

EXPLORE SPACE







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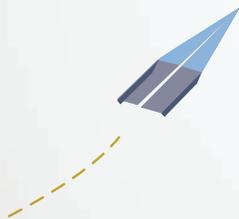
YOUR MISSION:

Space is an enormous concept. We want students to feel how amazing space is, and also to imagine themselves working there. Maybe one of these students will be the first woman to walk on Mars, or will start a private space exploration company!

ADVICE ON VOLUNTEERING



SAFETY CHECK: There's a lot to handle on these exhibits, but make sure students do it safely (no running, no poking each other in the eye, etc.)

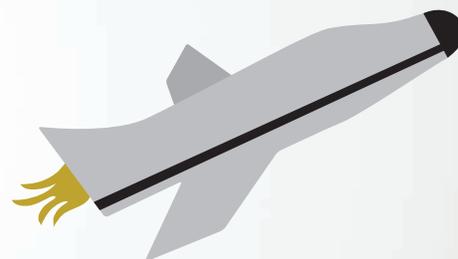


ENCOURAGE EXPLORATION: Ask questions and make sure everyone gets a chance to participate. A little positive feedback goes a long way.



GEEK OUT! You don't have to be an expert. Your curiosity and enthusiasm inspire kids to learn.

AREA OVERVIEW



WHAT'S IT LIKE TO WALK ON MARS?

What do astronauts actually do all day? This area introduces students to some of the concepts and tools used by astronauts, astronomers and other space experts to explore life outside of Earth's atmosphere.

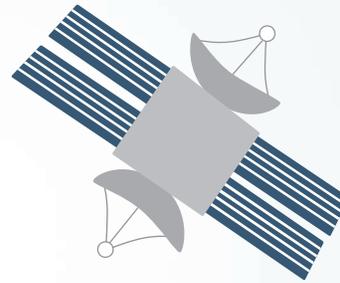
EXPLORE SPACE



- The sun is one of at least 100 billion stars in our galaxy. There are more stars in the sky than there are grains of sand on all of Earth's beaches.
- If you were traveling at the speed of light (186,000 miles per second), it would still take you 100,000 years to get across the Milky Way.
- You are made out of stars. Almost every element in your body (and on earth) comes from stardust - tiny pieces of stars that exploded eons ago.
- Astronomers have discovered a planet where it rains melted glass, sideways.

GRAND CHALLENGES

If you could do one thing to make life on Earth better, what would that thing be? Here's a **GRAND CHALLENGE**: according to some of the world's smartest people, this is a challenge that humans will face in the next 100 years. **What would you do to help solve it?**



HOW CAN WE EXPLORE NEW PLANETS, or find out what lives in the deepest parts of the Earth's oceans? What will it take to sustain human life on another planet? Today's students will help invent and improve vehicles and tools for exploration of the farthest reaches of the universe.

JOKES

What did the alien cook for lunch?

Unidentified frying objects

If a meteorite hits a planet, what do we call the ones that miss?

Meteowrongs



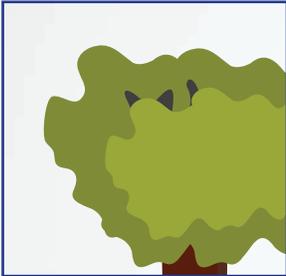
THERMAL IMAGING



SAFETY FIRST: HOW TO USE

- Ask students to line up, with the first student facing the thermal camera. Ask each student to place their hand on their heart and hold for a count of five. When they remove their hand, what do they see?

CONCEPT BREAKDOWN



- Thermal cameras let us see things that the human eye can't see.
- "Thermal" means that something is related to heat.
- All objects emit infrared energy (heat). Generally, the hotter an object is, the more radiation it emits.

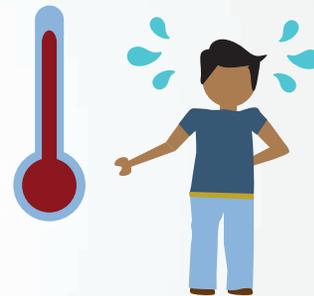


- A thermal camera (sometimes called an infrared camera) is essentially a heat sensor.
- The thermal camera measures the infrared radiation from objects and creates an electronic image showing different temperatures as different colors.



- For instance, a mosquito, your hand, and an ice cube will all be different temperatures, so a thermal camera will show them as different colors.

RELATE TO REAL LIFE!



A thermal imaging camera operates on the infrared spectrum: warm objects appear reddish, and cool objects appear more blue. Human beings can't see infrared, but mosquitoes can. When they see red, they know there's a warm body, and head in for a snack.

