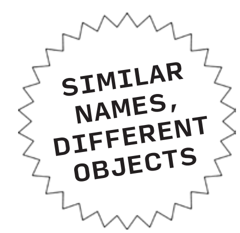
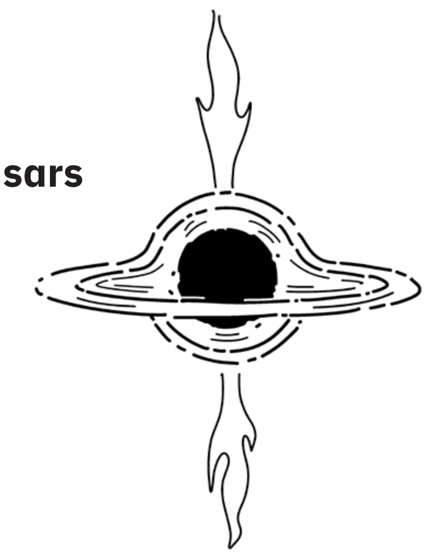
Lights Full On

1.4 billion years after the big bang

Pulsars vs. Quasars





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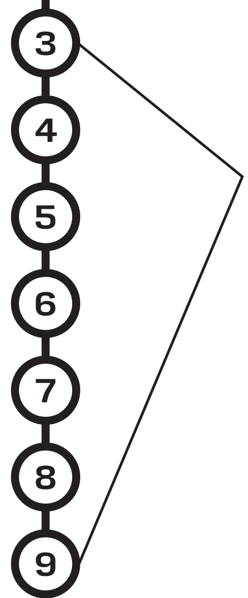

FACT: For the next many billions of years, the universe continued to expand and cool. Generations of stars came and went. Galaxies evolved and often collided, and the cosmic web of galaxies grew more and more complex.

Making a Neighborhood
9.1 billion years after the big bang

Hint: Our solar system is born. A "nebula," a vast cloud of gas and dust in outer space, begins to rotate around a star. Eventually, clumps of matter form planets orbiting the star. This explanation for solar system formation was developed in the 1700s by Swedish scientist Emanuel Swedenborg, German philosopher Immanuel Kant, and French scholar Pierre Laplace.

Icy objects in an outer region called the Kuiper Belt, discovered by astronomers Jane Luu and David Jewitt, are thought to be remnants from the formation of the solar system.

David Jewitt and Jane Luu

10

Impacts Call It an Era

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Impacts from objects orbiting the Sun helped build worlds in the early solar system. The scars visible on the Moon are from the last major collisions in the era of planet formation.

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Getting a Life

10.2 billion years after the big bang

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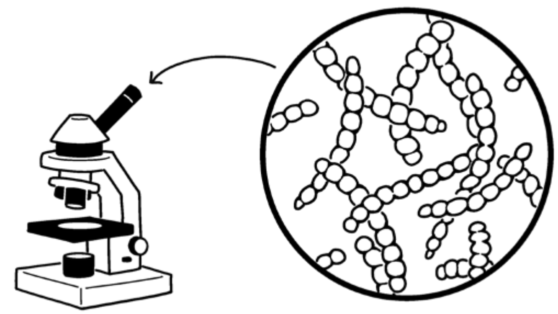

FACT: Throughout the next couple of billion years after life emerged on Earth, new single-cell organisms appeared. They are called **cyanobacteria**, and they produced so much oxygen, they changed Earth and the life on it. Cyanobacteria paved the way for a new kind of life that breathes oxygen–like us–to develop.

Emmett Chappelle

In 1958, African-American scientist Emmett Chappelle discovered that certain single-cell organisms are able to photosynthesize, like plants. This means they convert carbon dioxide to sugar and water into oxygen. His research and others' contributed to our understanding of cyanobacteria.

11

12

13

Hard Bodies

13.1 billion years after the big bang

Hint: At this time, all animals still lived in the sea. A rich and diverse population of arthropods, or hard-shelled organisms with exoskeletons, spread through the oceans. In the early twentieth century, American paleontologist Charles Doolittle Walcott was one of the first scientists to study arthropods and examined over 65,000 fossil samples during his career.

High Plains Drifters

13.35 billion years after the big bang

Hint: Life on Earth expands its habitat from the ocean to the land. Some amphibians join insects and plants and adapt to life outside of water. They set the stage for new forms of life to evolve. Between 1913 and 1963, Alice Wilson, Canada's first female geologist, mapped and conducted scientific studies of rocks and fossils in a 14,000-square-kilometer area of the Ottawa region—all alone! She focused on fossils of the Ordovician period, which is when life first took hold on land.

Bright Young Stars

13.63 billion years after the big bang

Hint: Star formation continues in our galaxy as new stars are born in clouds of gas and dust. The Pleiades, a group of hot young stars, first began to shine just before the dinosaurs died out on Earth. The earliest mammals were better suited to adapt to climate change. We try to understand our constantly-changing world with help from scientists like Dr. Kathleen R. Johnson of the Grand Traverse Band of Ottawa and Chippewa Indians. She focuses her research on the changing climate and weather patterns of millions of years ago.

Rocking the Cradle

13.69 billion years after the big bang

Hint: New stars form constantly in giant space clouds called nebulae. In 1902, English astronomer Sir James Jeans suggested that gravity causes the gas molecules in nebulae to clump together and create hot, dense globules. The cores in these globules become "protostars," as suggested by Japanese astrophysicist Chushiro Hayashi in 1966. They eventually get so large and hot that they burn hydrogen through a process called fusion, and a star is finally born!

14

Our Cosmic Connection

13.7 billion years after the big bang

Hint: People first walked on the surface of another celestial object in 1969, when Neil Armstrong stepped down from the lunar lander onto the Moon's surface and famously said, "One small step for a man, one giant leap for mankind." These footsteps and those of astronauts to follow have left a significant mark on our understanding of our place in the universe.

Hint: In 1976, paleoanthropologist Mary Leakey led an archaeological dig in Laetoli, Tanzania, Africa. Team members engaged in an elephant dung fight for a moment of fun. Andrew Hill, a member of the team, was dodging poop, and he tripped and fell face-first onto fossilized rock. As Leakey later confirmed, the fossils were footprints of our early human ancestors. The "Laetoli footprints," as they're called, are about 3.6 million years old.

