



STEM
DISCOVERY
CENTER

CLASSROOM ACTIVITIES



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USING THIS DOCUMENT

This document contains free resources for teachers which can be used in the classroom.

- The first three resources explain common processes used in scientific investigations, engineering challenges, and computer science.
- There are also links to free resources for teachers to introduce these processes to students so they may apply these concepts in the activities which follow.

There are also five activities which can be taught in the classroom before or after an Orlando Science Center field trip.

- These activities can help students make connections between classroom content and their experiences in one of our Discovery Labs.
- They may also be implemented as stand-alone activities in which students apply Florida science standards while thinking critically, collaborating, communicating, and using their own creativity.

Materials and procedures have been included for each activity. Teachers should use their own judgment as to what additional instructional strategies will be appropriate for their students' needs.

SDC LABS AND FLORIDA STANDARDS

This table includes which STEM Discovery Center field trip labs tie into each activity's content. It also lists which Florida standards teachers could adapt the lesson to integrate.

Activity	Florida Standards	SDC Labs
Scientific Investigations	Body of Knowledge: Nature of Science K-12	Pre-K/VPK: Moving Machines, Curious Chemical Reactions 1-2: Forces of Nature, Super worm Science, Mighty Magnets 3-5: Space Tech: <i>The Next Generation</i> 6-12: OSCSI
Engineering Design Process	Body of Knowledge: Nature of Science K-12	K-8: Adventures in Engineering Kindergarten: Little Engineers: Can We Fix It? Yes We Can! 3-5: STEM-Tastic, Roller Coaster Physics 6-12: Weather Balloon Challenge
Computer Programming	Body of Knowledge: Computer Science K-12	Kindergarten: Bee Robotics 1-2: Bee Robotics 3-5: Vex Robotics: Detour Ahead 6-12: Flight Lab
Pinhole Camera	SC.1.E.5.4; SC.1.P.8.1; SC.2.P.8.1; SC.2.P.9.1; SC.3.E.5.2; SC.3.E.5.3; SC.3.P.10.1; SC.3.P.10.3; SC.3.P.10.4; SC.4.P.10.1; SC.4.E.5.3; SC.4.E.6.5; SC.5.P.10.1; SC.5.E.5.3	1-2: Forces of Nature 3-5: Space Tech: <i>The Next Generation</i>
Engineering Oobleck	SC.K.P.8.1; SC.K.P.9.1; SC.1.P.8.1; SC.2.P.8.1; SC.2.P.8.2; SC.2.P.8.3;	K-8: Adventures in Engineering Pre-K/VPK: Curious Chemical Reactions



