EXPLORE WEATHER

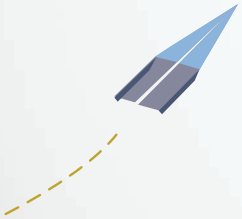
EXPLORE WEATHER

YOUR MISSION:

Get students excited about weather beyond the basics of rain or shine. You have a chance to motivate students to study the way weather shapes our world. A student you talk to today may uncover something cool from the distant past, or create new technology to save lives.

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

REMEMBER BEN FRANKLIN AND HIS KITE? We want to inspire that kind of curiosity in kids (without the danger of electrocution). What is lightning made of? What does it feel like inside a cloud?

WHY DOES THE SUN SHINE IN AUSTIN WHILE IT'S RAINING IN DALLAS?

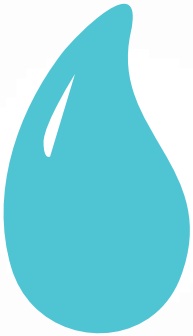
Weather is caused by the movement of air and water. Because the Earth is round, the sun shines more directly on some areas (equator), and less on others (poles). This creates different temperatures, which create air currents that push water and air all around the world.

EXPLORE WEATHER

- About 2,000 thunderstorms rain down on Earth every minute.
- When a storm drops 1 inch of rain in Houston, that's 10.8 billion gallons of water, or enough to fill 272 million baths!
- You can use pine cones to forecast the weather: the scales will close when rain is on the way.
- As the Earth gets warmer, the Amazon Rainforest is slowly turning into a desert, while the Sahara desert is getting greener.

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?**



WATER, WATER, EVERYWHERE, BUT NOT A DROP TO DRINK

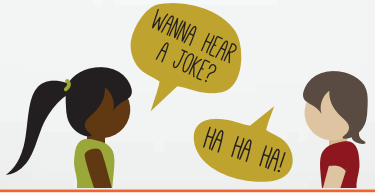
Water has lots of good uses, but only if it's clean. Some places don't have enough and others have too much. If you live near the ocean you have plenty of water, but ocean water is too salty to drink. Some water makes people sick with pollutants.

Can you help think of ways to provide access to clean water for all people?

JOKES

Why do you put on boots when it's raining cats and dogs?

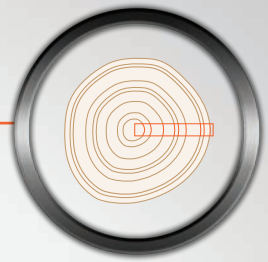
Because you might step in a poodle.



How does a tornado see?

With its eye.

PALEOCLIMATOLOGY



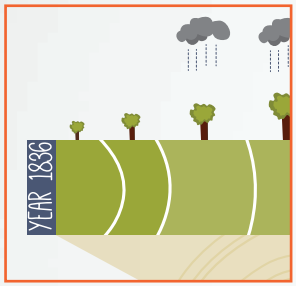
AREA: WEATHER

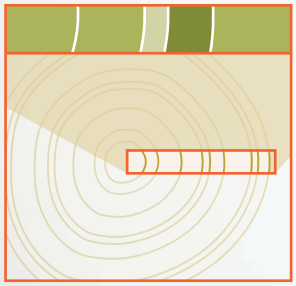
EXHIBIT: PALEOCLIMATOLOGY

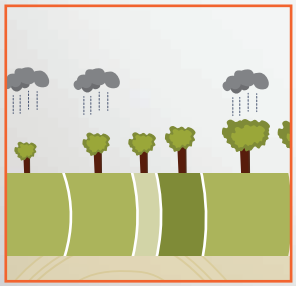
SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Give each student the chance to use the magnifying glass to examine the tree rings.
- Ask, which ring shows the wettest year? Which shows the driest?

CONCEPT BREAKDOWN







- If we want to know what the weather was like 50 years ago, we can check weather records.
- But what if we want to know what the weather was like 500 years ago?
- Paleoclimatologists use physical clues like tree rings to study past climates and look for long-term trends.
- Trees typically form one ring per year and their thickness is determined by the conditions they grow in. These rings are due to the change in growth speed during the seasons of a year.
- Trees grow faster in warmer, rainier times, so tree rings for rainy years will be wider and spongier.
- Trees grow more slowly in colder, drier times, so tree rings for dry years are more narrow and dense.

