ARIZONA SCIENCE CENTER
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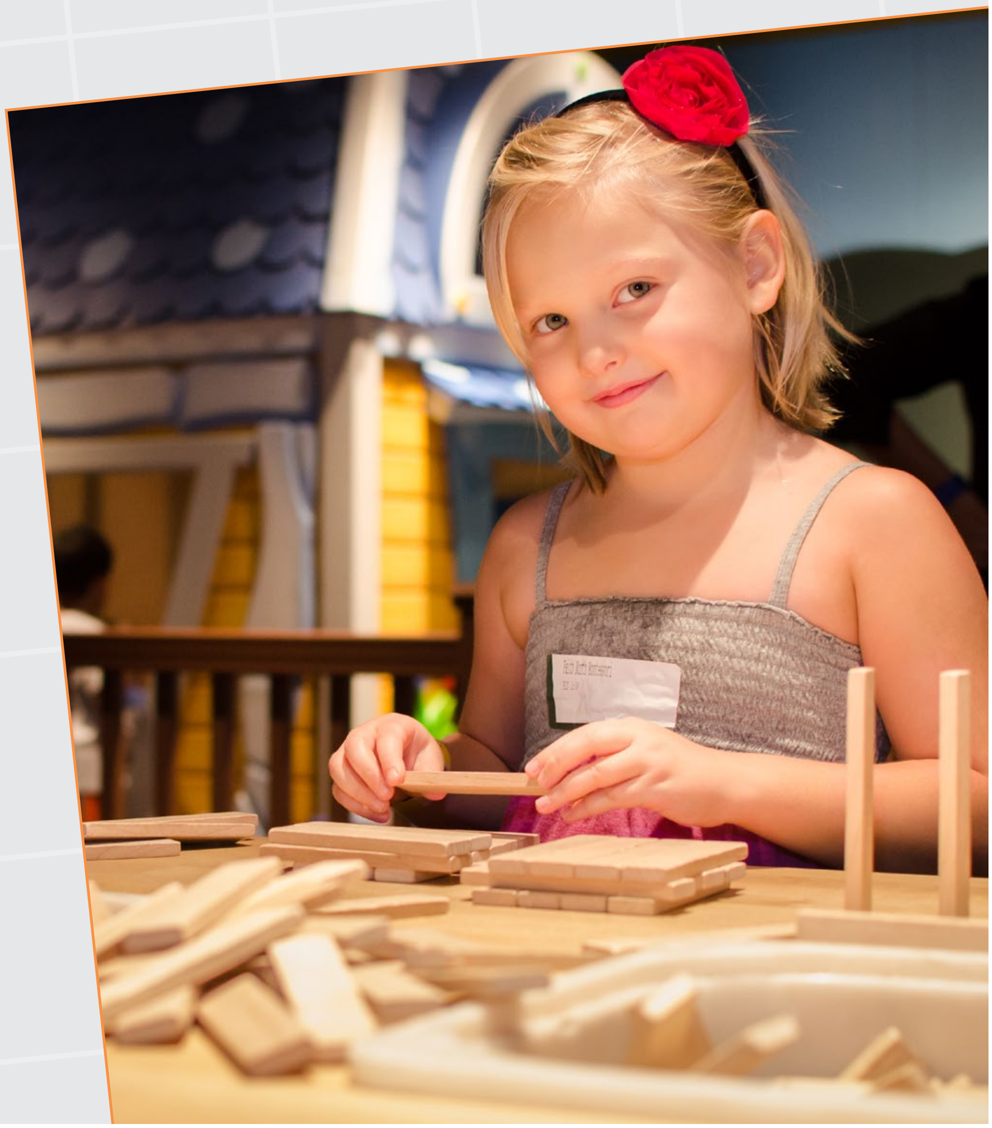
EDUCATOR GUIDE

FLIGHT ZONE & MANY HANDS MAKE A HOME

EXHIBIT GALLERY
STANDARDS
PRE-VISIT ACTIVITY
BOOKING TRIP



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INTRODUCTION

This Guide introduces concepts and activities for teachers to use with their students centered around the Flight Zone & Many Hands Make a Home 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 Flight Zone & Many Hands Make a Home 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 Flight Zone & Many Hands Make a Home.