Distant Ancestors

13.696 billion years after the big bang

Illustrations by Ian Crovella

TEACHER VERSION

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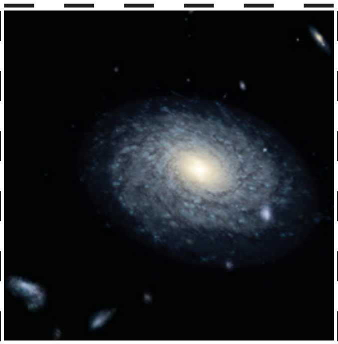

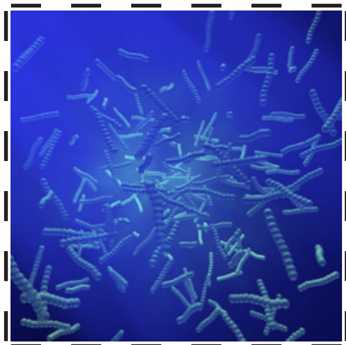
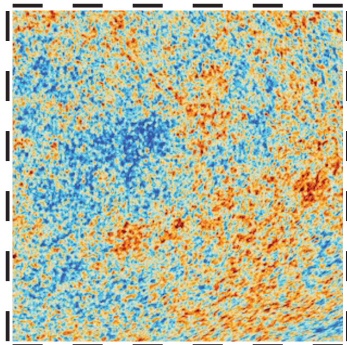
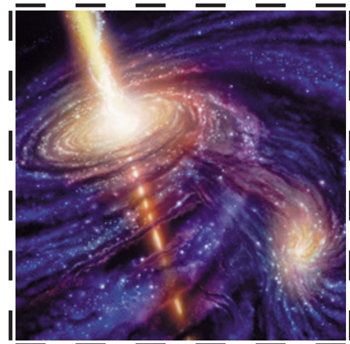
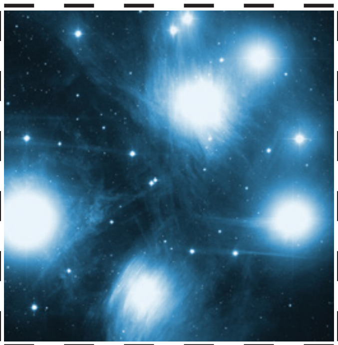
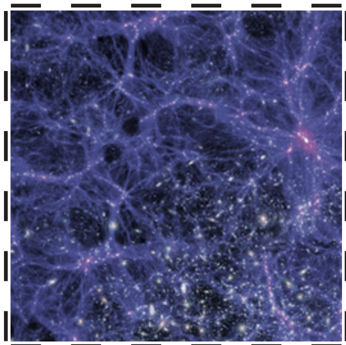
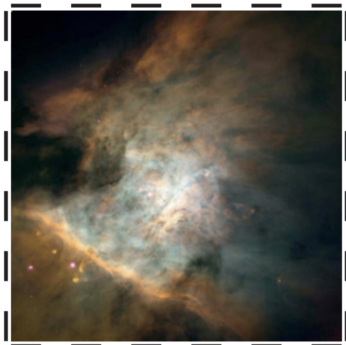


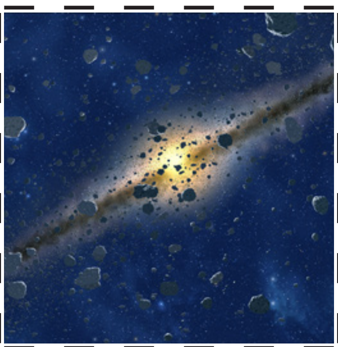
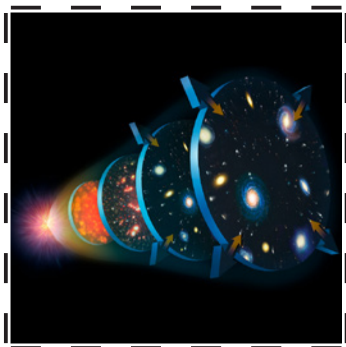

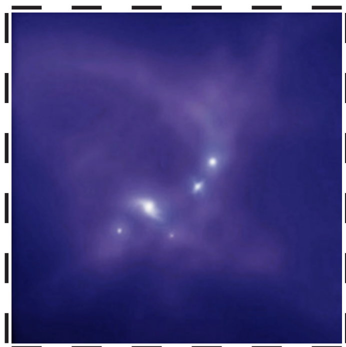


TEACHER VERSION

BILLIONS OF YEARS

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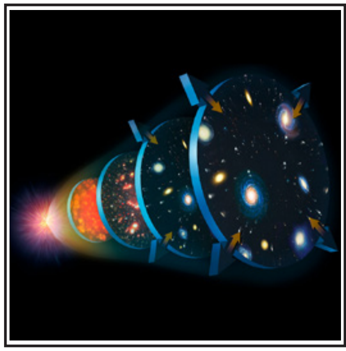

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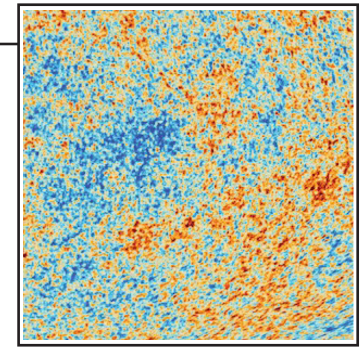

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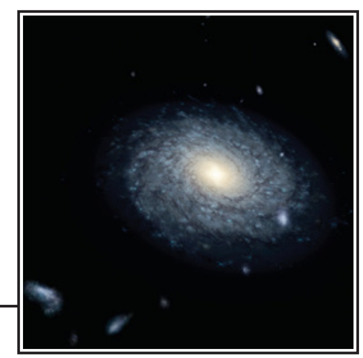

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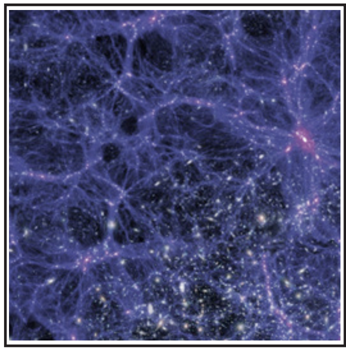

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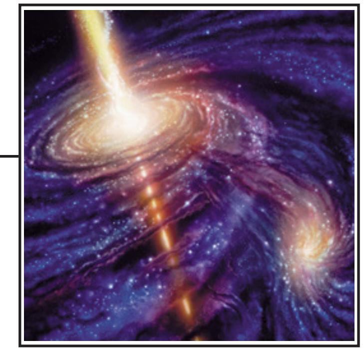