RELATE TO REAL LIFE!

If you know what to look for, you can find clues about the Earth's past in all kinds of places. If you live in the Permian Basin of Texas, for example, you may be able to find fossils of sea creatures in the desert around where you live. That's because the Permian Basin used to be the Permian Sea!

You can also find clues from rocks and dirt. What color is the dirt? Is it wet or dry? Are the rocks hard or soft? Do they have pieces of crystal in them, or do they have lots of little holes? Geologists use these clues to find out about volcanic activity in an area, to determine whether an earthquake is likely, or to find oil or natural gas.

AREA: WEATHER

EXHIBIT: PALEOCLIMATOLOGY

PALEOCLIMATOLOGY

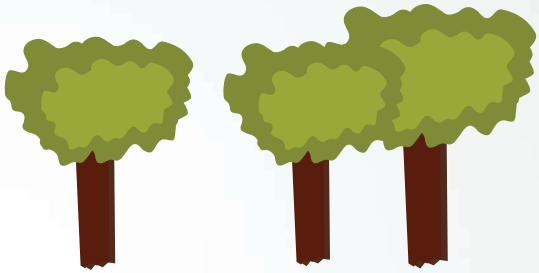
QUESTIONS

Why do we want to know if it rained a million years ago in Texas?

Paleoclimatology, geology, and archeology are all scientific fields that study the past. Clues in tree rings, rocks, and bones help us understand a lot about our planet.

For instance, we know what kind of dinosaurs lived in Texas—one from the Jurassic Period was called Iguanodon—and that Midland, Texas used to be underwater! Studying past climate patterns also helps us understand our own climate and to predict upcoming weather patterns.

CAREERS



A **PALEOCLIMATOLOGIST** investigates past climate conditions, using trees, rocks, fossils, and many other physical clues.

AVERAGE SALARY: $94,000

ADDITIONAL INFORMATION

Imagine if you never took a bath or a shower. All the dirt that landed on your skin would stay there. If you spent a hot day in the desert, your skin would collect a layer of sweat and dust. If you sat by a campfire, your skin would collect a layer of wood smoke. Ice and rocks on the Earth's crust act like your skin, collecting layers of information. Scientists use core samples of ice or dirt to see a record of Earth's climate history in the layers of its crust.

PLASMA BALL

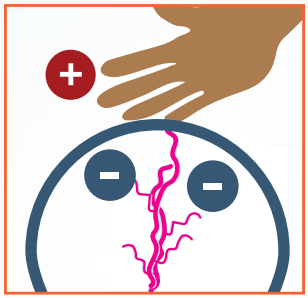
AREA: WEATHER

EXHIBIT: PLASMA BALL

SAFETY FIRST: HOW TO USE

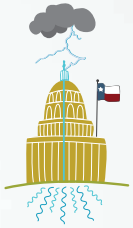
- Okay for students to handle.
- Invite students one at a time to move their fingers around the surface of the glass globe.
- Two students can put their fingers on opposite sides of the globe.

CONCEPT BREAKDOWN



- You're electric! When you touch the ball, you are conducting electricity through the water in your body.
- The reason that happens is that the human body is on average about 60% water, mostly salty water. And water is a really good **conductor** of electricity.
- The "lightning" you see is created by the attraction between **positive charges** (your hand) and **negative charges** (the electrons).
- This plasma ball is filled with gases and a high voltage electrode.
- When nothing is touching the ball, the current flows randomly.
- When you touch the ball, some of the current can flow through the glass and into you.

RELATE TO REAL LIFE!



What **aren't** you supposed to do in a thunderstorm? You're **not** supposed to run outside and stand in a field. You're also **not** supposed to stand under a tree. Why not? Have you ever seen a tree that's been hit by lightning? It's been electrocuted.

Lightning is electricity that follows an electrical circuit between a thundercloud and the ground. This circuit is made of the charged ions in the air. What happens if you stand in the middle of that circuit? Your body will conduct that electricity into the ground – and that's a very dangerous place to be.

