AMPHITHEATER ELEMENTARY SCIENCE GUIDE

8/12/2015

Fourth Grade

The following pages provide guidance to teachers when implementing science instruction in Amphitheater Elementary Schools. This guide will be revised regularly to ensure alignment with current Arizona State Standards and the requirements of the district.

FOREWARD

One of the best ways to engage children in their learning and in the world around them is to provide hands-on opportunities to learn and actually "do" science. Science and engineering education is more important than ever. Becoming college and career ready not only involves gaining factual knowledge, it also involves teaching children to question, explore, build, collaborate, explain, analyze, think critically and creatively, and communicate. Science provides the opportunity for all children to be engaged and solve problems which require these skills.

Over the past two years we have implemented new curriculum in the areas of reading and mathematics. Both of these curriculum areas are critical to student success. Science skills and processes give students real situations to apply what they have learned in reading, writing, and mathematics. Technical writing is necessary when students record their observations, record their analysis of data, and develop conclusions and reports. Integration of the subject areas is critical.

A committee of district teachers met over the past six months to discuss science in our schools, review the Arizona Science Standards, make recommendations regarding the teaching of science, discuss the need for materials, and to develop a science curriculum framework for our schools. According to the committee's analysis, science instruction is scarce in most elementary classrooms, if taught at all. There are classrooms where science is taught regularly. This was a pleasant finding. **The committee is recommending that science be taught a minimum of 90 minutes per week for all students beginning with the 2015-2016 school year.**

A common question is, "How will we fit this in?", or, "What should we give up?" in order to teach science. *You will be given the flexibility to reduce some of the time spent on reading and/or math in order to teach science.* Many creative scheduling ideas have come up when teachers begin to talk about how to fit the teaching of science into the day/week.

We introduce the **Amphitheater Elementary Science Guides**. These guides lay out the Arizona Science Standards by grade level, list important academic vocabulary in science, give suggestions for materials and resources and provide many other details for teachers as they prepare their science instruction. We added engineering standards to our curriculum because we know that this type of thinking and "doing" is an important part of STEM education. Inquiry and the Engineering Design Process are the two main threads from Kindergarten through fifth grade. The new curriculum guides will be available electronically and in print. Each school will be scheduling a time to review and discuss the guides, allocate time and resources toward science, and to inventory their science materials.

The guides are not all inclusive. There are many more resources in the community that are not listed, and many more materials that are very effective and practical. We hope to add to these as teachers contribute what they use in their classrooms.

Thank you for all you do to teach science to our youngest scientists!

Sincerely,

Dr. Roseanne Lopez, Chief Academic Officer Elementary Education

Amphitheater Elementary Science Curriculum Plan	
Grade: 3-5	**Strand: 1 Inquiry Process (Science Lab)**

Enduring Understandings (Big Idea)

Inquiry uses the scientific process to conduct a complete investigation which is embedded into all areas of science.

Essential Questions

What is the process for conducting an investigation?
What evidence should be in a science journal during a complete investigation?
How do we use scientific investigations to find answers to questions?
How is scientific knowledge generated and validated?

Understanding the Content of this Standard	Essential Knowledge, Skills, and Processes
1. Identify a problem.	• Make **observations** • Ask questions • Clarify that a problem is **testable** and not an opinion. (Testable: What soil is best? Not Testable: Which is the best color flower?) • Collect **research** • Write a formal question to solve • **Predict** the **results** in a **hypothesis** (using "if-then" language)
2. Scientific testing	• Demonstrate safe behavior and appropriate procedures • Find and list materials and tools • List the complete steps to conduct the **investigation** • Identify the **variables** for the **investigation** • Conduct the **investigation** repeating the test three to five times (i.e. multiple groups, or repeated testing) • Make **observations** and measurements • Record **data** in a **data chart** (chart, table, list, log)
3. Analyze data and draw conclusions	• Organize the data into **graphs** (bar, pictograph, tally chart) • **Interpret** the results of the data • **Compare** the results to the **hypothesis** • Generate questions for possible future **investigations**
4. Communication	Explain the results • Create a display of the complete **investigation** • Include a science journal with all parts of the **inquiry process** including **research**, testing, and **analysis** • Present the results with others (classroom, grade level, Science Fair)

Science Vocabulary	
inquiry, scientific process, experiment, investigation, opinion, hypothesis, variables, independent variables, dependent variables, controlled variables, observations, data chart, graphs, interpret, testable, results, compare, communication, analysis, research, predict, data, trials, models, patterns/trends, reasonable, outcomes, conclusion, diagram, question, evidence, label, classify, etc.	
Assessment	
Research report Science Fair projects (individual, group, or class) Interpretation and evaluation of data and graphs to answer the relevant question Science journal showing reflections throughout the inquiry process Presentation of the complete inquiry process Teacher observation	
Materials	**Resources and Ideas**
Research materials specific to each design	Research sites for kids: • www.factmonster.com • www.kidsclick.org • www.ipl.org/div/kidspace • www.kidrex.org www.sciencebuddies.org/ www.sarsef.org/ *(volunteers are available through SARSEF)* www.powershow.com/view/26bf93-Mzg0N/LPS_Science_Fair_Bill_Nye_the_Science_Guy_powerpoint_ppt_presentation FOSS kits Engineering is Elementary units Teachers Pay Teachers BrainPop

Amphitheater Elementary Science Curriculum Plan	
Grade: 4th	**Strand 4 (embedded Strand 1 & Strand 2): Life Science**

Enduring Understandings (Big Idea)
Characteristics of Organisms

Essential Questions

How do living things interact with their environment?