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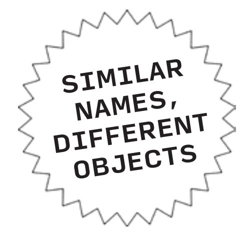

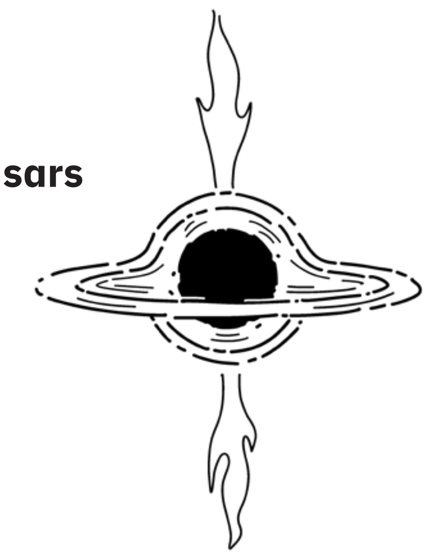

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3 4 5 6 7 8 9

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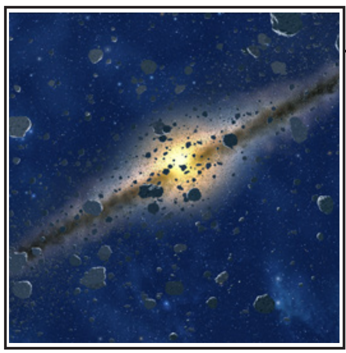

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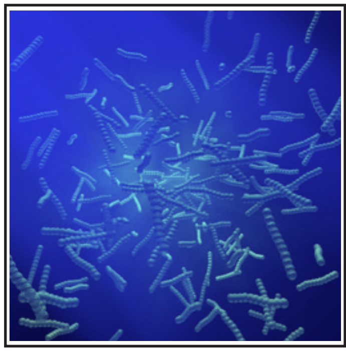

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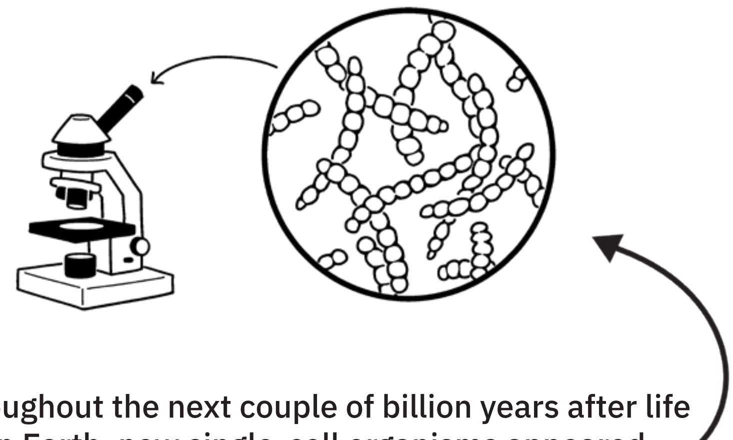
Hint: American scientist J. William Schopf found fossils in Western Australia of the oldest life. They are almost as old as Earth. These early traces of life provide a model in our search for life in the universe. Astrobiology is the study of potential life beyond Earth, and it is a popular topic in science as space exploration continues to inspire curiosity.



FACT: Throughout the next couple of billion years after life emerged on Earth, new single-cell organisms appeared. They are called **cyanobacteria**, and they produced so much oxygen, they changed Earth and the life on it. Cyanobacteria paved the way for a new kind of life that breathes oxygen–like us–to develop.

11

In 1958, African-American scientist Emmett Chappelle discovered that certain single-cell organisms are able to photosynthesize, like plants. This means they convert carbon dioxide to sugar and water into oxygen. His research and others' contributed to our understanding of cyanobacteria.

Emmett Chappelle

12

13

Hard Bodies

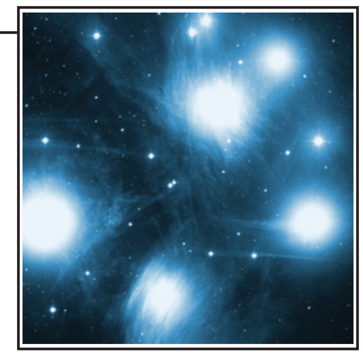
13.1 billion years after the big bang

Hint: At this time, all animals still lived in the sea. A rich and diverse population of arthropods, or hard-shelled organisms with exoskeletons, spread through the oceans. In the early twentieth century, American paleontologist Charles Doolittle Walcott was one of the first scientists to study arthropods and examined over 65,000 fossil samples during his career.

High Plains Drifters

13.35 billion years after the big bang

Hint: Life on Earth expands its habitat from the ocean to the land. Some amphibians join insects and plants and adapt to life outside of water. They set the stage for new forms of life to evolve. Between 1913 and 1963, Alice Wilson, Canada's first female geologist, mapped and conducted scientific studies of rocks and fossils in a 14,000-square-kilometer area of the Ottawa region—all alone! She focused on fossils of the Ordovician period, which is when life first took hold on land.



Bright Young Stars

13.63 billion years after the big bang

Hint: Star formation continues in our galaxy as new stars are born in clouds of gas and dust. The Pleiades, a group of hot young stars, first began to shine just before the dinosaurs died out on Earth. The earliest mammals were better suited to adapt to climate change. We try to understand our constantly-changing world with help from scientists like Dr. Kathleen R. Johnson of the Grand Traverse Band of Ottawa and Chippewa Indians. She focuses her research on the changing climate and weather patterns of millions of years ago.

Rocking the Cradle

13.69 billion years after the big bang

Hint: New stars form constantly in giant space clouds called nebulae. In 1902, English astronomer Sir James Jeans suggested that gravity causes the gas molecules in nebulae to clump together and create hot, dense globules. The cores in these globules become "protostars," as suggested by Japanese astrophysicist Chushiro Hayashi in 1966. They eventually get so large and hot that they burn hydrogen through a process called fusion, and a star is finally born!

14

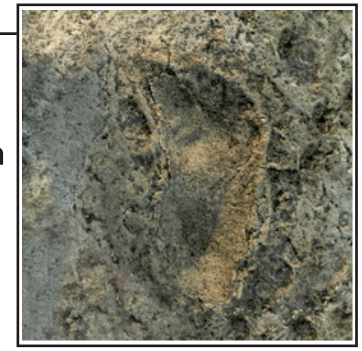
TEACHER VERSION

Our Cosmic Connection

13.7 billion years after the big bang

Hint: People first walked on the surface of another celestial object in 1969, when Neil Armstrong stepped down from the lunar lander onto the Moon's surface and famously said, "One small step for a man, one giant leap for mankind." These footsteps and those of astronauts to follow have left a significant mark on our understanding of our place in the universe.

