ARIZONA SCIENCE CENTER
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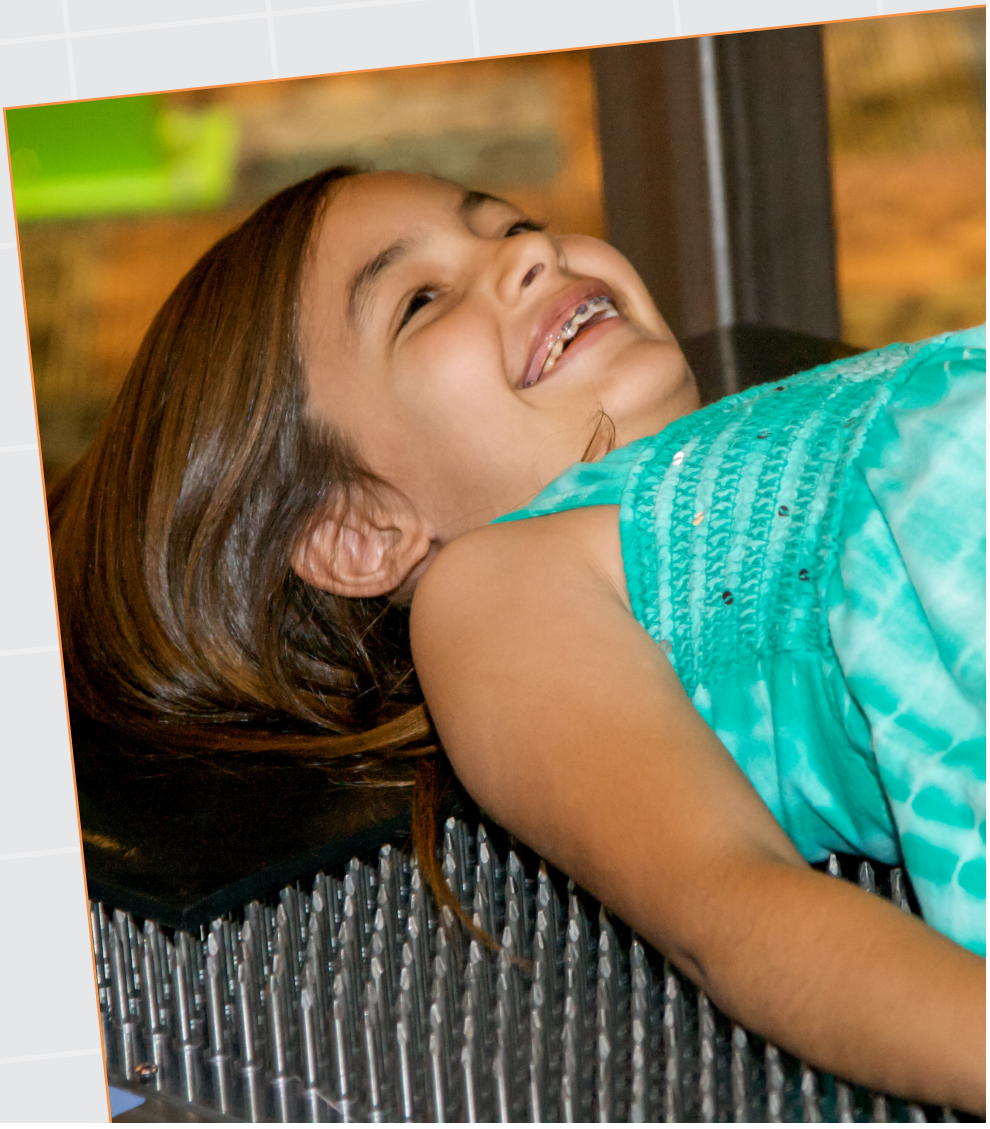
EDUCATOR GUIDE

