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Technology TEACHER GUIDE

How to Use your Field Trip Guide

Field Trip Guides provide structure and suggestions on a particular theme within COSI's exhibition areas. This will allow you, your students and your chaperones to be prepared to explore science and discover fun. We suggest you begin by selecting goals for your visit. These goals may include enhancing aspects of your science curriculum, understanding what it means to be a scientist, or showing your students that science learning can be cool and fun! If you have particular curriculum goals, use this Field Trip Guide to connect what you are doing in your classroom with our pre- or post visit activities. We recommend making copies of the Scavenger Hunt for each of your chaperones, so that they can guide the students through the exhibits and help record information. Our Scavenger Hunts are designed to be open-ended, and focus on process skills and scientific thinking. As a result, there may not be one right answer for each of the questions. This means you will NOT find an answer key for any of the scavenger hunts. Instead, you'll find descriptions the science concepts that we hope you'll experience. If you feel you need more clarification, you can always contact us at fieldtrips@mail.cosi.org.

COSI is a big place. As a result, you may not see everything in one day. Take your time- don't rush, and allow your students to explore the things that they find interesting. All too often kids are pulled away to the next area just as they start to get involved in an experience. Rather than trying to see it everything, select just a few areas to spend your day. You will see less, but you will learn more.

Some COSI Exhibits related to Technology & Innovation

COSI is a great place to learn about the science and technology. If not for creative and innovative scientists, we would not have many of the luxuries we have today, like cars, cell phones, or even indoor plumbing. Use this Field Trip Guide to explore the technology of the past, present and future.

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PROGRESS

Listen to what old lady Progress has to say about technology and innovation, then step into the past to explore topics like communication, transportation, and recreation. Travel through time to the small Mid-western town of Progress and interact with the technology of 1898. Around the corner, find yourself a generation later in 1962 and see the changes progress makes

Wires and Waves

The electric telegraph translates mechanical action (dots and dashes from the telegraph key) into electrical pulses, and then back into mechanical action at the other end. It was all made possible by Hans Christain Oersted's 1820 discovery of the connection between electricity and magnetism.

Oersted discovered that a current-carrying wire forms a magnetic field around itself. By wrapping several coils of wire around an iron core, the iron becomes a magnet — but only as long as the electrical current continues in the wire. If the current is shut off at the other end, the electromagnet loses its pulling power. With a suitable transmitter, sending "on" and "off" electrical signals down a wire, an electromagnet attached to a spring and mounted above an iron plate can act as a receiver. When the current is "on," the electromagnet is pulled down to the plate. When the current is "off," the spring pushes the electromagnet up.

The Horseless Carriage

The modern automobile arose in response to the limitations of the most common 19th century mode of transportation, the horse. The day of the horse is remembered fondly, but in reality, horses were dangerous, dirty, and prone to drop dead on the street. The typical horse would produce 22 pounds of manure a day. 15,000 dead horses had to be removed from the streets of New York City in 1890. When you add horses tendency to bite, kick, and bolt at loud noises, and you have a picture different from popular myth.

In the early days, horseless carriages came in three forms. There were the internal combustion engines that burns gasoline, which prior was commonly used to power kitchen stoves. There were the steam-powered vehicles, or "steamers," and there were the electric models. It was unclear even by 1900 which design would win out, as each stubbornly held onto about a third of the market. In the end, the electric car faded, mostly because of the poor state of battery technology. The steamer had its own technical difficulties, but was hurt more by poor business decisions and bad luck, including an outbreak of a horse disease in several major cities. This caused city officials to empty the city horse troughs, depriving the steamers of their water source.

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Food Preparation

The challenge of food preparation is an ancient one. If you can preserve food, then more people can eat, and less goes to waste. Improper preservation, however, you run the risk of food poisoning. Canning was first used as a preservation technique in the 1800's. By the 1830's, shops were selling food in metal cans. The first cans were opened with hammer and chisel. In these early days, the preservation process was poorly understood. In canning, food is both heated, to kill any germs already present, and locked away inside its container, to isolate it from germs in the air. In the mid-1800's, many deaths resulted from inadequately heated canned foods.

As implied by their name, frozen TV dinners were ushered along by another quickly developing technology, the television. In 1953, the first of these complete dinners were offered by Swanson Foods. In the 1970's and 80's, frozen foods again adjusted to technology, this time to the increasingly common microwave oven. For the first time, food was advertised as “microwave-ready” and sold in “microwave-safe” containers.