Hint: In 1976, paleoanthropologist Mary Leakey led an archaeological dig in Laetoli, Tanzania, Africa. Team members engaged in an elephant dung fight for a moment of fun. Andrew Hill, a member of the team, was dodging poop, and he tripped and fell face-first onto fossilized rock. As Leakey later confirmed, the fossils were footprints of our early human ancestors. The "Laetoli footprints," as they're called, are about 3.6 million years old.



Distant Ancestors

13.696 billion years after the big bang

Illustrations by Ian Crovella

Exploring Environment Evolution

A SHORT–ANSWER HANDOUT

Our environment is affected by our actions. Looking at how we affect our environment locally helps us understand how we affect our environment on a long-term and global scale. This handout inspires thought about how we change environments to meet our needs.

PART ONE: BEFORE AND AFTER

Two important sites will be built in this mountain range in the 1920s and 1930s. Can you guess what they are?

This is an image of Los Angeles from 1896. What changes can you imagine that people made since then to make living easier? How many people do you think could live here comfortably? What resources do they need to survive?

If you want thousands of people to be able to live sustainably in this area less than 100 years later, what do you need to prepare for them?

The Hollywood Sign (originally "Hollywoodland") was installed in 1923, and Griffith Observatory opened its doors in 1935.

This is a picture taken from the same location but in 2024. What changes have people made since 1896? Can you list a few things in the foreground and middleground that are different?

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How many people do you think can comfortably live in this place now? What changes would you make if you wanted even more people to live sustainably in this area in another 100 years?

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Griffith Observatory now stands prominently on the slope of a mountain that overlooks Los Angeles. What do you think people needed to do to create an observatory at that location?

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Griffith Observatory under construction in 1934

PART TWO: MOVING TO MARS?

Think about what we would need to make the Martian environment livable.

Surface of Mars

Los Angeles

Mars is very cold. NASA's *Curiosity* rover has a **MARS DAILY WEATHER REPORT** that you may check anytime. The low temperature is typically -100°F, and the high temperature is around 10°F. There is 100 times less atmosphere than on Earth, and it is made almost entirely of carbon dioxide. That's what we breathe out, not in. There is hardly any useful air for people on Mars. There is no liquid water on the surface of Mars, either. There is frozen water buried under the ground at some locations and at the polar ice caps. Mars is a harsh place.

List three things that people would need in order to live on Mars. Think about basic human needs first.

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Where can we get these things we need to survive? Do we need to bring them from Earth, or do you think there is a way to get what we need from Mars?

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Living on Mars will be hard. List three things that Earth already has that Mars needs for people to be able to live there **sustainably** (This word is defined in the Module 5 glossary.).

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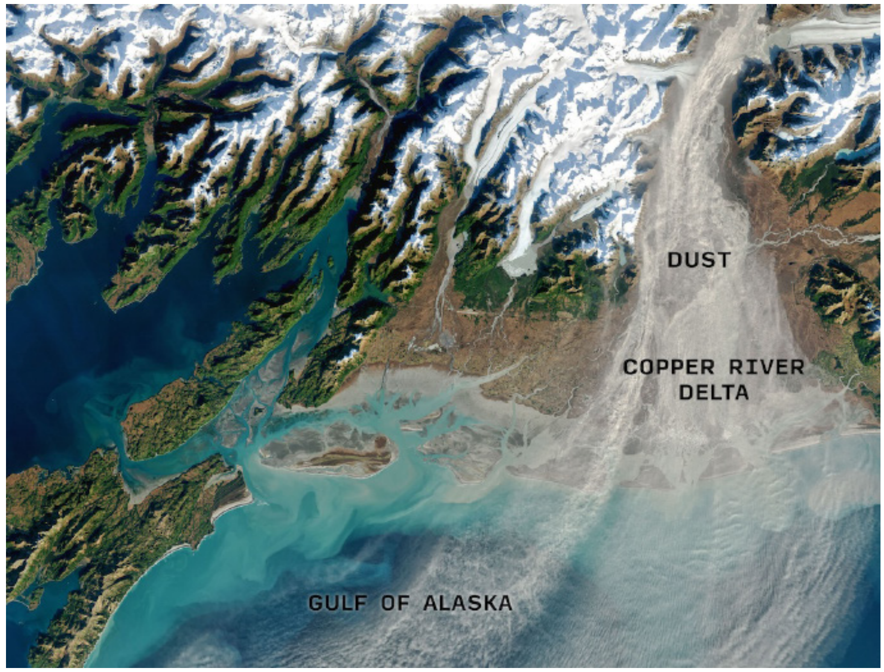
PART THREE: OBSERVING CHANGES ON EARTH

NASA has satellites that observe Earth and resources that let you see what is happening. Earth Observatory Kids (linked below) is published with support from NASA's Landsat, Terra, and Aqua missions and is written for audiences aged 9 to 14.

Explore the **EARTH OBSERVATORY KIDS WEBSITE**.

Find and describe one way that people are using space to observe changes on Earth. Then, explain how space helps us understand Earth better. For example, satellites can track dust from space. That's demonstrated in this image of the Copper River valley in Alaska. This true color image was taken by the *Landsat 8* satellite on October 22, 2020. The view lets us see how the dust is blown out past the land and how it interacts with the sea.



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WRAP UP: Now you can see how we change the environment in which we live and how that can translate to changing environments on other worlds as well. Understanding that we have all the resources we need right now to maintain balance at home is important. Earth is the only planet that now has everything we need. Living sustainably is possible when we observe and plan for the changes that are certain to come.

IMAGE CREDITS IN ORDER: JARRED DONKERSLEY, SECURITY PACIFIC NATIONAL BANK COLLECTION/LOS ANGELES PUBLIC LIBRARY, DR. DAVID REITZEL, AUSTIN CHALK, NASA/JPL-CALTECH/ASU/MSSS, DAVID PINSKY, JOSHUA STEVENS/*LANDSAT*

The Roll of a Lifetime

AN EXPERIMENT TO DO WITH AN ADULT

IT'S THE YEAST YOU CAN DO!

ACTIVITY OBJECTIVE

In this hands-on activity with a delicious result, participants witness an organism changing its environment and the environment changing the organism, too.