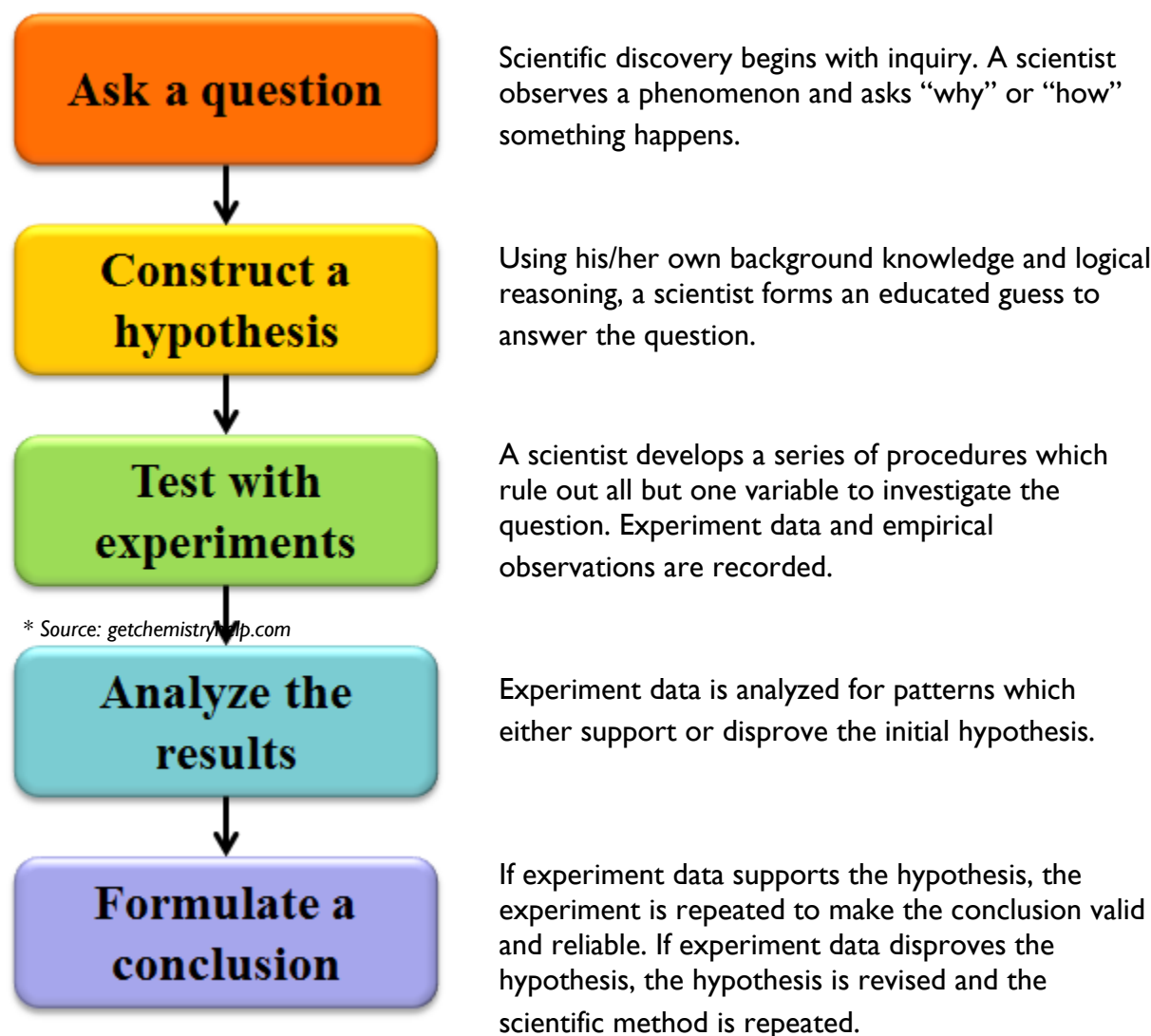
Classroom Activities

	SC.2.P.8.6; SC.2.P.9.1; SC.3.P.8.2; SC.3.P.8.3; SC.4.P.8.1; SC.5.P.8.1;	Kindergarten: Little Engineers: Can We Fix It? Yes We Can! 3-5: STEM-Tastic!, Roller Coaster Physics
Magnetic Scavenger Hunt	SC.1.P.8.1; SC.2.P.8.1	Pre-K/VPK: Moving Machines, Curious Chemical Reactions 1-2: Forces of Nature, Super worm Science, Mighty Magnets
Design a Balloon Rocket	SC.K.P.12.1; SC.K.P.13.1; SC.K.E.5.1; SC.1.P.12.1; SC.2.P.10.1; SC.2.P.13.1; SC.2.P.13.3; SC.2.P.13.4; SC.3.P.10.2; SC.4.P.10.1; SC.4.P.10.2; SC.4.P.12.1; SC.4.P.12.2; SC.5.P.10.2; SC.5.P.13.1; SC.5.P.13.2; SC.5.P.13.3; SC.5.P.13.4; SC.6.P.11.1; SC.6.P.12.1; SC.6.P.13.1; SC.6.P.13.2; SC.6.P.13.3; SC.8.P.8.2; SC.912.P.12.2; SC.912.P.12.3;	K-8: Adventures in Engineering Kindergarten: Little Engineers: Can We Fix It? Yes We Can! 1-2: Forces of Nature 3-5: STEM-Tastic, Roller Coaster Physics 6-12: Weather Balloon Challenge
Rusty Experiment	SC.912.P.8.2; SC.912.P.8.7; SC.912.P.8.8; SC.912.P.8.10	9-12: OSCSI



SCIENTIFIC INVESTIGATIONS

The scientific method is a process used during investigations to make empirical observations which are testable. Evidence resulting from these scientific investigations must be based on evidence and be replicable by others for verification. While there is no rigidly defined “scientific method,” the following steps provide an outline of how to use empirical observation to generate valid and verifiable explanations.





