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 or man to walk on Mars, or will start a private space exploration company!

ADVICE ON VOLUNTEERING

SAFETY CHECK: Look for this symbol in the scripts. Our exhibits are hands-on, but some require close supervision. Make sure students explore safely (no running, no poking each other in the eye, etc.) and follow instructions from the facilitator.

ENCOURAGE EXPLORATION: Ask questions about what they see, hear, and feel and make sure everyone gets a chance to participate. A little positive feedback goes a long way.

GET EXCITED! You don’t have to be an expert. Your curiosity and enthusiasm inspire kids to learn.

AREA OVERVIEW

WHAT DO ASTRONAUTS DO ALL DAY? What’s it like to wear a space suit, or live on the International Space Station? 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

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

▪ The sun is one of at least 100 billion stars – and that’s just 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.

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### SAFETY FIRST: HOW TO USE

- Okay for students to touch.
- All the students will gravitate toward this display. Explain the mission to the students, then divide students into two groups. Ask one group to explore the other space exhibits while the first group takes turns. Then switch.

### MISSION:

You are a payload specialist and must retrieve a broken satellite (worth a billion dollars!) near the International Space Station. Hurry, before it moves out of range!

### GOAL:

Move the satellite from the right of the display to the post on the left. Once the student places it successfully OR runs out of time, pick up the satellite and place it in the housing on the right again for the next student.

### RULES:

Each student gets one chance (**30 seconds**) to manipulate the arm while watching the monitor above the display. Other students act as Mission Control, giving instructions to the astronaut.

### CONCEPT BREAKDOWN

- Tools like the robotic arm, combined with a camera, allow for astronauts in the International Space Station to handle and move objects that they can’t physically see.
- Robotic arms were used to assemble the ISS, which traveled to space in pieces.
- Surgeons direct robots to help wounded people thousands of miles away, and may soon be able to stitch up an astronaut on the ISS.

### RELATE TO REAL LIFE!

There are usually between 3-10 astronauts in orbit in the International Space Station, and hundreds more people back on Earth at the Mission Control Center.

They work together to conduct research, make repairs to the space station, and respond to any kind of emergency.

Robotic arms like the one in this exhibit are an important part of the ISS. These arms are used to move equipment and supplies around the station, to support astronauts working in space, and to service instruments on the space station. **Astronauts work hard in training to learn to use these robotic arms!**
So, what is a robot?

- A robot is a machine designed by humans to do human tasks. A robot either works automatically or is controlled by a computer. By that definition, movie robots like WALL-E or R2D2 are one kind of robot, a washing machine is another, and a self-driving car is a third.

Once we make robots to do all the work for us, what will humans do?

Can we design robots to know right from wrong, or to have a conscience?

If a robot causes an accident, who is to blame: the robot or the designer of the robot?

A team of researchers at University of California, Berkeley, programmed a robot to do something amazing: fold towels!

**What’s so amazing about folding towels?**

The trick is that towels are flexible objects that change shape. Designing robots to respond to those kinds of conditions was a major advancement in robotics!
**HOW MUCH DOES IT WEIGH?**

**SAFETY FIRST: HOW TO USE**

- Okay for students to touch.
- 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 soda weigh about 25 pounds.)

**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 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.
**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?

**Where is the can the heaviest?**
The Sun.

**Why is the can heaviest there?**
Because the Sun has the most mass, and a stronger gravitational pull.

**Where is the can the lightest?**
The moon.

**Why is the can lightest there?**
Because the moon has the least mass, and a weaker gravitational pull.

**Careers**

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

**Average 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!
SAFETY FIRST: HOW TO USE

- Open the website and use CRTL+scroll to zoom in so that Texas 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.

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

**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 cartilege of a shark's fin impacts behavior or survival.

**AREA: SPACE**

**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.

**AVERAGE SALARY: $55,000**

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EXHIBIT: SPOT THE STATION

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

**CONCEPT BREAKDOWN**

**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.

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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!

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

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.
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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