Before your visit, and while exploring Progress, you may want to discuss some of these questions and issues with your students:

- The town of Progress sits on the corner of “Hope Street” and “Fear Street.”
- Have your students make observations about the storefronts, people and technology in 1898. Make note of the food in the stores, the music, the toys, the modes of transportation, and the communication devices. Did they have electricity? Cars? Radios? How would they cook dinner or entertain friends. Pay close attention to detail in 1898, so you can compare and contrast the same town in 1962.
- As you pass through the tunnel to 1962, you'll notice some huge changes have taken place. The town is now in the mid-20th century and has all the benefits of television, microwave ovens, cars, and supermarkets. What are some of the biggest difference you notice?

Just a few of the changes include:

- The technology that was used to send telegraphs led to the development of wireless radio transmission, allowing the Bird Man to run the progress radio station.
- The produce market expanded to become a supermarket, with prepackaged, preserved foods ready for consumption.
- Horse and buggy gave way to automobiles in the early 20th century, allowing people to travel farther faster. Airplanes helped to extend that travel even further, making cross-country journeys possible in a few hours instead of a few weeks.
- In the 1960's everyone wanted to own a television, especially the new colored models. They were pricy for the time, but a must-have item.

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GADGETS

Admired for their ability to change how we do things, gadgets are tangible proof of how creativity advances technology. The Gadgets exhibition area contains a variety of exhibits that allow guests to explore the building blocks of more complex gadgets: pulleys, gears, lasers, and electric circuits.

Guests can examine the inner workings of everyday gadgets by taking them apart in the Gadgets Café. Groups of 66 or fewer can reserve a space in the café on weekday mornings. Groups of 6 or less can drop in to any open café.

Technology is not only the tools we use. It's also the processes we use to make those tools. These exhibits show how gadgets are made and let you build some gadgets of your own.

Bridge Building

Create small-scale bridges, towers, and other structural gadgets from aluminum components. There are three main types of bridges: beam, arch, and suspension. In all three types of bridges, the foundations must carry the full weight of the bridge. The major difference are the arched bridges are in compression and thrust outward on their support bearings, whereas the cables of the suspension bridges are in tension and exert a continual pull on their end anchorages.

A bridge must be able to withstand great forces (gravity or torque). To do this, all forces exerted on the bridge must cancel each other out. Triangles are the strongest structural shape and are often employed in bridges. The triangle is strong because the shape distributes stress evenly and supports itself. Try this… in 25 minutes or less, design a bridge that can hold eighty pounds of weight without touching the floor.

Gadget TV

Watch off-the-wall videos of odd industrial processes set to eclectic musical selections. Each selection highlights a different facet of industry, from plastic toy manufacturing, to the making of a CD-ROM, or to a dream trip inside an ice cream factory. Guests even "feel" the tactile realities of these processes as they vibrate along industrial test tracks, "bake" under heat lamps, and even get sprayed by industrial robots. Try this… go gadget spotting : identify as many simple machines as you can in one video.

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OCEAN

Poseidon's realm takes two forms in this unique learning environment. On one side of the exhibition, Poseidon reigns over a mythical playground, symbolizing the ancient means for understanding the sea. On the other side of Ocean, Poseidon is the namesake of an undersea research habitat, now symbolizing the modern means for understanding the sea. Based on real ocean exploration technology, the "D.S.B. Poseidon" uses submersibles and sonar to explore the scientific side of Ocean. This research facility would be able to hold a number of scientists, technicians, and/or military personnel each with a specific role and job responsibility. Think about some of the jobs that would be necessary to keep this habitat in working order. In this area, check out the following:

- The Nautilus Submersible is similar to the Alvin sphere, which was used to seek out the wreckage of the Titanic. The Nautilus Submersible can reach a maximum depth of over 14,000 ft, and can hold three passengers for up to 72 hours. What are the challenges for remaining underwater in a small space for that length of time?

- The SAM suit, or Submersible Atmospheric Mechanism, is a suit designed to maintain even pressure of one atmosphere to a depth of 1000 ft and weighs 800 pounds. It is hinged so that two people lower the top portion while the third climbs in and is closed up in the suit and then wiggles their arms into the sleeves. The buoyancy of the atmosphere in the suit enables the diver to move easily once they have been lowered into the ocean with a crane. The suit comes equipped with a scrubber to remove $CO2$ from the atmosphere in the suit. Because the suit maintains a constant pressure of one atmosphere, the diver is able to breathe bottled air instead of using mixed gases.

- SONAR is a detection system based on the reflection of underwater sound waves. It listens with a sensitive microphone or hydrophone, for reflected pulses of submarines, obstacles, or marine animals. Acoustic oceanography is used to map the ocean floor and detect marine life. Side-scan sonar provides a different perspective on what the seafloor looks like. The equipment is usually attached to a "sled" that is towed behind a ship.