FIFTH-GRADE NGSS STANDARDS ADDRESSED

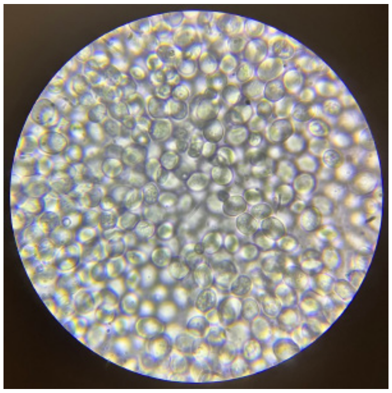
5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5.LS2.B (5-LS2-1): Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment.

UNDERSTANDING BREAD AS AN ENVIRONMENT

Ever since life began on Earth over 3.5 billion years ago, living things have affected Earth. Life and Earth are intertwined, and neither can change without affecting the other. This is true even for the organisms in bread.

Yeast is a simple organism that people use when making bread. It can change its environment if the conditions are right. All living things need the right chemical ingredients, water, energy, and a stable environment. We can see this in action and end up with delicious dinner rolls.



BAKING YEAST CELLS - 40X

The yeast in bread uses the flour for chemicals, sugars as energy, and water. The stable environment is usually a bowl on the kitchen counter. Yeast makes the dough rise and gets it ready for baking by turning sugars into gas. That adds bubbles, and those make bread fluffy and delicious. Yeast alters its environment in a short time, and luckily for us, it's one way to make bread extra tasty.

Follow this simple recipe with an adult to see the yeast in action and end up with rolls!

MATERIALS NEEDED

- two large bowls
- a whisk or fork
- a spatula or wooden spoon
- measuring cups and spoons
- a clean dish towel or plastic wrap
- a large, clean, flat surface
- an oven
- an 8- or 9-inch square or round baking dish
- 2 ½ cups all-purpose flour or bread flour (Spoon and level your flour. Do not scoop it out of the package. This ensures that your dough doesn't get too tough.)
- 2 ¼ teaspoons active dry yeast (one packet)
- 1 ½ teaspoons salt
- 2 tablespoons granulated sugar
- 3 tablespoons vegetable or olive oil
- 1 cup warm water (about 110°F)
- 3 tablespoons of melted butter or plant-based alternative spread
- (optional) fruit preserves, honey, gravy, *etc.*

INSTRUCTIONS

1. Add the flour (chemicals), sugar (energy), salt, and yeast (organism) to a large bowl (stable environment).
2. Mix them together well using a whisk or fork.
3. Add the oil and warm water. The yeast will activate now that it has everything it needs to eat and produce waste (We promise this is a good thing and not gross!).
4. Mix the ingredients with your silicone spatula or wooden spoon until they come together and form a dough.
5. Once the ingredients are combined, it is time to knead the dough. Put a little flour on a flat surface. Wash and dry your hands, then put some flour on them. Transfer the dough to your floured surface.
6. Knead the dough by hand for five full minutes by smooshing it out into a flat shape about ½ inch thick, then folding it in half, rotating it 90°, and folding it again. Repeat.
7. If the dough is too wet to knead, add a tablespoon of flour. If it is too dry, add a bit of water. Knead until the dough is smooth and stretchy.

Kneading develops chewy **gluten**, a sticky protein that helps trap the carbon dioxide bubbles released by yeast. This helps your bread develop a light and fluffy texture.

INSTRUCTIONS CONTINUED...

8. Place the dough in a greased bowl and turn it to coat all sides in the oil, and cover with plastic wrap or a dish towel. Place it in a stable environment of about 70 to 75°F.
   - Tip: If it's too cold or too hot outside, place a baking dish on the bottom rack of your unheated oven and have an adult fill it with boiling water. Place your dough on the middle or top rack and shut the door.
9. The dough should double in size in about an hour.

If your dough grew, that's a sign that the yeast has changed its environment! When you added the warm water, the yeast activated and fed on the sugar and starches in the flour. Then, a chemical reaction occurred, and the yeast released a new substance, carbon dioxide gas. Do you see signs of bubbles? Those are the carbon-dioxide gas pockets. The air pockets made your dough grow.

10. Divide the dough ball into nine equal-sized portions. Shape them into smooth topped balls and place into a greased 8- or 9-inch square or round baking dish.
11. Cover again and let these rise until doubled in size. This will take about another hour.
12. Have your adult preheat the oven to 400°F and bake your dinner rolls for 15 minutes or until the tops are a light golden brown.

When you put bread in the oven, the yeast responds to its warming environment by making even more carbon-dioxide bubbles. This continues until the environment gets too hot for the yeast (around 122°F) and they start to die off. Yeast cells don't have brains or nervous systems, but they did complete an important function. You can thank them for the energy they will give you.

13. After removing the rolls from the oven, immediately brush them with butter or olive oil to make them shine.
14. Enjoy with your favorite spreads or sandwich fixings. Try different combinations with the rolls that you, with the help of the yeast, made from scratch.