Scientific Method Activity Resources:

Scientific inquiry is a component of all of the activities in this document. If you have not yet familiarized your students with the scientific method, the following resources contain activities meant to introduce students to scientific investigations.

- **Double Bubble Science**

<http://www.pdesas.org/module/content/resources/16037/view.ashx>

Grade Level: Elementary

In this lesson, students will understand how to use the scientific method to find answers to questions by investigating how household items create bubbles.

- **Testing the Scientific Method Through Thumb Wars**

<http://www.scienceteacherprogram.org/gen-science/SSubramaniam09.html>

Grade Level: 6-8

Students will have an opportunity to go through the entire process of the scientific method using the game "Thumb Wars".

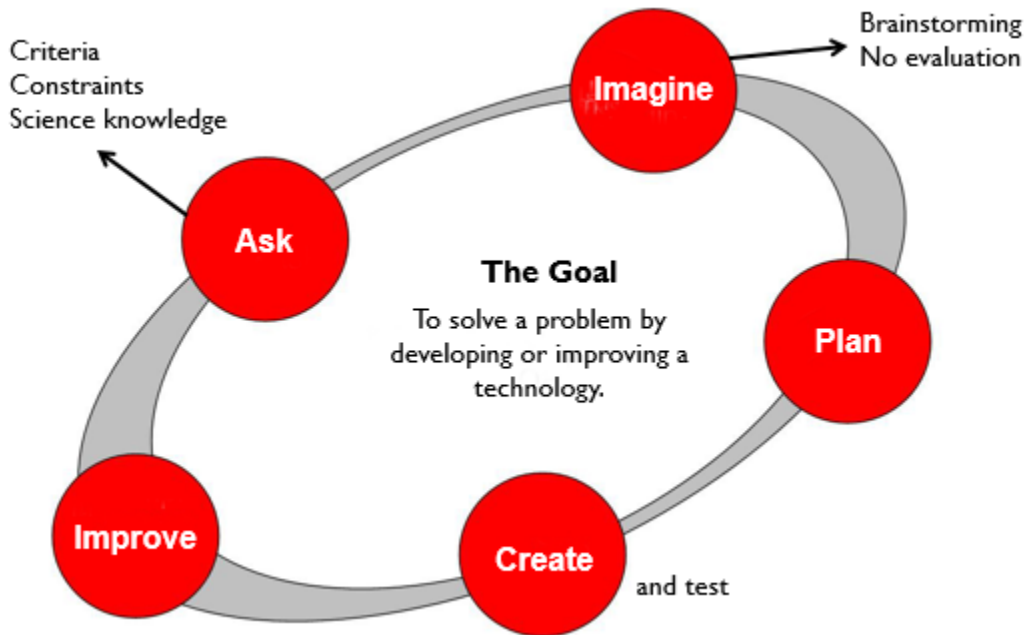
- **Comparing Experiments and Other Types of Investigations**

Grade Level: 6-12

- Ask students to work in pairs or small groups to conduct a simple scientific investigation. For example: How much vinegar can we add to baking soda before it ceases to produce a chemical reaction?
- The first time students conduct the investigation, do not give the students any more guidance beyond posting the scientific investigation question on the board and outlining required behavior for safety.
 - Allow students to investigate on their own, only providing guidance for safety. If students ask how they should proceed mixing (i.e. "Should we add the baking soda to the vinegar, or the vinegar to the baking soda?), simply respond by asking what they think they should do.
 - At the end of the lesson, ask students to share their results. As students attempt to compare their results, lead them to realize their results are not reliable (i.e. too many variables, inability to replicate because procedures were not carefully noted, explanations not tied to evidence).
- Ask students to help you develop a more reliable and accurate scientific investigation to answer the question. Provide guidance where necessary in developing the procedures and deciding what written records need to be kept. Conduct the investigation a second time having students follow these procedures and compare results.
- Have students reflect on the two different investigations and discuss which method produced more reliable and accurate results.