  There are two types of acoustic sonar, active and passive. Active uses the same concept as side-scan, except it is attached to the submarine and emits acoustic energy out into open water, instead of, at the ocean floor. Active sonar is the familiar "pinging" sound you hear in submarine movies. Passive is where the sonar unit is placed under the sub and "waits" for sound to come to it, instead of, waiting for the reflections of sound it sent out. Sonar is an acronym standing for SOund Navigation And Ranging. It was first used in the 1920's.

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SPACE

How big is the universe? What drives humanity to the stars? These are questions that have piqued the curiosity of many, and whose answers change as we gain more information about the universe. *Space* offers opportunities to think about these questions while at the same time relive some of history's great space explorations. Below you'll find some background information for questions that your students may have.

The Dawn of American Space Exploration: Gemini Program

When NASA launched Project Gemini, there were essentially three objectives or goals:

1. To subject man and equipment to spaceflight up to two weeks in duration.
2. Develop methods for rendezvousing and docking vehicles in space.
3. Train astronauts in the rendezvousing and docking procedures

April 12th, 1964 marked the beginning of the program with an unmanned flight. Gemini 3, the first of the manned Gemini missions, launched on March 23, 1965. Astronauts Gus Grissom and John Young blasted off five days after the Soviets made the first-ever space walk. The Gemini space program ended on November 15, 1966.

The Mercury Project

Project Mercury was the United States' first successful manned spaceflight program. It ran from 1959 through 1963 with the goal of putting a man in orbit around the Earth.

Mercury spacecraft (also called a *capsule* or *space capsule*) were very small one-man vehicles. Only 1.7 cubic meters of volume, the Mercury capsule was barely big enough to include its pilot--and this ride provides guest the opportunity to experience a piece of space history. The engineers who first designed the capsule called the astronauts the "human payload" and did not even want to include a window! This seems like an obvious engineering choice; a window is a dangerous weakness in an otherwise strong outer shell. The astronauts insisted, and as history clearly records, the American public quickly associated the space program with the astronauts themselves, rather than the engineers and technicians who were so crucial in making the space program happen.

How did the Mercury astronauts go to the bathroom in space? Alan Shepard's flight was only 15 minutes long, but the launch was delayed. Shepard did not have a urine reservoir enclosed in his suit. He was given permission to urinate in his suit. A urine reservoir was added to the space suit for the second Mercury flight.

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The Space Shuttle Era: Shuttle Simulations

The space shuttle is a glider. When it returns home from Space, it merely falls from the sky. The four forces acting on a plane are lift, drag, weight, and thrust. The three main forces acting on the shuttle are lift, drag, and weight. Unlike a plane, the space shuttle has no thrusting engines or fuel when it's returning home. On a commercial jet plan, the passengers, crew, and luggage take up the entire length of the plane. Astronauts on the space shuttle only occupy the front end of the spacecraft called the crew cabin. The crew cabin is the only area within the shuttle where it contains pressurized air for astronauts to breathe.

Astronauts use Single-System Trainers (SST). It allows the pilot to learn how to fly the shuttle into and from space. The simulators contain computer models with software that allows the astronauts to interact with controls and displays similar to those aboard the shuttle. The astronauts train to recognize malfunctions and to correct the errors. The astronauts train with fixed-based simulators. These simulators give astronauts the feel of on-orbit operations. All on-orbit procedures are practiced hundreds of times in simulators before the astronauts fly into space. Motion-based simulators provide crews with the experience of launch, ascent, and orbital entry as well as de-orbit, reentry, and landing. The crew also practices with integrated simulations, which include the ground control teams (Mission Control Center).

Freedom Space Station

The mission of the International Space Station is to enable long-term exploration of space and provide benefits to people on Earth. With six state-of-the-art laboratories, the Space Station will be the premiere research facility in space, four times larger and more capable than any previous space station. It is hoped that it will allow for advancements in medicine, technology, and science. For example, studies in micro and hyper gravity will help researchers better understand its effects on humans and offer insight into how the human body works.

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Science Standards

Grade 3 Science and Technology

1.Describe how technology can extend human abilities.

3.Investigate ways that the results of technology may affect the individual, family and community.

Grade 4 Science & Technology

1.Explain how technology from different areas (transportation, communication, entertainment, manufacturing) has improved human lives.

2.Investigate how technology and inventions change to meet people's needs and wants.

Social Studies Standards

Grade 3 Geography

8.Identify systems of transportation used to move people and products and systems of communication used to move ideas from place to place.

Grade 3 History

3.Describe changes in community over time including changes in: business, physical features, education, transportation, technology & recreation.

Grade 3 Social Studies Skills & Methods

6. Use a problem-solving/decision-making process.

Grade 5 History

1. Create timelines and identify possible relationships between events.

Grade 5 Social Studies Skills & Methods

9. Use a problem-solving/decision-making process.

Process Skills are the actions that it takes to "do science." These are some of the scientific process skills that your students will be using as they explore the exhibits at COSI.