AREA: WEATHER

EXHIBIT: PLASMA BALL

PLASMA BALL

QUESTIONS

What happens if lightning hits your house?

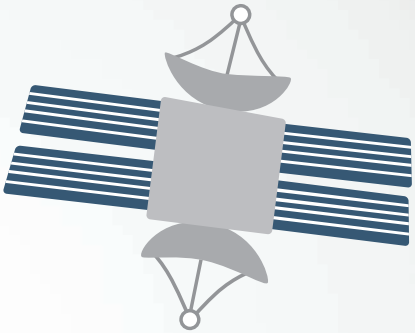
Most buildings use lightning rods to protect against electrocution. Lightning tends to concentrate on anything that sticks up from the ground (like people or trees).

Lightning rods attract that charge and give it a path to safely travel down into the ground. This is called **grounding**.

What happens if you're in a car in a lightning storm?

The car's rubber tires act as insulators from electricity. If lightning hits the car, the rubber tires will break or ground the electrical circuit, protecting it and you from the lightning strike.

CAREERS



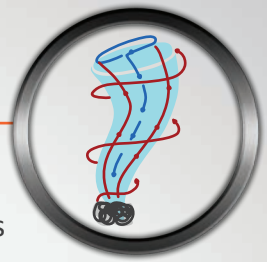
An **ELECTRICAL ENGINEER** might design cell phones, invent a bionic arm, build a satellite, or create special effects for movies!

AVERAGE SALARY: $95,000

ADDITIONAL INFORMATION

HOW HOT IS A LIGHTNING BOLT? About 54,000 degrees Fahrenheit. That's 5 times hotter than the surface of the sun!

TORNADO TUBE



AREA: WEATHER

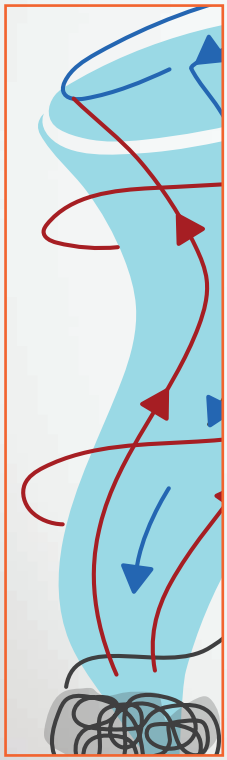
EXHIBIT: TORNADO TUBE

STUDENTS CAN TOUCH

SAFETY FIRST: HOW TO USE

- Turn on the blower and leave it on throughout your shift. This shows how a tornado forms.
- Students can take turns holding the tornado bottles at the center, with the liquid on top, giving the bottles four good swirls in the same direction.

CONCEPT BREAKDOWN



- A tornado is a powerful whirlwind that happens when a mass of cool, dry air collides with a mass of warm, moist air.
- Cool air presses down.
- Warm air presses up.
- The pressure between cool and warm air creates unstable air between the areas.
- When a strong wind pushes this unstable air from the side, a rotating cloud, or funnel cloud, can form.
- The rising warm air creates an updraft.
- If the funnel cloud touches down to earth, it can create an upward pull strong enough to lift trees, animals, and buildings.
- It's a funnel cloud until it touches the ground. Then we call it a tornado.

RELATE TO REAL LIFE!

Why do Texas and Oklahoma get so many tornadoes? It's because the warm, moist air from the Gulf of Mexico scoots westward, hits the cool, dry air that forms over the Rocky Mountains, and comes tumbling backwards as unstable air.

Not all tornadoes cause damage. Some are funnel clouds that never touch ground, and some are small tornadoes that only touch down for an instant. But some tornadoes cause lots of damage. In May of 2011, a huge tornado hit Joplin, Missouri, killing 158 people and flattening everything in its path. The tornado was a mile wide.

AREA: WEATHER

EXHIBIT: TORNADO TUBE

TORNADO TUBE

QUESTIONS

How many of you have seen a dust devil? How about a funnel cloud?

Has anyone seen a tornado?

Where does the word "tornado" come from?

It comes from the Spanish word "tronar," which means "thunder."