GET CHARGED UP

EXHIBIT GALLERY
STANDARDS
PRE-VISIT ACTIVITY
BOOKING TRIP



600 E. Washington St.
Phoenix, AZ 85004
602.716.2000
azscience.org

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INTRODUCTION

This Guide introduces concepts and activities for teachers to use with their students centered around the Get Charged Up gallery at the Arizona Science Center, Phoenix, Arizona. This guide is divided into standards aligned activities based on grade level. There are three types of activities in this guide. The first type introduces students to concepts found in Get Charged Up and provides them with background experiences that will enhance their field trip and understanding. The second type of activities are those that students can perform during a field trip.These may include handouts, interactive notebooks or information challenges for the gallery. The final type of activity allows for review and reflection of the experiences following the field trip.This curriculum guide encourages the use of the 5 E's of inquiry by encouraging students, teachers, and chaperones to Engage, Explore, Explain, Elaborate, Evaluate as they explore Get Charged Up..

GET CHARGED UP EXHIBIT GALLERY

Experimentation Station: This station is where all the fun Get Charged Up! activities

Concepts: Physics

All About Pendulums: Seven pendulums are housed together for direct comparison of amplitudes, swing rates (periods), lengths and masses.

Concept: Gravity, Potential Energy, Kinetic Energy, Oscillating Motion

Ball Launcher: Heavy balls follow a curved path through space. Five hoops can be arranged to mimic his curve so the ball flies through them!

Concept: Launch trajectory, Gravitational Potential Energy

Bed of Nails: Visitors can lie on a down on a bed containing thousands of nails without injury.

Concept: Distribution of Mass and Weight

Bernoulli Blower: Air pressure suspends four balls in midair. Their height can be changed by covering up certain holes.

Concepts: Bernoulli's principle, Air Pressure, Lift

Color Mixing: Prisms are used to divide white light into a color spectrum.

Concepts: Light Spectroscopy, Refraction

Dancing Iron Dust Trees: 81 electromagnets change their strength and orientation in time to music, while magnetic iron dust follows along and provides an exciting visualization.

Concepts: Electromagnets

Disappearing Glass Rods: When submerged in a clear liquid, all but one glass rod disappear. When a magnifying glass is submerged, the image through it becomes clear.

Concepts: Refraction, Shell's Law

Does it Conduct?: An open circuit can be closed by tubes that contain various materials, some of which conduct electricity and close the circuit.

Concept: Electric Circuits, Conductor vs. Insulator

Downhill Racer: Two identical wheels with radially adjustable weights can change their speed and win, lose or tie!.

Concept: Angular Momentum Conservation, Moment of Inertia

Electric Circuits: Assemble an electrical circuit using various components.

Concepts: Electric Circuits

Electric Motor: Press a button to send an electrical pulse into coils which repels magnets and spins the motor.

Concept: Magnetic Induction

Electromagnetic Workbench: A quartet of magnets under a table can be controlled using knobs and switches. Changing their strength and orientation results in manipulation of objects on the table.

Concept: Electromagnets; Magnetic Field Lines

Forces in Action: The exhibit that encompasses the Weigh Yourself and Weight Wall exhibits.

Concept: Gravity, Normal Force

Giant Lever: A giant upright pulley can be pulled from either side by ropes. The height of the rope determines how easy the tug-of-war is.

Concept: Torque, Leverage, Simple Machine

Magnetic Ball Wall: A series of tubes can be arranged vertically to allow plastic balls to follow their obstacle course to the floor.

Concept: Gravitational Potential Energy

Pulley Power (Pulley Chairs): Three different arrangements of pulleys offer varying levels of difficulty as visitors try to hoist themselves up.

Concept: Simple Machines

Strobe String: Visitors try to match the speed of the strobe light to the rotation of the string. This creates the illusion that the string is not moving.

Concept: Photo-illusions, Light, Zoetrope Effect

Take a Spin (Momentum Machine): A rotating platform houses a sturdy pole whose spin rate changes depending on the weight distribution of the spinner.

Concept: Conservation of Angular Momentum, Lenz's Law, Power Generation, Magnetic Induction

Weight Wall: A very steep wall that has scales at certain heights. They show less than the climber's true weight according to how high the climber is.