THERMAL IMAGING



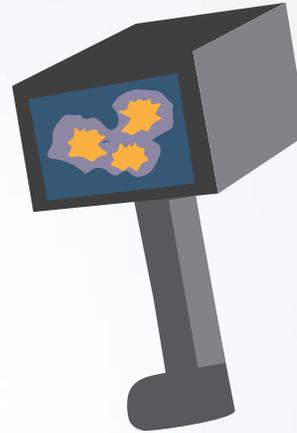
QUESTIONS

What are some uses for thermal imaging?

- Astronomers studying new galaxies -- NASA uses an infrared camera on the Hubble Telescope because it can see through clouds of space dust
- Meteorologists mapping temperatures of the Earth to understand and predict weather patterns
- Space station mechanics locating a leak in a spacecraft



CAREERS



An **ONCOLOGIST**, a doctor who specializes in treating cancer, uses thermal imaging to locate tumors or cancerous cells

AVERAGE SALARY: \$300,000

ADDITIONAL INFORMATION

HEAT-SEEKING RESCUE MISSIONS



Thermal imaging helps save lives, and can even be powerful enough to see recent footprints.

Rescuers use it to search for people trapped in rubble after an earthquake or tornado.

Firefighters use it to locate people and fire through smoke, dust, darkness, and even walls.

HOW MUCH DOES IT WEIGH?



SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Give each student a turn lifting each of the four cans. Ask them to predict whether each can will be heavier or lighter than on Earth. (Don't tell them this, but the can representing the sun is secured in place so the students cannot lift it up. The gravity of the sun would make the can of Coke weigh about 25 lbs.)

CONCEPT BREAKDOWN



Mass measures how much matter an object contains. Weight measures the pull of gravity on that object. When you travel to a different planet, your mass doesn't change, but your weight does.



The moon has a weaker gravity than Earth, so when you try to walk there, you bounce. You can't walk on the sun, but if you could, the sun's powerful gravity would cause you to sink into the surface.

RELATE TO REAL LIFE!

Imagine you're standing on a ladder and your friend is a few rungs down, holding onto your ankles. If your friend is very strong, you'll find it very hard to move. If your friend lets go altogether, you can climb right up the ladder.



Gravity works the same way: it's the force that keeps you from floating up. In fact, people DO exert a gravitational pull on each other. However, because our bodies are tiny compared to the Earth, the pull is not very strong.

HOW MUCH DOES IT WEIGH?



QUESTIONS

Try lifting the can on the left. That's how much a can of soda weighs on Earth. Now try lifting the can on Jupiter. Can you feel the difference?

Which of the cans is heaviest?

The Sun.

Why is the can heaviest there?

Because the Sun has the most mass.

Which of the cans is the lightest?

The moon.

Why is the can lightest there?

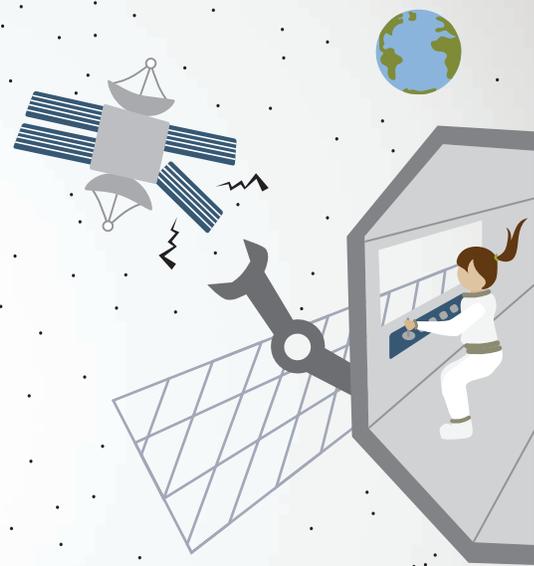
Because the moon has the least mass.



CAREERS

ASTRONAUTS pilot spacecraft and travel to space to run science experiments, repair space stations, and explore the Earth and other planets.

ANNUAL SALARY: \$90,000



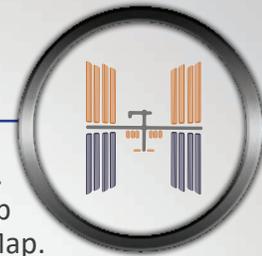
ADDITIONAL INFORMATION



Say you weigh 100 pounds on planet Earth. Guess how much you'd weigh on the moon? Just 17 pounds. But on Jupiter, your same 100-pound body would weigh 236 pounds. And on the sun, you'd weigh more than 2,700 pounds!