FLIGHT ZONE EXHIBIT GALLERY

Principles of Flight: Visitors will be introduced to the world of aeronautics in this touch screen interactive. They will learn about the principles of Drag, Lift, Weight, and Thrust in flight.

Concepts: Flight Dynamics, Aviation, Aerodynamics

How Things Fly: Learn about the flight dynamics of pitch, roll, and yaw in this flight simulation interactive.

Concept: Flight Dynamics, Aviation, Aerodynamics

Paper Airplane Launcher: Using the Engineering Design Process, design your own paper airplane, test it's flight and modify your design to improve your results.

Concept: Engineering Design Process, aerodynamics, aviation

Helicopter Design: Using the Engineering Design Process, design and modify your own or a sample helicopter design. Test the helicopter's flight and modify your design to improve your results.

Concept: Engineering Design Process, Gravity, Forcest

ESSENTIAL QUESTIONS

These questions provide the framework for guiding learning through Flight Zone. *(4 Questions)*

What are the Four Forces of Flight?

Whose Principle is used to describe why flight is possible?

How does the flight of a helicopter differ from an airplane?

What parts of an airplane cause it to Pitch, Roll, and Yaw?

EDUCATOR RESOURCES

NASA Educator Information - NASA Education

Boeing Educational Resources (Engineering / Flight / Resources) - Education

Smithsonian Air and Space Museum - Educator Resources

Discover more about the atmosphere and flight - Earth's Atmosphere

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MANY HANDS MAKE A HOME EXHIBIT GALLERY

Air Conditioner: Visitors can see a real air conditioner and learn a little about the history of air conditioning in Arizona.
Concepts: Technological Adaptation, Home Building

Bathroom Walls are Different: Beneath the paint, paper or tile in the bathroom, you will find green board or wonder board. This layer contains waterproofing. If the bathroom is part of an exterior wall, you will find layers of insulation beneath the green board. This weather proofing is not used in walls in the interior of the house.
Concept: Architecture, Building Planning

Blue Print Blocks (KEVA Planks): A table of the rough blueprints of a house containing a central reservoir of KEVA planks.
Concept: Structural Integrity, Physics of Architecture

Building Homes Man: This exhibit has a video explaining 5 important people involved with building a home.
Concept: Architecture

Carpenter's Toolbox: Visitors can look at the tools that a carpenter uses on the job.
Concept: Architecture, Specialized Tool

Circuit Challenge: Visitors will learn how many appliances can operate on the same electrical circuit.
Concept: Electricity, Circuit Building

Design a Floor Plan: Visitors use a simulated CAD program to design their ideal house. Visitors can place various objects around the house like lights, furniture, plants, and electronics.
Concepts: Building Planning

Electrician's Toolbox: Visitors can look at the tools that an electrician uses on the job.
Concept: Specialized Tools, Simple Machines in Tools

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Homes that Beat the Heat: Guests design an energy-efficient house for a hot climate.

Concept: Architecture, Energy Efficiency

Kitchen: Guests are able to select the finishes they desire on a new kitchen.

Concept: Color, Interior Decorating, Materials

Laying the Foundation: A wall exhibit/mural dedicated to the inner workings of pouring a foundation.

Concept: Building Construction

Map of Phoenix: A large map that displays the cities in Phoenix.

Concept: Navigation, City Planning

Pipes and Valves: This exhibit allows guests a "hands on experience" with plumbing systems in a house. The objective is to connect the pipes to send hot or cold water to the appliance.

Concept: Plumbing

Phoenix Growth: A history exhibit that explains the pipeline system that was built to replace the salty ground water that households had previously used.

Concept: Historic Plumbing, Technological Advancement

Play Space: A fun house for the youngest visitors under 4 years old.

Concept: Construction, Housekeeping, Cognitive Development, Motor Development

Plumber's Toolbox: Visitors can look at the tools that a plumber uses on the job.