Concept: Normal Force, Gravity

Weigh Yourself: A scale that you use to weigh yourself to compare to the weight from the Weight Wall Exhibit.

Concept: Gravity**Seeing with Sound:** A display of various ultrasounds.

Concept: Neonatal Development and Medical Equipment

ESSENTIAL QUESTIONS

These questions provide the framework for guiding learning through The Get Charged Up Gallery. *(4 Questions)*

If you push open a door from the middle of the door, why does it take more work?

If you are in a building or underground, a compass might not work. Why?

Why does a heavy moving object requires more force to stop?

Find two cans of different soup with identical weight. Why will one roll faster down a slope than the other?

EDUCATOR RESOURCES

Engineering resources for the elementary classroom - Engineering is Elementary

Introduction to magnetism - Magnetism

How To Make An Electromagnet

Make a simple circuit with conductive paint.

Build a Simple Circuit from a Pizza Box (No Soldering)

Simple Drop Gravity Virtual Lab - Virtual Lab - Compare gravity on different planets

Newton's Laws Newton's Laws of Motion Interactive

Optics activities for kids - Easy Activities

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STANDARDS BY GRADE LEVEL *(Some or part of the gallery meets these Arizona State Standards)*

THIRD GRADE

STRAND 5	CONCEPT 3	PO 1	Demonstrate that light can be: reflected (with mirrors), refracted (with prisms), and absorbed (by dark surfaces)
STRAND 5	CONCEPT 3	PO 2	Describe how light behaves on striking objects that are: transparent (clear plastic), translucent (waxed paper) and opaque (cardboard)
STRAND 5	CONCEPT 3	PO 3	Demonstrate that vibrating objects produce sound.
STRAND 5	CONCEPT 3	PO 4	Demonstrate that the pitch of a sound depends on the rate of the vibration (Music instruments between the first and second floors).

FOURTH GRADE

STRAND 5	CONCEPT 3	PO 1	Demonstrate that electricity flowing in circuits can produce light, heat, sound, and magnetic effects.
STRAND 5	CONCEPT 3	PO 2	Construct series and parallel electric circuits.
STRAND 5	CONCEPT 3	PO 3	Explain the purpose of conductors and insulators in various practical applications.
STRAND 5	CONCEPT 3	PO 5	State cause and effect relationships between magnets and circuitry.

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STANDARDS BY GRADE LEVEL *(Some or part of the gallery meets these Arizona State Standards)*

FIFTH GRADE

STRAND 5	CONCEPT 2	PO 1	Describe the following forces: gravity and friction
STRAND 5	CONCEPT 2	PO 2	Describe the various effects forces can have on an object (e.g., cause motion, halt motion, change direction of motion, cause deformation).
STRAND 5	CONCEPT 2	PO 3	Examine forces and motion through investigations using simple machines (e.g., wedge, plane, wheel and axle, pulley, lever).
STRAND 5	CONCEPT 2	PO 4	Demonstrate effects of variables on an object's motion (e.g., incline angle, friction, applied forces)

EIGHTH GRADE

STRAND 5	CONCEPT 2	PO 2	Identify the conditions under which an object will continue in its state of motion (Newton's 1st Law of Motion).
STRAND 5	CONCEPT 2	PO 3	Describe how the acceleration of a body is dependent on its mass and the net applied force (Newton's 2nd Law of Motion).
STRAND 5	CONCEPT 2	PO 4	Describe forces as interactions between bodies (Newton's 3rd Law of Motion).

PRE VISIT ACTIVITY "TOOLS OF THE TRADE"

by Casey Crowley

OVERVIEW/DESCRIPTION

In this lesson, students will explore how to make a circuit and then they will identify and classify a selection of items as either conductors or insulators of electricity. After predicting whether an object will conduct electric current, they use a bulb and battery circuit to test their predictions.