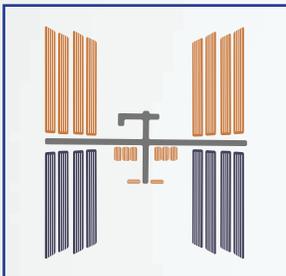
The display screen will show students what they weigh on any planet. Just enter a weight and select a planet to see the result.

SPOT THE STATION



- Students should not touch the monitors, mouse, or keyboard.
- **If the Internet is working:** The Trailblazer Facilitator will set up one screen to show the full-screen view of the ESA Tracking Map. The other screen will show “Spot the Station” and live footage. Explain what students are seeing and talk about chances to see the ISS at night.
- **If the Internet is NOT working:** The Trailblazer Facilitator will set up the videos of the ISS and prepare a screen capture of the ESA Tracking Map to discuss.

CONCEPT BREAKDOWN

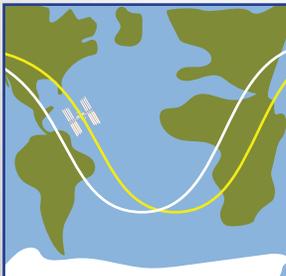


The International Space Station, or ISS, is a satellite where people live and work in low Earth orbit.

Snap your fingers. The ISS just flew 5 miles! It travels at about 5 miles per second, or more than 17,000 miles per hour. That’s fast enough to go to the Moon and back in about a day.



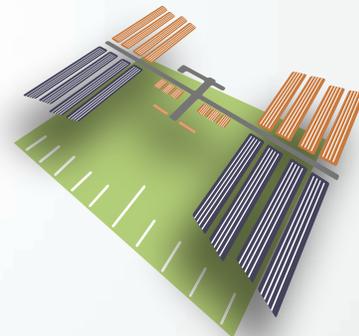
Launched in 1998, the first parts of the ISS were blasted into space and assembled robotically. Astronauts have spent over 1,000 hours to add more parts while floating 250 miles above the planet.



The ISS is the 3rd brightest object in the sky after the moon and Venus. “Spot the Station” online predicts when it will be overhead, and the European Space Agency keeps a Tracking Map to show where it is right this moment!

RELATE TO REAL LIFE!

The ISS has a complete surface area the size of a US football field, with more liveable space than a 6-bedroom house.



The ISS weighs almost 1 million pounds, including visiting spacecraft. That’s about the same as eleven Boeing 737 airplanes (or a million footballs).

Its internal pressurized volume is 32,333 cubic feet, about the same as a Jumbo Boeing 747.

SPOT THE STATION



QUESTIONS

When do astronauts sleep?

Because the ISS is orbiting the earth, the astronauts on it see night and day 15 times every 24 hours. Instead of going to bed 15 times a day, they stay on Houston time, so they can talk to their friends at Mission Control.

How much did the ISS cost?

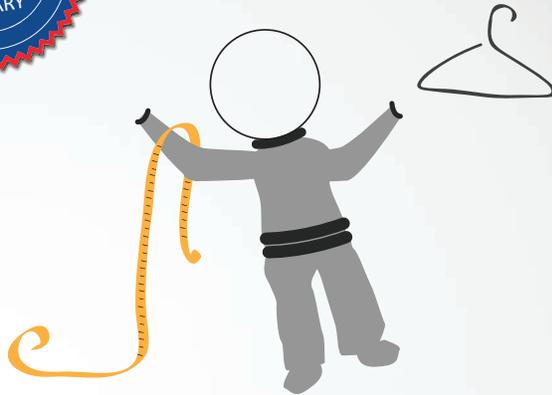
At a \$120 billion value, it's the single most expensive object ever built.

What good does the ISS do for people back on Earth?

As of 2018, NASA reports nearly 2,000 spinoff inventions related to space travel: artificial limbs, infrared ear thermometers, freeze drying, memory foam, cordless vacuums, Olympic swimsuits, scratch-resistant glass, invisible braces, and 3D food printing—so far!



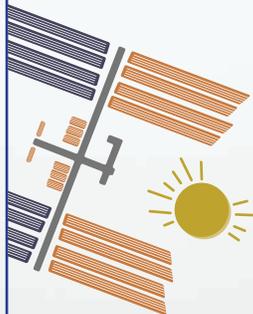
CAREERS



SPACESUIT ENGINEERS design and construct the suits that support astronauts in outer space and, someday, on other planets like Mars. Spacesuit engineers take 36 measurements of astronauts' bodies to make sure the suit and gloves fit perfectly and protect the astronauts against temperature extremes in the vacuum of space.