ENGINEERING DESIGN PROCESS



ASK questions that will help you achieve your goal.

- What are the criteria my design needs to meet?
- What are the constraints which limit me?
- What science and math content will I need to consider as I design my technology?

IMAGINE at least two possibilities for design.

- What could be some solutions?
- Brainstorm ideas.

PLAN the design before building.

- Collaborate with my team to make a plan for our design.
- Make a list of the materials needed.

CREATE at least one design solution.

- Follow the plan and create it.
- Test design and evaluate results.

IMPROVE the design based on evidence around the original design criteria.

- Make the design better.
- Re-test and evaluate results.



Engineers are people who use their knowledge of math and science, as well as their own creativity, as they create and improve technology to solve problems. The Engineering Design Process is a tool engineers use when developing new technology or improving existing technology.

- In a scientific inquiry, an answer to a question is investigated and this answer is determined from gathered evidence either to be correct or incorrect. The goal of a scientific inquiry is to understand the natural world around us by forming logical explanations. The scientific method is often a part of engineering, as engineers *ask* questions to gather scientific data they will need to consider as they create their designs.
- In the Engineering Design Process there is no correct answer, but instead infinite possible solutions to a problem. An engineer uses creativity as he/she creates one possible solution to this problem and considers math and science in order to determine whether the design is an efficient solution to the problem. The goal of engineering is to design and improve technology which solves a problem or fulfills a desire.

Engineering Design Process Activity Resource:

If you have not yet covered the Engineering Design Process with your students, the following resource contains an activity meant to introduce students to the Engineering Design Process and guide them through engineering activities.

- Teach your students the song in this YouTube video:
<https://www.youtube.com/watch?v=6dR3iKaWUoU>
 - Make up dance and movement to the lyrics to teach your students.
 - Older students could also make up their own song with accompanying movements about the Engineering Design Process.
- Engineering Design Process Sticky Notes
 - Lead your students through one of the engineering design challenges in this document. Draw a large diagram of the engineering design process on the board.
 - After each step of the engineering design process, have students write one word to describe something they did on a post-it note (each student should write something different from the other students in their group).
 - Then, have students place their sticky note on the corresponding step of the engineering design process on the board.
 - At the end of the activity, review what students did during each stage of the engineering design process by reading through the sticky notes. Emphasize that students did not move through the engineering design process in one order- they went back and forth between the steps (i.e. going to back to asking questions after testing). Also point out that there were things students did during all of the steps (i.e. collaborating, thinking).



COMPUTER PROGRAMMING

A computer program is a set of commands created by people to do something. A computer will only follow a program's instructions. Computer engineers design and test a program and then troubleshoot errors to improve the program.

The following resources contain free content and activities teachers can use to implement computer programming into their classrooms:

- [Code.org](#)
 - This website contains free activities and curriculum structured to teach students how to create computer programs in K-12.
- [Scratch](#) (ages 8-16 years) and [Scratch Jr](#) (ages 5-7 years)
 - Students can design computer programs to create and share stories, games, and animations.
- [Blockly Games](#)
 - Blockly Games is a series of K-12 educational games that teach programming. It is designed for children who have not had prior experience with computer programming. By the end of these games, players are ready to use conventional text-based languages.



PINHOLE CAMERA

Objective: Students follow the scientific method to determine the most effective size to make an aperture in a pinhole camera to display an image of the sun.