Where is the safest place to be during a tornado if you don't have a basement?

The safest place is an inside room without windows on the bottom floor, away from metal or glass.

CAREERS

An **ATMOSPHERIC SCIENTIST** studies tornadoes, hurricanes, and other weather patterns – sometimes from inside comfortable laboratories, and sometimes outside in the middle of storms!

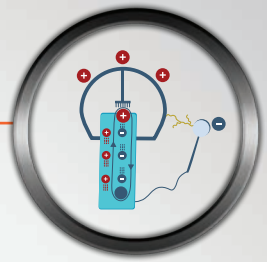
AVERAGE SALARY: $90,000

ADDITIONAL INFORMATION

A tornado in Oklahoma once picked up an entire herd of cows, carried them across the countryside, and then set them down unharmed.

Usually, a tornado's color matches the color of the ground it travels over.

VAN DE GRAAFF GENERATOR



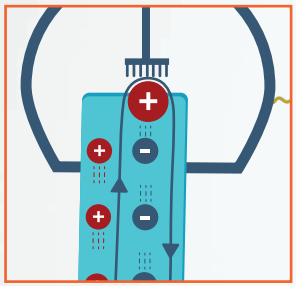
AREA: WEATHER

EXHIBIT: VAN DE GRAAFF GENERATOR

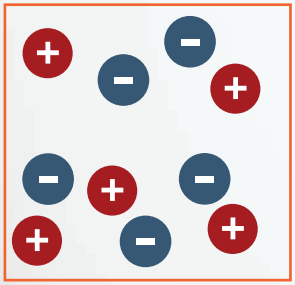
SAFETY FIRST: HOW TO USE

- **Do not touch this exhibit until you have received training from the Trailblazer Facilitator.**
- **Do not touch this exhibit if you have a Pacemaker or ICD (Implantable Cardioverter Defibrillator).**
- Students should only touch this exhibit under the supervision of a trained adult.

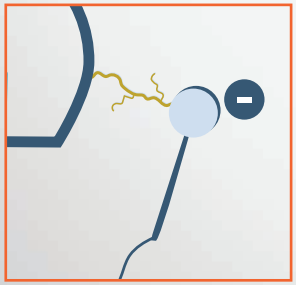
CONCEPT BREAKDOWN



- The machine's moving belt generates static electricity through friction.
- Friction creates positive charges in some atoms and negative charges in other atoms.



- When the charges are separated, this causes an electrostatic charge.
- The belt collects the electrostatic charge.



- The charge is transferred to the metal dome, where it accumulates.
- When you put your hand or the wand near the dome, the charge jumps into it. Can you see and hear the spark?

RELATE TO REAL LIFE!

What happens when you walk on carpet with your socks and reach for a door knob?

What happens to your hair when you've been wearing a hat all day in winter and you take it off?

You've been generating **STATIC ELECTRICITY** through friction – just like this machine.

AREA: WEATHER

EXHIBIT: VAN DE GRAAFF GENERATOR

VAN DE GRAAFF GENERATOR

QUESTIONS

What part of weather is caused by static electricity?

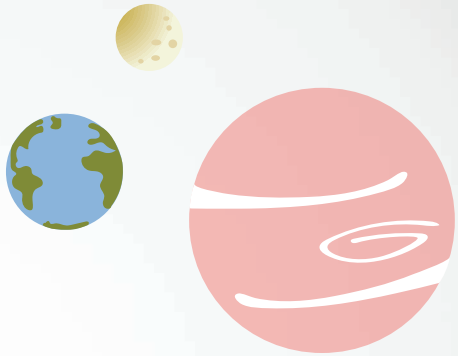
Lightning!

VAN DE GRAAFF GENERATORS will make your hair stand up. This is especially true for fine hair without a lot of product in it.

What else can you do with a particle accelerator?

- Sterilize food or surfaces
- Perform nuclear physics experiments
- Produce X-ray beams that can be used in nuclear medicine

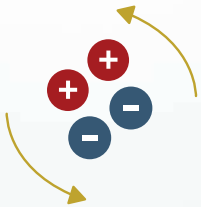
CAREERS



A **PARTICLE PHYSICIST** explores the interactions of elementary particles (like leptons, quarks, etc.) to understand how the universe works.