Concept: Specialized Tools

Roof Structure: Triangular and parallel roof structure models between a back-light and a piece of welder's shield material that changes color as pressure is applied.

Concept: Structural Integrity, Building Physics

How Does A Toilet Work: Guests learn all about the core of the toilet (the siphon) and "low flow" appliances to help us conserve our precious resources.

Concept: Water Conservation, Appliances

Water in the House: A cross-section rendering the pipe system within a house, including colored lighting to indicate the path cold, hot, and drain water takes.

Concept: Plumbing

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What's Inside Your Wall: Highlights the wiring, piping, cable and ductwork installation before a wall is sealed.
Concept: Building Planning, Architecture

ESSENTIAL QUESTIONS

These questions provide the framework for guiding learning through Many Hands Make a Home. *(4 Questions)*

Why are houses built in Phoenix different from houses built in Flagstaff?

How many different jobs does it take to build a house? Why?

As a city planner, you are asked to design a city that uses water more efficiently. What are important things to consider in the design?

Your city has grown from 40,000 people in the 1970's to 3,000,000 in the 2010's. What does this increase in population size mean for water use, electricity, trash, and transportation?

EDUCATOR RESOURCES

Discover how Phoenix is changing now and in the future - Why Phoenix?

Explore how Phoenix is doubling recycling rate by 2020 - Phoenix wants to double recycled trash by 2020

REACT - Renewable Energy Activities - Choices for Tomorrow - Great pdf of lessons and activities.

Discover Home Building with the Three Little Pigs - Activities and lesson guide from OMSI. Also, engineering activities - Children's Engineering: The Three Little Pigs

Try designing circuits with a circuit simulator - DoCircuits - Circuit Simulator

Explore the Phoenix Planning and Development Map - Zoning Map

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PRE VISIT ACTIVITY "WATERPROOF ROOF"

by Casey Crowley

OVERVIEW/DESCRIPTION

This activity explores how roofs are designed differently in diverse climates in order to protect the inside of buildings. Students will work in groups to design a roof structure both in terms of shape and materials to protect the inside of a model house from a simulated rainstorm. Additional testing may be done that is specific to each climate (desert, tropical and arctic).

BACKGROUND

The pitch (or angle) of a roof is usually proportional to the amount of precipitation the building anticipates. Houses where there is low rainfall may have flatter roofs than areas with high rain or snowfall levels. In these areas, steeply pitched roofs with efficient gutter systems are prevalent. The materials chosen to make a roof will also vary with different climates.

STEM CONCEPTS

Climate

Structural and Materials Engineering

Engineering Design

Teamwork

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5 E'S OF INQUIRY

Engage:
What does the roof of your house look like? What is it made of? Do you think people who live in the rainforest have the same type of roof as people who live in the desert? In this activity, you will be assigned a climate, either desert, tropics or arctic. You will then build a model house with a roof designed to withstand the weather extremes associated with that climate.

Explore:
Divide students into groups of 2-3. Assign each group a climate (you can have them draw from a bag, chose a number, etc.). Students may need a few minutes to research their particular climate and the weather extremes associated with it (or you can provide them with a short description of the climate).

5 E'S OF INQUIRY

(Explore continued)

Then show students what materials they will have available to build their design with. The plastic storage container will be the "house" that they will be building their roof on top of. In their groups, the students should create a plan for their roof design. Once they have a drawing and materials list, they may gather their materials and start building their roof.

Once the groups have built their roofs, each group should briefly present their design to the entire class. They should be able to explain how the design meets the demands of the weather extremes of their assigned climate. Then they should test their roof to see how well it will fair in a "rainstorm" (remind students that most climates will have some rainstorms). The other groups should observe and take note of what worked and what didn't in each design.

(Optional) If you want to have a second round of testing specific to each climate, you can have the arctic roof test for the weight of snow (by adding pennies to the roof). Test the roof designed for desert climates by placing an ice cube inside the house and using a blow dryer to simulate heat (the goal being to keep the ice cube from melting). For the tropics roofs, try dumping 2 liters of water on the roof instead of just 1. If you are doing these climate specific tests, be sure to let the students know ahead of time so they can plan their designs accordingly.