Vocabulary:

Pinhole camera

Sun

Aperture

Light

Reflect

Materials: stiff white paper, push pins, sharpened pencils, hole punchers

Procedures:

- This activity can be related to lessons about the sun and/or light. Lead a classroom discussion with your students about our solar system's sun and/or how light travels. Since it is never safe to look directly at the sun, we need to use technology to make an image of the sun which is safe to look at, like a pinhole camera.
- Explain that a pinhole camera is a simple device which projects an image. It functions by directing light through an aperture (a small opening or hole). The light passes through this aperture and is reflected on a screen on the other side. Because light travels in a nearly straight line, the small opening lets in a limited amount of light. This allows the light to reflect off of the screen in such a way that it produces an image which is reversed and upside-down.
- On a sunny day, give students two sheets of stiff, white paper. With a pin, have students punch a small hole in the center of one of the sheets of paper.
- Take the students outside and instruct them: With the Sun behind you, hold the two sheets of paper in your hands. The rays of the Sun will pass through the pinhole and project on to the second sheet of paper (the screen). Move the screen until the image is centered and in focus. What you are seeing is not just a dot of light coming through the hole, but an actual image of the Sun!
- Have students punch a larger hole in a second sheet of paper with a sharpened pencil, and in a third sheet of paper with a hole puncher. Repeat the above procedures and have students record their observations about how well the image can be seen.
- Lead a classroom discussion comparing results and have students conclude which sized aperture was the most efficient at projecting a clear image of the sun.



ENGINEERING OOBLECK

Objective: Students follow the Engineering Design Process to design an Oobleck recipe.

Vocabulary:

Physical property

Solid

Liquid

Physical change

Viscosity

Non-Newtonian fluid

Engineering Design Process

Troubleshoot

Materials: Corn starch, water, mixing bowls, mixing spoons, measuring spoons, newspaper or tablecloths to cover work surfaces

Procedures:

- Before the lesson, combine 2 parts cornstarch with 1 part water to make a large batch of Oobleck.
 - You should be able to squeeze it into a ball in your hand; when released, it should flow. Add cornstarch if too fluid, water if too solid.
- Groups of 2-4 Students will follow the Engineering Design Process to design an Oobleck recipe.
- **Ask:** Give each group a handful of pre-made Oobleck in a bowl to explore. Guide a student discussion about the Oobleck's liquid and solid properties. Explain that Oobleck is a Non-Newtonian fluid: Its viscosity undergoes a physical change when pressure is applied to it.
- **Imagine:** Give each group a bowl of cornstarch with a measuring spoon, a bowl of water with a measuring spoon, a mixing bowl, and a mixing spoon. In their groups, students explore the cornstarch and water to determine which ingredient gives Oobleck solid and liquid properties.
- **Plan:** Groups measure and mix the cornstarch and water until they create high quality Oobleck.
- **Create:** Each group writes instructions on how to make high quality Oobleck. Have groups switch recipes and follow the other group's recipe exactly. Groups should provide feedback about how easy or difficult the instructions were to follow, and the quality of the Oobleck they created.
- **Improve:** Students should troubleshoot the instructions in their recipe based on feedback. Have students exchange recipes and troubleshoot at least one more time.
- Have students share their results at the end.



MAGNETIC SCAVENGER HUNT

Objective: Students conduct a scientific investigation about magnetism through a scavenger hunt.

Vocabulary:

Magnet

Attract

Repel

Materials: Class set of magnets, sticky notes, rulers

Procedures:

- Ask students to share their background knowledge about where they have seen/used magnets before. Lead students through exploring the magnets and discuss how magnets have two poles which attract the opposite pole and repel the like pole. Ask students to hypothesize what objects in the classroom would be affected by magnetism (either attracted or repelled by a magnet).
- Allow students to explore the classroom in small groups using their magnets to find objects which are affected by magnetism. Have students bring smaller objects to their tables which are affected. Students can leave a sticky note on objects which are too large to move.
- Compare results at the end and whether students' original hypotheses correlate with their observations. Have students discuss what properties all the affected materials have in common. Students should conclude that all of the materials have metal in them.
 - Metal may not be visible in some objects, so students will need to discuss what is inside these objects to conclude that they do indeed contain metal (i.e. plastic coated paper clips).
- Have students determine which objects are more affected by magnetism by placing one small object they found at one end of a ruler, and a magnet at the other. Slowly and steadily, slide the magnet closer to the object along the ruler until it moves because of the magnetism. Compare how close the magnet had to get to each object until it showed the effects from the magnetic field.
- Compare results and have students theorize why some objects were more or less affected by the magnetism.