AVERAGE SALARY: $80,000

ADDITIONAL INFORMATION



The **VAN DE GRAAFF** used to be the fastest particle generator in the world!

WHAT IS THE FASTEST NOW? The Large Hadron Collider (CERN) in Switzerland, where scientists recently identified the Higgs boson, a fundamental particle that is a building block of the entire universe.

Did you know the Large Hadron Collider was almost built in Texas instead?

WEATHER STATION

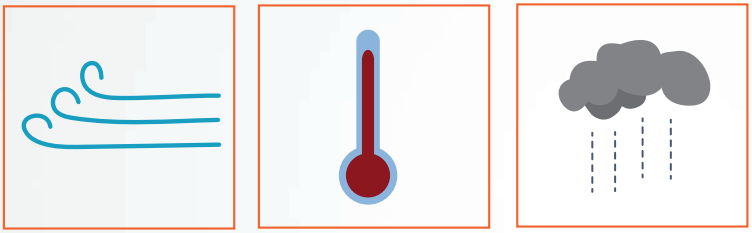
AREA: WEATHER

EXHIBIT: WEATHER STATION

SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Students can take turns using the blower to turn the anemometer.
- Students can measure temperature with the digital thermometer.
- Students can measure humidity with the hygrometer.

CONCEPT BREAKDOWN

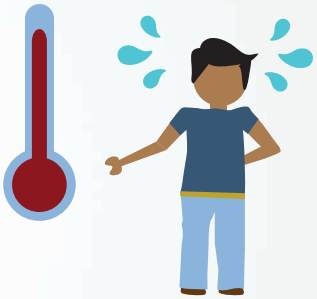


Meteorologists aren't guessing. They use lots of data to predict the weather, including:

- air temperature
- wind
- humidity
- atmospheric pressure
- and rain and snow patterns

This data forms the patterns you see on the weather channel, and lets meteorologists predict when hurricanes and tornadoes may form.

RELATE TO REAL LIFE!



Now that we live with air conditioning and heaters, most of us don't need to pay quite as much attention to the weather as our ancestors did. But if you're a farmer or a sailor, you're probably paying close attention to the weather. A big rain can help crops grow, or it can drown the plants before harvest. A big wind can push your boat to its destination – or it can land you somewhere very unexpected!

AREA: WEATHER

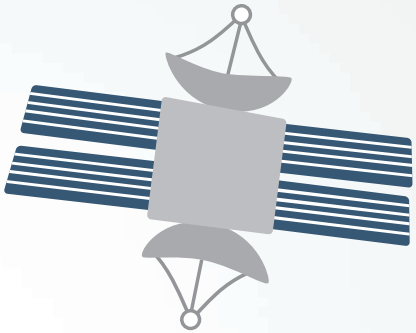
EXHIBIT: WEATHER STATION

WEATHER STATION

QUESTIONS

- What is the weather outside today?
- What's the temperature? Is it unusually hot or cold?
- Is there moisture in the air? Is it raining?
- Is there a breeze, or a strong wind? How fast is the wind blowing?
- How can we be prepared for today's weather (for example, do we need an umbrella or sunglasses? What if there's a tornado warning? What if there's an ice storm coming?)
- If you were a farmer, what kind of work would today's weather be good for?

CAREERS



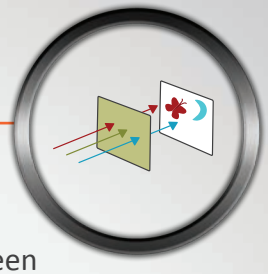
A **METEOROLOGIST** uses satellites, aircraft, ships, balloons, and computer models to track information to understand and predict the weather.

AVERAGE SALARY: $117,000

ADDITIONAL INFORMATION

HOW DOES A STORM CHASER KNOW WHEN TO FIRE UP THE TRUCK? They measure the conditions that form storms. Storms are formed by a collision of warm and cool air to create unstable air. Just like meteorologists, storm chasers look at weather data and predict where and when those collisions will occur.