PICTURES BY DR. DAVID REITZEL

Modern and Pleistocene Los Angeles Name: ______________________

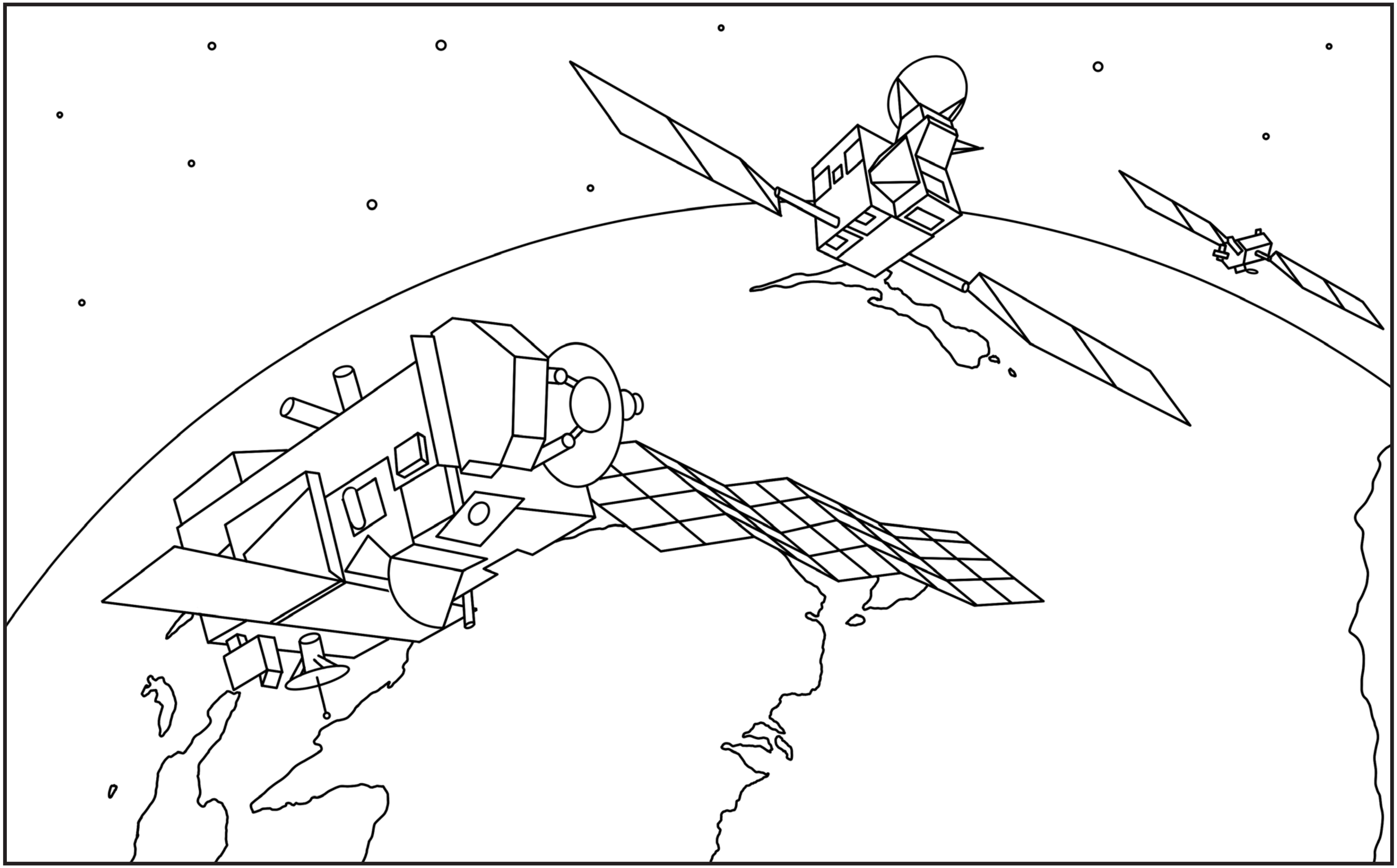
Los Angeles is home to one of the most famous Pleistocene fossil deposits in the world (La Brea Tar Pits). It contains a rich record of life in southern California from 11,000 to 50,000 years ago.

By Ian Crovella

Earth Observation Satellites

Name: ______________________

Observing the full picture about our changing climate takes a fleet of satellites. NASA's network of satellites provides climate scientists with the information they need to predict accurately how Earth's climate will respond to changes we make. The satellites pictured are: **Aura** (left; studies Earth's atmosphere), **GCOM-W1** (middle; observes water-cycle changes), and **OCO-2** (right; studies CO_2 levels).



By Ashley Ferrum

A-Z Responsible Disposal

Do you reduce, reuse, recycle, or repurpose any of your belongings? Most household items have more than one option for disposal. Choosing how you dispose of these common household items is an opportunity to be responsible and help our planet stay healthy.

The symbol(s) next to each item cooresponds to instructions for responsible disposal below.

- **A** aerosol cans
- **B** batteries
- **C** cardboard
- **D** drink cans
- **E** electronic waste
- **F** food cans
- **G** glass bottles
- **H** household containers
- **I** ice cream cartons
- **J** jars (lids removed)
- **K** kitchen utensils (plastic)
- **L** leftover food
- **M** magazines
- **N** newspapers
- **O** old clothes
- **P** plastic bags/wrappers
- **Q** quilts/blankets/towels
- **R** rubber bands
- **S** soiled pizza boxes/napkins
- **T** toilet paper tubes
- **U** used toys
- **V** video games/consoles
- **W** water/soda bottles
- **X** Xerox paper (regular paper)
- **Y** yogurt cups (lids removed)
- **Z** Ziploc bags

Recycle: *All* items with this symbol must be empty, clean, and dry to avoid contaminating other recyclables. Item must not be shredded. In Los Angeles, you don't need to bag your blue bin recyclables. Check your local recyclable collecting service for the most accurate guidance.

Reduce: Items with this symbol usually may not be recycled curbside. Purchase and use this item mindfully. Check with your local recyclable collecting service guidelines for how to responsibly dispose or recycle this item. Or, there might be a more reusable alternative!

Reuse: Items with this symbol may be reused or donated. Donation helps others and reduces waste. Research whether a local shelter or donation center accepts your item.

Repurpose: Crafts, gifts, and other useful items could be made with this item.

Compost: All Los Angeles Sanitation and Environment (LASAN) customers should use the green bin to dispose of all food scraps and food-soiled paper, along with their existing yard waste.

These guidelines are based on 2024 CalRecycle guidelines and are not the same for every community. Always check your ***local recyclable collecting service*** *for up-to-date guidelines.*

Imagining Jobs in Space

A SHORT–ANSWER HANDOUT

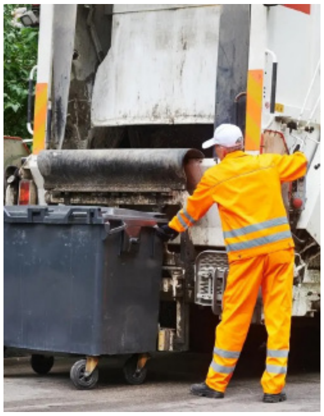
There are many choices for careers and jobs here on Earth. Some are new versions of jobs we have done for a long time. For example, sanitation workers handle garbage collection, which is vital for keeping resources like water clean and our communities healthy. Most of these jobs evolved out of our need to use the resources around us to make our environment more livable.

PART ONE: ECO–FRIENDLY JOBS

Pick one of the jobs below and research to find out what people do in that job. Write your description of the job below.