AVERAGE SALARY: \$72,000

----- ADDITIONAL INFORMATION -----



Astronauts need 75 to 90 kilowatts of electricity to live and perform science experiments on the ISS. The best source of energy in orbit is from the sun.

The four sets of solar arrays on the ISS could generate enough to power more than 40 homes on Earth.

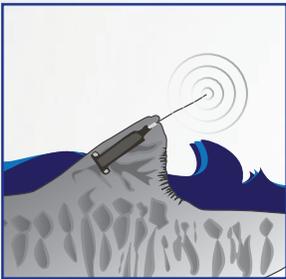
SHARK TRACKER



SAFETY FIRST: HOW TO USE

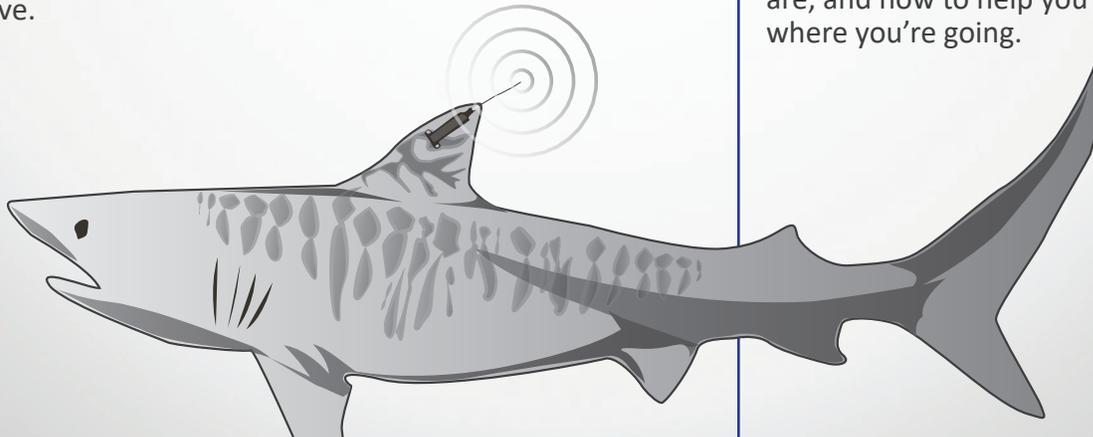
- Open the website and use CTRL+scroll to zoom in so that Texas is in the center of the screen with the Gulf of Mexico showing. For every dot on the screen you see, a shark has recently been there. Click on a dot to learn more about that shark and its migration habits.

CONCEPT BREAKDOWN



- Scientists study all of the places sharks swim to learn more about them and keep them safe.
- Marine Biologists capture a shark safely, study it, give it a special tracker, and return it to the ocean without harm.

- The tracker uses a GPS, or Global Positioning System. GPS uses 24 satellites, orbiting 12,550 miles above us, to calculate where the sharks are at all times, day or night.
- Learning about the migration patterns of sharks helps make sure that we keep big ships away from the areas they need to live.



RELATE TO REAL LIFE!



HOW MANY OF YOU HAVE LOOKED UP DIRECTIONS ON A CELL PHONE?

When you look up directions, your phone uses GPS. Just like the shark tracker, the satellites in orbit calculate where you are, and how to help you get where you're going.

SHARK TRACKER



QUESTIONS

Why do we want to protect sharks, aren't they scary?

- They're an important part of the ecosystem.
- Sharks are apex predators, the top predator in the food web. Sharks are like the lions of the sea. Protecting sharks maintains the delicate balance of the food web in the ocean.

How long does the GPS track the shark?

- 5 years

Does installing the tracker hurt the shark?

- There may be some brief discomfort, but after a half century of study, there is no evidence that tagging the cartilage of a shark's fin impacts behavior or survival.



CAREERS

An **ELASMOBRANCHOLOGIST** is a marine biologist who studies sharks in the wild, examines rare specimens, and conducts experiments in the lab.

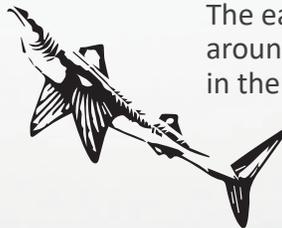


AVERAGE SALARY: \$55,000

----- ADDITIONAL INFORMATION -----

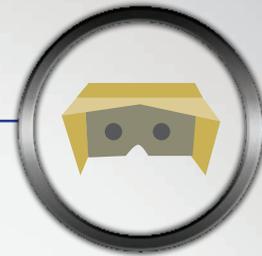
SHARKS EVOLVED ON EARTH BEFORE TREES!