FORECAST THE WEATHER



AREA: WEATHER

EXHIBIT: FORECAST THE WEATHER

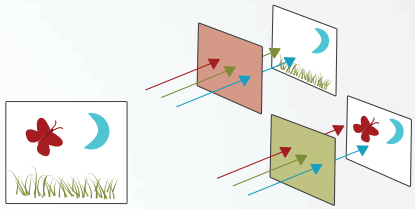
SAFETY FIRST: HOW TO USE

- Students should not touch the computer.
- Give each student a chance to stand in front of the green screen and see themselves on the monitor. What happens when they hold up the green fabric?

CONCEPT BREAKDOWN

- When you see a meteorologist on TV, they are standing in front of a map. But guess what? The map isn't really there.
- The meteorologist is actually standing in front of a **green screen**, not in front of a map. The map is added with computer technology.
- Green screen technology is used by meteorologists – and in the movie business – to create imaginary worlds.
- How does a green screen work?
  - Light is made up of a spectrum of colors. Together, all of these colors make white light. Separately, each of these colors has a different wavelength. The **blue molecules** in light, for instance, have a shorter wavelength than **red molecules**.
  - Scientists can use the different wavelengths to **filter** light by color. Filters block some wavelengths and allow others through.
  - Because **green is the color that's furthest away from human skin tones**, a person is most visible against a green background.
  - A video technician uses **filters** to remove the green background and replace it with a map of the weather, monsters, an imaginary city, or anything else!

RELATE TO REAL LIFE!



Color filters, like the ones used in green screens, are used in all kinds of places.

Every time you put on **sunglasses**, you're using a color filter. The lenses in your sunglasses are designed to block out some wavelengths of light and allow others to pass through to your eyes. **"Blue-blocker"** sunglasses block the blue part of the light spectrum, so what you see is mostly **yellow-toned**.

Movie-makers and photographers use color filters to create different effects. If you've ever used a filter setting on a smart-phone camera, you've already got experience as a visual effects editor!

AREA: WEATHER

EXHIBIT: FORECAST THE WEATHER

FORECAST THE WEATHER

QUESTIONS

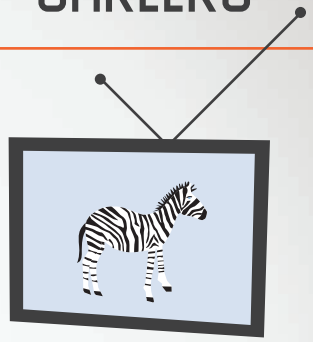
Why is the sky blue?

- The short answer is, **it's not blue!** But the sky does appear blue for most of the day. Why?
- The sun gives off a whole spectrum of light.
- That light then hits the Earth's atmosphere, which is made up of nitrogen and oxygen gas molecules that act as a filter for sunlight.
- Longer-wave particles pass through the gas molecules pretty easily, but shorter-wave particles hit the gas molecules and get scattered around.
- Since **blue light** has the shortest wavelength, its particles are scattered the most. So when you see a blue sky, you're really looking at lots of filtered and scattered light particles.

Why is the sky red at sunset?

Because the sun is lower in the sky at sunset, the light has to pass through more of the atmosphere. That means more water vapor and dust particles to filter the sunlight. The more of these particles in the air, the more the **blue** light is absorbed away, leaving **reds** and **oranges** visible.

CAREERS



VISUAL EFFECTS EDITORS use computers, puppets, animation, and more to create and edit visual effects (VFX) for film and TV.

AVERAGE SALARY: $75,000

ADDITIONAL INFORMATION

WHAT MAKES A RAINBOW?

A rainbow is sunlight refracted in water droplets in the air. That's why you see rainbows right after a rain.

Light enters the water droplet and bends out into all the different wavelengths separate out. A rainbow is actually all the different wavelengths of light stretched out next to each other – with the shortest wavelength (**violet**) on the bottom and the longest (**red**) on the top.

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.

Facebook.com/TAMESTEM

Twitter.com/TAME_STEM

#DRIVINGSTEM

Texas Alliance for Minorities in Engineering

Schedule your own Trailblazer experience:

TAME.ORG/TRAILBLAZER