BACKGROUND

An electric circuit is an unbroken loop of conductive material that allows electrons to flow continuously. If a circuit is "broken," its conductive elements no longer form a complete path, and continuous electron flow cannot occur. Conductors are materials that electricity can flow through easily. These materials are made up of atoms whose electrons can move freely. Insulators are materials that are the opposite of conductors. The atoms in insulators are not easily freed and are very stable, therefore preventing or blocking the flow of electricity.

STEM CONCEPTS

Circuits

Electricity

Insulators & Conductors

Classification

Teamwork

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5 E'S OF INQUIRY

Engage:

Divide students into groups of 2-3. Give each group a D battery, 2 wires stripped at the ends and a bulb. Ask them to use their critical thinking skills to see if they can figure out a way to get the bulb to light up. Once each group is successful, have them draw a diagram of their circuit.

Explore:

Now that we have a functioning electric circuit, we are going to experiment with various objects and materials to see which ones will conduct electricity in our circuit and which ones will not. Give each group a bag of 10 items (a mix of

5 E'S OF INQUIRY

(Explore continued)

conductors and insulators). Have each group predict which items they think will conduct electricity and which will not (they should record their predictions in their notebooks). Give each group a 3rd stripped wire (alternatively, have them cut one of the wires they already have into two pieces and strip the newly cut ends themselves). Have the groups test each item for conductivity and make a list of which items do complete the circuit successfully and those that do not.

Explain:

After seeing which items work to complete our circuit and which do not, what conclusions can we make? What kinds of materials conduct electricity? What kinds of materials don't conduct electricity? Things that conduct electricity are called conductors and things that don't conduct electricity are called insulators. What is different about conductors and insulators at the atomic level?

Elaborate:

When might you want a material to conduct electricity? When would you want an item to NOT conduct electricity? Can you think of some examples of things you see in your house or at school that are conductors? How about insulators?

Evaluate:

Have students draw a picture of their testing set up in their notebooks and make a list of the items that were conductors and the items that were insulators. Also, have them give at least three examples of things in the school or at home that are conductors, and at least three things that are insulators.

TAKE HOME MESSAGES

Students will better understand how circuits work and what materials conduct electricity and what materials do not. They will also be able to identify some common applications for insulators and conductors

SUPPLIES

For each group:

3 pieces of wire (stripped at the ends)

Battery (size D)

1.5 volt bulb and socket

Paper fasteners

Variety of materials that are either conductors or insulators; enough for each group to have ten items (examples: metal paper clip, paper, eraser, aluminum foil, rubber band, pencil, coin, hairclip, key, bobby pin, bottle cap (plastic or metal), nail, toothpick, string, cardboard square, wax paper, etc.)

TALKING POINTS/OPEN ENDED QUESTIONS

What is electricity? Who makes circuits? Why do we need circuits?

RESOURCES

This activity was modified from: http://tryengineering.org/lesson-plans/insulators-and-conductors & http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.lp_electric/electric-circuits/

Sparkfun tutorial on circuits: https://learn.sparkfun.com/tutorials/what-is-a-circuit

NEXT GENERATION SCIENCE STANDARDS

4th grade

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

8th grade

N/A

ARIZONA STATE SCIENCE STANDARDS

4th grade

Strand 1: Inquiry Process
- Concept 1: Observations, Questions, and Hypotheses
  - PO 3: Formulate predictions in the realm of science based on observable cause and effect relationships.
- Concept 2: Scientific Testing (Investigating and Modeling)
  - PO 3: Conduct controlled investigations in life, physical, and Earth and space sciences.

Strand 5: Physical Science
- Concept 3: Energy and Magnetism
  - PO 1: Demonstrate that electricity flowing in circuits can produce light, heat, sound and magnetic fields
  - PO 3: Explain the purpose of conductors and insulators in various practical applications.

8th grade

Strand 1: Inquiry Process
- Concept 1: Observations, Questions, and Hypotheses
  - PO 3: Generate a hypothesis that can be tested.
- Concept 2: Scientific Testing (Investigating and Modeling)
  - PO 3: Conduct a controlled investigation to support or reject a hypothesis.

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