Recycling Technician

Forestry Worker



Sanitation Worker

Agricultural Specialist

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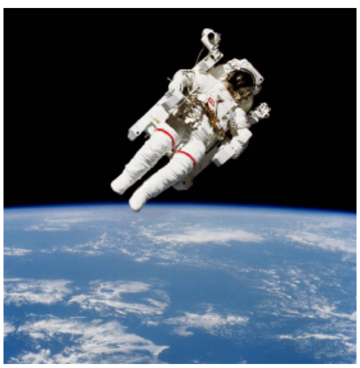
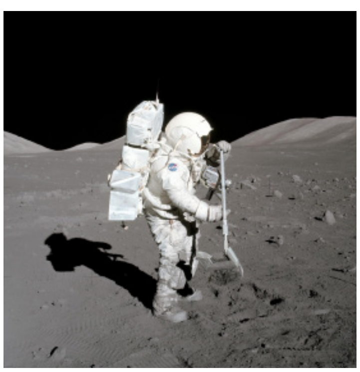
Exercise: Think of places in your community where these jobs have an impact. Describe how at least one of these jobs makes an impact below.

PART TWO: JOBS IN SPACE

Imagine a future version of a job people do on Earth but is a job done in space, or on the surface of a moon or a planet other than Earth. Here are two examples.



Pilot-astronaut Bruce McCandless tests a device to allow him to move around Space Shuttle *Challenger* without a tether for the first time ever. On Earth, he is a pilot. In space, what would you call this new job he is doing—testing equipment outside of a spacecraft? There are no wrong answers.



Scientist-astronaut Harrison H. Schmitt uses a special rake to collect lunar samples on the *Apollo 17* mission. These will be studied later. On Earth, he was a geologist (prefix *geo* means "earth" or "ground"). What would you call the job he is doing on the Moon? There are no wrong answers.

Think of a job on Earth that would be needed in space. What do you call this new job? For example, a delivery driver would be needed in space because people need supplies delivered. In outer space you might need a shuttle pilot to bring supplies. We don't drive in orbit. Use your imagination!

How do you think, based on what you know about the job on Earth, the job might work in outer space or on another planet? Would you need special equipment to protect the worker or to get the job done? Would the job be easier or harder in this unique location?

PART THREE: VISUALIZING THE JOB

Using your idea and your description written for Part Two, draw a person working in space or on another planet or moon and doing that job. Be imaginative—it can either be based in reality or complete fantasy. Include any robots or other machinery and equipment, like space suits, that are needed for the job.

Don’t worry if your drawing is not as good as someone else’s. You will get better each time you draw something.

PART FOUR: REALITY

Remember the eco-friendly Earth job examples from Part One? Here we have described the *actual* space-based versions of these jobs.

Sanitation and Recycling in Space: Astronauts can process small pieces of trash in a high-temperature reactor, which breaks the waste down into water, oxygen, and other gases which the crew can use or vent as needed. Besides the gases, the leftovers of the waste are greatly reduced in size and sterilized. Since it costs so much to get things into orbit, astronauts work hard to get as much use from those items as possible. What can we learn from what we do on Earth to best prepare us to live in space? Is there anything you can try at home?

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Forestry in Space: Seeds were taken into space for the *Apollo 14* mission and when returned to earth, they did grow. There are, however, currently no jobs that involve forests in space. Someday, if we plant forests in space, these jobs might be needed. Planning will begin here on Earth. What would you need to bring to the Moon if you wanted to plant a forest?

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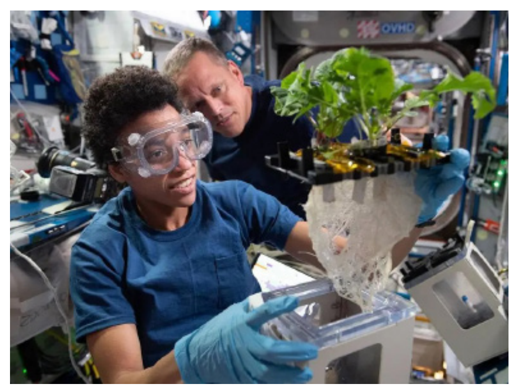
Agricultural Specialists in Space: The Vegetable Production System (Veggie) has been used aboard the *International Space Station (ISS)*. Plants tested in Veggie so far include lettuce, leafy greens, flowers, and even radishes. Growing food is an important part of our research for living in space. Plant-growth experiments in space need to be compared to how plants grow on Earth. Can you think of ways to prepare to do agricultural experiments in space? Are there experiments you can do at home now to prepare?



In 2022, NASA astronauts Jessica Watkins and Bob Hines used instruments in the *International Space Station's* Veggie facility to test soilless methods of growing plants.

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WRAP UP: Discuss why these jobs on Earth work best when they're in balance with our environment. How can we translate maintaining a healthy environmental balance into working in space?

Citizen Science

HELP POWER REAL RESEARCH

No matter your age or level of experience, you can help scientists change the world, and have fun doing it, too! Citizen Science projects are direct ways to help real researchers online. Citizen Science makes research possible that would not be possible otherwise. These projects result in new discoveries, create new data with many uses, and expand our understanding of Earth, life, and outer space.

Here are two sites that contain Citizen Science projects.

NASA CITIZEN SCIENCE

You can help make actual scientific discoveries with data from NASA! Through collaborations with NASA scientists, search for undiscovered worlds, protect and improve life on Earth and in space, and decode the secrets of the universe.

https://science.nasa.gov/citizen-science/

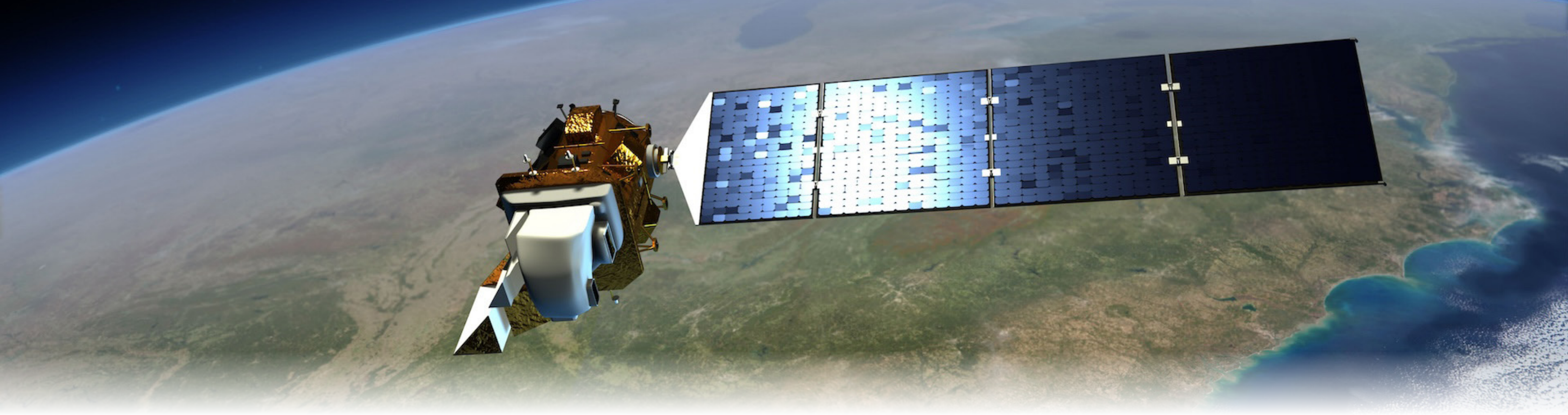
ZOONIVERSE

The Zooniverse is a big portal for people-powered research. You can classify data from many research fields, including climate, biology, space, medicine, history, and more! In the Zooniverse, there's a place for everyone to contribute to science.