DESIGN A BALLOON ROCKET

Objective: Students follow the engineering design process to design a rocket propelled by a deflating balloon which can transport a designated mass.

Vocabulary:

Thrust

Kinetic energy

Weight/mass

Force

Gravity

Mechanical energy

Potential energy

Friction

Materials: balloons of several shapes and sizes, string of several types of material, plastic straws (non-bendy), tape, paper clips

Procedures:

- Before the lesson, make a demonstration rocket balloon. Tie one end of a length of string (approx. 10-15 ft. long) to a chair, door knob, or other support.
 - Put the other end of the string through the straw.
 - Pull the string tight and tie it to another support in the room.
 - Blow up the balloon (but don't tie it.) Pinch the end of the balloon and tape the balloon to the straw.
- Challenge students to follow the engineering design process to design a balloon rocket.
 - The teacher should set a goal for students for the distance the balloon should travel and the mass/weight the rocket must transport that distance.
 - Mass/weight can be added by attaching paper clips to the straw/balloon.
- **Ask** Show students the demonstration rocket and launch it by releasing the mouthpiece so the air escapes. Discuss how the moving air from the deflating balloon creates motion and how the balloon slows and stops moving, tying in grade-appropriate vocabulary.
- **Imagine/Plan:** Give each small group of students a sample of each available material they can choose from and allow them to explore their properties. Students should then choose their materials and draw a plan for their design.
- **Create:** Students build and test their rockets to see if they meet the criteria.
- **Improve:** Students improve their rockets and test a second time. Students who succeed in meeting the criteria can use a timer to see how fast their rocket travels the required distance and improve their rocket to travel at a greater speed.



RUSTY EXPERIMENT

Objective: Students will conduct an experiment to determine whether rust is the result of a physical or chemical change and how to alter the speed of that process.

Vocabulary:

Chemical change
Oxidation

Physical change
Acid

Rust/Iron oxide

Materials: steel wool pads (without soap), tap water, salt water, vinegar, clear fingernail polish, vegetable oil (optional extras: spray-on car wax, polyurethane finish, furniture polish)

Procedures:

- Discuss students' background knowledge about chemical and physical changes. Ask students to consider whether rusting metal is a chemical or physical change.
 - Dampen a steel wool pad with approximately $\frac{2}{3}$ cup fresh water and put it in a first saucer.
 - Dampen a steel wool pad with approximately $\frac{2}{3}$ cup salt water and put it in a second saucer.
 - Make a mildly acidic solution by mixing $\frac{1}{3}$ cup vinegar with a $\frac{1}{3}$ cup tap water. Use all of this solution to dampen a steel wool pad and put it in a third saucer.
 - Leave a dry steel wool pad in a fourth saucer. This is your control.
 - Observe the steel wool over several days. Which pad rusted the fastest? The second fastest? The third fastest? Take pictures of the rusted pads and write up your results.
- Explain the result using grade-appropriate vocabulary. Rust is a result of oxidation and creates a new material, iron oxide. Therefore, it is a chemical reaction.
- Lead students in a discussion about how rust affects people in real life and how people try to prevent it. Present the rest of the materials to students (fingernail polish, vegetable oil, and any optional materials you have) and ask them to hypothesize which material(s) they predict will be most effective at preventing rust.
 - "Pre-treat" steel wool pads by coating them in any of the following: clear nail polish, spray-on car wax, vegetable oil, polyurethane finish, and furniture polish. You do not have to use all of these substances, but try to select at least two.
 - Dampen your pre-treated steel wool pads with water (just as you did in experiment #1) and put them on a saucer. Come back and observe the steel wool pads at the same intervals of time as before.
- Discuss: Which pre-treatment worked the best? Why?