The earliest known tree, Archaeopteris, lived around 350 million years ago, and sharks arrived in the fossil record 400 million years ago.



Prehistoric sharks represent the Earth's first fully jawed vertebrates.

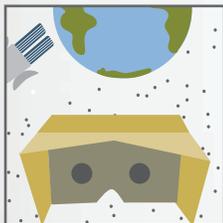
VIRTUAL REALITY (VR) SPACEWALK



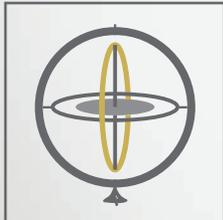
SAFETY FIRST: HOW TO USE

- Okay for students to touch.
- **To prevent the spread of germs that cause infections, such as Conjunctivitis, or pink eye,** use a sanitizing wipe on the VR headset after each use.
- Students should face inward so they can brace against the cabinet for stability.
- Students should hold the headset with both hands and turn their arms and head slowly in all directions to watch the 360° video. The video will loop continuously.
- Each student should get 30 seconds to try the headset. Ask the other students to explore the other space exhibits so that students can take turns. Then switch.

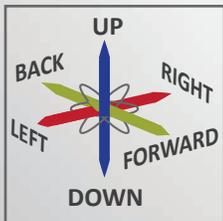
CONCEPT BREAKDOWN



How do smartphones make virtual reality work? Many phones use gyroscopes and accelerometers to track the six directions you can move in 3-D space.



A **gyroscope** is the sensor which is used to sense the position, level or orientation based on the principle of angular momentum. It works with an **accelerometer** to detect which way the phone rotates, and how fast.

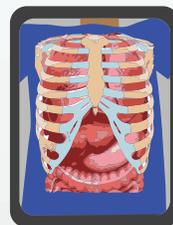
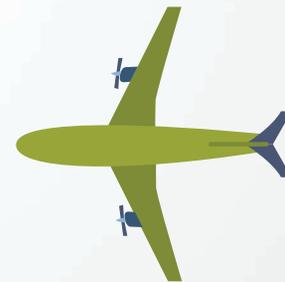


When the phone senses movement to the left, its code tells it to adjust the display so the image or video also moves left.

RELATE TO REAL LIFE!

Have you ever wished you could step inside a game or a video, instead of watching it on a flat screen? Virtual Reality (VR) lets gamers play and interact with a 3D virtual world.

Pilots rely on cutting edge VR training for dangerous situations, like learning how to fly and land a fighter jet. VR also helps people to safely overcome phobias like a fear of heights.



Medical students can use VR to practice operations. Once they become doctors, they may even use VR with internal cameras to perform the actual surgery!

VIRTUAL REALITY



QUESTIONS

What's the difference between Virtual Reality and Augmented Reality?

- Virtual reality immerses you entirely into a simulated world. Augmented reality overlays virtual elements onto the real world. For example, this exhibit puts you into a completely **VIRTUAL REALITY**. In our Biotechnology area, another exhibit **AUGMENTS REALITY** by projecting digital organs onto a real picture.

Will VR make people lazy?

- The most popular VR experiences focus on being physically active. How can you design VR experiences to encourage standing, walking, and full-body movements?



CAREERS



VR SOFTWARE DEVELOPERS design and test virtual reality experiences and trainings for surgeons, architects, pilots, astronauts, film producers, artists, game designers, and more.

AVERAGE SALARY: \$108,000

----- ADDITIONAL INFORMATION -----

ASTRONAUTS TRAIN WITH SPECIAL VR EQUIPMENT

underwater at NASA in Houston. For every hour they need to spend weightless in a spacewalk repairing the International Space Station (ISS), they practice for seven hours underwater. If practice makes perfect, VR helps your practice to be as realistic as possible!



VIRTUAL REALITY DRONE RACING is a sport growing in popularity. Players wear VR headsets connected to cameras on racing drones, so they have a first-person view as they pilot their drones through an obstacle course. The first player's drone to cross the finish line (without crashing) wins—and even better, they might be scouted by employers as a future pilot or astronaut!

THANK YOU!

Thank you for inspiring students and encouraging them to explore careers in STEM. We could not do this work without you, and we truly appreciate your support.

If you took photos today and plan to post to social media about your experience, please consider tagging the TAME State Office. We would like to recognize your hard work and may share images and stories on TAME.org or with our corporate partners who help bring this experience to different communities around Texas.



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Texas Alliance for Minorities in Engineering

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