Explain:

Have students discuss what design features of their roofs seemed to work best and any other observations they want to share. What conclusions can we make about roof design after our testing? How might the angle of the roof affect how well it repels water? What materials are more hydrophobic than others? What materials work better for your climate than others?

Elaborate:

Give students more time and materials time to improve and retest their roof designs. If some groups finish early have them assist other groups with their designs.

What happens to all the water that runs off the roof? In arid climates, people often save the rainwater that runs off their roof to reuse. How might they do this? In some places there is too much water running off roofs and sidewalks and roads, why might this be a problem?

Do you think your roof design might be considered "green?" Why or why not?

Evaluate:

Have students write a letter to a housing developer explaining why their roof design would be a good choice for their particular climate. Make sure they include the results from their testing. If their design did not fully succeed, have them explain in the letter what improvements would need to be made in order to have the roof be functional.

TAKE HOME MESSAGES

Students will better understand the relationship between roof design and climate. They will also gain insight into using the engineering design process to solve a problem.

SUPPLIES

Large bin or sink for testing roofs, or access to outdoor area for testing

Water (1 liter per team)

Measuring cup

Building materials for each group: plastic storage container (at least 10 x 25 cm), measuring cup, materials readily available to your classroom such as leaves, grass, cotton balls, paper towels, string, paper clips, paper, cardboard, tape, newspaper, wooden dowels, branches, shells, craft sticks, pipe cleaners, non-waterproof fabric, wax, oil, etc. You may also provide foil, wax paper or plastic pieces, but each piece used must not be larger than 4 square centimeters.

Optional – ice cubes, hair dryer, pennies (for climate specific testing).

TALKING POINTS/OPEN ENDED QUESTIONS

Do you think real engineers have to make modifications to their designs as they are building them? Why or why not? Do you think they succeed perfectly the first time, every time?

RESOURCES

This activity was modified from: http://tryengineering.org/lesson-plans/waterproof-roof and https://www.teachengineering.org/view_activity.php?url=collection/wpi_/activities/wpi_roofs_for_different_climates/roofs_for_different_climates.xml

A brief history of roofs: http://www.book-of-roofs.net/

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NEXT GENERATION SCIENCE STANDARDS

4th grade

3-5. Engineering Design

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

8th grade

MS. Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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ARIZONA STATE SCIENCE STANDARDS

4th grade

Strand 1: Inquiry Process
- Concept 4: Communication
  - PO 1: Communicate verbally or in writing the results of an inquiry.
  - PO 3. Communicate with other groups or individuals to compare the results of a common investigation.

Strand 2: History and Nature of Science
- Concept 2: History of Science as a Human Endeavor
  - PO 2: Describe science-related career opportunities

Strand 3: Science in Personal and Social Perspectives
- Concept 2: Science and Technology in Society
  - PO 3: Design and construct a technological solution to a common problem or need using common materials.

8th grade

Strand 3: Science in Personal and Social Perspectives
- Concept 2: Science and Technology in Society
  - PO 3: Design and construct a solution to an identified need or problem using simple classroom materials.

Strand 2: History and Nature of Science
- Concept 2: History of Science as a Human Endeavor
  - PO 4: Evaluate career opportunities related to life and physical sciences.

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Please see below for rate information:

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Chaperones $6*
AZ State Certified Educators .... Free

**General Admission is waived for Focused Field Trip Certified Educators, their students, and chaperones (40%+ free lunch = Title 1)*

General Groups

Children (ages 3–17) $6
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Add-ons

Traveling Exhibitions- Price Varies, Click here for details
CREATE .... Price varies
(chaperones/teachers are free as they are not participating in the challenges)
Planetarium $4/person
IMAX $5/person

EDUCATOR PROFESSIONAL DEVELOPMENT

Freeport- MacMoran Foundation Center for Leadership in Learning

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SCIENCE CLASSROOM EXPERIENCES

Science on Wheels

STEM Club