https://www.zooniverse.org/

HELP

- Worried that your classifications may be incorrect? That's OK—many people will see the data, and everyone's classifications will be combined to produce a result. The combined knowledge of many people tends to give the right answer.
- If a project in which you're interested is on pause, check back later; projects are typically updated with new data regularly.



Surf the Earth-observing Web

Check out these trusted online educational resources from NASA and continue your Earth-observing journey. You can make a positive impact on our planet's health simply by staying informed about climate science.

NASA CLIMATE KIDS

This K-8 portal from NASA's Jet Propulsion Laboratory has games, activities, crafts, videos, and articles about climate science. There is much to learn from NASA's missions that study Earth! This site for students tells the story of our changing planet through the eyes of the NASA missions studying Earth.

https://climatekids.nasa.gov/

EYES ON THE EARTH

Keep an eye on Earth's health with this beautiful 3D visualization. You can discover what Earth-observing satellites are up there, where they are, and what they're doing right now. You can even view near real-time data and images of recent Earth events.

https://eyes.nasa.gov/apps/earth/#/

EO KIDS

This resource created for students ages 9-14 features articles and hands-on activities about Earth science published with support from NASA's *Landsat*, *Terra*, and *Aqua* satellite missions.

https://earthobservatory.nasa.gov/blogs/eokids/

SPOT THE STATION

Watch the *International Space Station* pass overhead! It is the third brightest object in the sky and easy to spot if you know when to look up. This mobile app and website makes it easy to find.

https://nasa.gov/spot-the-station/

NASA CLIMATE CHANGE

This is NASA's central hub for climate science. Get connected to the latest articles, videos, interactive data, resources, and more.

https://science.nasa.gov/climate-change/

Internet Resources

Not all websites are equally accurate. The world wide web, while convenient, can frequently provide incorrect and incomplete information. Below is a list of some of the best space science websites recommended by Griffith Observatory educators.

GRIFFITH OBSERVATORY

The most-visited public observatory in the world.

https://griffithobservatory.org

ASTRONOMY CLUBS

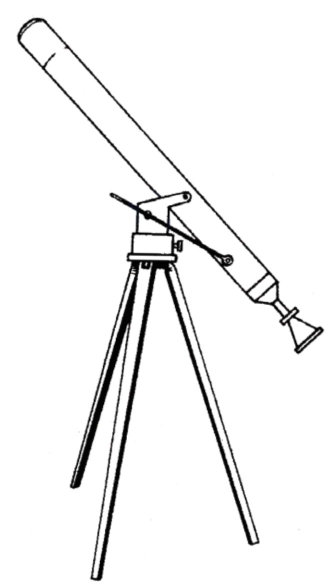
Find an astronomy club near you! Amateur (and some professional) astronomers are happy to share their telescopes, their enthusiasm, and their knowledge. A list of local clubs and more information may be found on our website:

https://obs.la/astronomyresources

CITIZEN SCIENCE PROJECTS

You may make a real contribution to astronomy by participating in these scientific projects.

Help scientists with their research into stars, Mars, Earth, galaxies, astronautics, the Sun, and black holes! Multiple projects are listed at this website:
https://science.nasa.gov/citizen-science



Another useful site that lists multiple Citizen Science projects:
https://zooniverse.org

NASA WEBSITES FOR SPACE FANS

Check out games and projects for budding space scientists:
https://spaceplace.nasa.gov/menu/play

Explore space with NASA’s remarkable app, “NASA’s Eyes:”
https://science.nasa.gov/eyes

Visit websites dedicated to learning for grades 5 through 8:
https://nasa.gov/learning-resources/for-students-grades-5-8

Watch NASA’s live and original programming for free:
https://plus.nasa.gov

GRIFFITH OBSERVATORY

INTERNET RESOURCES CONTINUED...

RESOURCES FOR TEACHERS

Free lesson plans and activities for K-12 from Jet Propulsion Laboratory:
https://jpl.nasa.gov/edu/

Find Next Gen STEM learning opportunities for students in multiple settings:
https://nasa.gov/learning-resources/for-educators

Search NASA's educational activities and resources by subject, type, and grade level:
https://science.nasa.gov/learn/catalog

YOUTUBE CHANNELS

Griffith Observatory

European Space Agency

PBS Space Time

MORE WEB LINKS

California Science Center: Astronomy education programs, workshops, lesson plans, and resources. https://californiasciencecenter.org

The Lunar and Planetary Institute: Astronomy education programs, workshops, and resources. https://lpi.usra.edu/education

StarDate: The public education and outreach arm of the McDonald Observatory, Texas.
https://stardate.org

WorldWide Telescope: This website turns your computer into a telescope and brings together data and imagery from telescopes around the world.
https://worldwidetelescope.org

Astronomical Society of the Pacific: Organization of professional and amateur astronomers with astronomy education conferences, education programs, and resources, including professional development opportunities for teachers. https://astrosociety.org

Planetary Society: Open membership organization that sponsors planetary events and programs. Its "Space for Kids" page lists many at-home activities.
https://planetary.org/kids

Exploratorium: A resource for at-home experimentation and projects.
https://exploratorium.edu/explore

GRIFFITH OBSERVATORY®

Acknowledgments

Griffith Observatory is owned and operated as a public service by the City of Los Angeles, Department of Recreation and Parks. The work of the Department is overseen by the Board of Recreation and Park Commissioners, appointed by the Mayor of Los Angeles with confirmation by the Los Angeles City Council.

The Griffith Observatory Online School Program is made possible by Griffith Observatory Foundation. The primary role of the Foundation is supporting and promoting Griffith Observatory in its mission to inspire everyone to observe, ponder, and understand the sky.

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