Observing - Use your senses to gather information.
Measuring- Use tools and numbers to quantify objects or phenomena.
Categorizing - Place objects into groups based on similarities or differences.
Communicating - Use words, pictures, graphs and diagrams to share your ideas.
Investigating - Follow a scientific method to formulate questions, conduct an experiment.
Applying - put the information you've gathered to use.
Inferring – Make an assumption based on your observations.
Questioning – Wonder and ask about things and find ways to discover answers.
Predicting - Decide what will happen in the future based on your observations.

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Vocabulary Words

Technology
Invention
Innovation
Design
Communication
Transportation
Recreation
Creativity

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Classroom Connections

It is important that your visit to COSI is not a one day event. Help your students make connections between your classroom lessons and your field trip to COSI by doing some activities related to your visit. Below are some lessons that you can use as pre-visit or post-visit activities to help connect your field trip to your classroom experiences and extend your students' learning. Consider doing one activity every day for a week before your visit.

Historical Research Project

Objective: Using the internet do a research project about technology.
Materials: Internet, resources
Procedure:

1. Necessity is the mother of invention. When we find a need that is not being fulfilled, we create stuff to improve the situation. Pick one of the following suggested inventions, and write a short report on that thing and how it came to be. Suggested inventions include: telephones, light bulbs, television, radio, automobiles, the internet, bicycles, airplanes, computers, video games, space shuttles, etc.

2. You may want to answer some of the following questions: Who invented it? When? Why? How long did it take? What would life be like without it? What is the next step in this technology? What is being done to make it better?

Technology Classification Grade 3-5

Objective: Classify technology into time periods
Materials: Paper & pencil, chalkboard
Procedure:

1. Brainstorm a list of inventions that we use every single day, from lifesaving advances like medicines and genetic research, to general uses like cars and phones, and even small but helpful tools like shoelaces and post-it notes.
2. Once you have a list of about a dozen items, decide in small groups which ones are things that you could not live without, and which ones don't really impact your life.
3. Write a short story or play about life without one of those crucial innovations.
4. Take another look at the list, and circle the things that were probably around in the year 1962. Underline the things that were probably around all the way back in 1898. When you visit Progress, try to find out if your predictions were correct.

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Lava Lake: A Design Process

Objective: There is an island in the center of a six foot pit and lava, and you need to drop off supplies to its inhabitants. Design a way to drop food and supplies onto the island without touching the lava.

Materials: length of string, masking tape, paper or plastic cups, ping pong balls, sheets of paper, scissors, paper bags, rubber bands, other random materials

Procedure:

1. Using string, tape a circle on the ground with a six foot diameter. Place the plastic cup in the center of the circle. Provide students with a ping-pong ball, tape, 3 sheets of paper, scissors, 2 rubber bands, and additional items if desired.
2. Explain to students that the small island (paper cup) is in the center of a terrible lava pit (string circle.) The inhabitants of the island are in need of food and water (contained inside a ping-pong ball.)
3. In small groups, they are to design and construct a way to set the ball down in the paper cup, without knocking it over. Allow 5 minutes for planning, 10 minutes to construct the device, and a few trials to test out the device.
4. Were they successful? What could they do to improve their design? If it worked, does it work every time? Did they work together as a team? Could you have done it on your own?

COSI Connections

When you visit COSI, you will see examples of really amazing technology at the time they were invented, like the Mars Rovers in Space, SAM suit in Ocean, or even the telephone in Progress. Do you think all of these things worked perfectly the first time they were used? What kinds of challenges do you think their inventors had in the early stages?

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Get Ready for Your Field Trip

Objective: Prepare students for their day at COSI.
Procedure:

1. Ask your students if they have been to COSI before. For those that have, find out some of their favorite things, and write these on the board.

2. Ask students to tell you some of the things that they have learned over the past week about Tell them that when they are at COSI they should look for examples of inventions and technology.

3. Review the safety rules and code of conduct, and answer any questions that they have.

After Your Visit

You have learned about technology and innovation at COSI, use that information and inspiration for the creation of your own invention. Spend a few weeks working in small groups on an invention of your choice. Select something that will somehow improve your lives in your classroom, or solve a problem that you have been having. What are the benefits of your invention? How much will it cost? Do you foresee any challenges? Send pictures or stories of your inventions back to COSI, c/o Field Trips, 333 W. Broad St., Columbus, OH, 43215 and we'll put them on display. Below are some invention ideas to get you started.

- An invention that will help me to remember to do my homework
- An invention that will help me wake up and get to school on time
- An invention to keep my desk organized.
- A new game for the playground or for Gym Class
- Something that will help my teacher