Understanding the Content of this Standard	Essential Skills and Processes
Always use concepts from strand 1 (inquiry process) when teaching each unit.	
Compare & contrast plant and animal structures.	• Explain the **function** of each **structure** in growth and survival • Compare & contrast plant and animal structures as well as their functions
How are animals classified?	• Distinguish **characteristics** that are used to **classify** an animal
What are adaptations?	• Identify **adaptations** that allow animals and plants to survive in their **environments** • Explain how individual adaptations aid in survival
Inherited plant and animal characteristics.	• Draw the conclusion that living in an environment selects for a specific characteristic • Understand that selected **traits** for an environment are inherited to improve survival for a species
How have individuals contributed to scientific innovations?	• Research the various contributions of scientists in this field (i.e., Gregor Mendel) • Describe how science and technology (agriculture, medicine) have improved the lives of many people and animals. • Critique the benefits and risks related to the use of technology. • Investigate careers related to Life Science

Science Vocabulary

Characteristics of Organisms
structure, function, roots, stems, leaves, flowers, muscles, bones, nerves, vertebrates, invertebrates, classify

Diversity, Adaptation, and Behavior
adaptation, camouflage, mimicry, physical, mutualism, parasitism, environment, characteristics, inherit, advantage

Assessment	
Formative	**Summative**
• Lesson checks- (e.g.- worksheets) • Center activities (teacher observation) • Science Journals	• Unit test (multiple choice, written response) • Performance assessment
Materials	**Resources**
	• Teacher Pay Teachers • Discovery Education • Khan Academy • Pearson Interactive Science Kit • Arizona Game & Fish presentation • University of Arizona – Marine Awareness & Conservation Society • Tucson Wildlife Center • Arizona Desert Museum presentations • Reid Park Zoo • Many resources on the web • http://www.sciencekids.co.nz/animals.html

Amphitheater Elementary Science Curriculum Plan	
Grade: 4th	**Strand 5 (embedded Strand 1 & 2): Physical Science**
Enduring Understandings (Big Idea) Energy and Magnetism	
Essential Questions	
How are electricity and magnetism used, and what is the relationship between them?	
Understanding the Content of this Standard	**Essential Skills and Processes**
Always use concepts from strand 1 (inquiry process) when teaching each unit.	
What are the characteristics of magnetism?	• Investigate how **magnets attract** and **repel**. • Distinguish the difference between **temporary** and **permanent magnets**.
How does energy flow through a circuit?	• Construct a **circuit** with various objects (**battery**, **light**, **motor**). • Understand that there is a **pathway** between objects.
How can energy be transferred from place to place by electrical currents?	• Create a **series** and **parallel circuit**. • Differentiate between a **series** and **parallel circuit**. • Construct models to investigate how different **circuits** affect the objects in the circuit.
What role do insulators and conductors play with the flow of energy?	• Differentiate between an **insulato**r and **conductor** and its affects upon various objects (i.e.-copper, rubber, aluminum)
How is energy (magnetism and electricity) transferred in various ways between objects?	• Construct an **electromagnet** • Design a **telegraph**- (understanding the importance of the telegraph)
How have individuals contributed to scientific innovations?	• Research the various contributions of scientists in this field (i.e., Nicola Tesla, Benjamin Franklin, Albert Einstein, Thomas Edison, Michael Faraday, Andre-Marie Ampere). • Describe how science and technology (i.e.-computers, air conditioning, medicine) have improved the lives of many people. • Critique the benefits and risks (pollution, destruction of natural resources) related to the use of technology. • Investigate careers related to magnetism and electricity.

Science Vocabulary	
Characteristics of Magnetism magnetism, force, repel, attract, north and south poles, temporary magnet, permanent magnet, compass **Characteristics of Energy** electricity flow, energy source, d-cell, pathway, simple circuit, charges, open and closed circuit, series circuit, parallel circuit, switch, filament, negative and positive characteristics of a battery, components, flashlight, motor, light bulb, fan, insulator, conductor, electromagnet, telegraph	
Assessment	
Formative	Summative
• Lesson checks- (e.g.-worksheets) • Center activities (teacher observation) • Science Journals	• Unit test (multiple choice, written response) • Performance assessment
Materials	**Resources**
• Foss Kits – "Magnetism and Electricity" kit • Fossweb.com • Batteries • Clips • Wire • Light bulbs	• Pearson Interactive Science Kit • TeacherPayTeachers • TEP booklets & activities (free for teachers) • Discovery Education • Khan Academy (Electricity and Magnetism – physics) • Reading A-Z leveled readers • Many resources on the web- search under "electricity and magnetism PowerPoint" • www.neok12.com/electromagnetism.htm • www.fplsafetyworld.com • www.sciencekids.co.nz • www.readworks.org

Amphitheater Elementary Science Curriculum Plan	
Grade: 4th	**Strand 6 (embedded Strand 1 & Strand 2): Earth and Space Science**
Enduring Understandings (Big Idea) Earth's Resources	
Essential Questions	
How do Earth's resources change?	
Understanding the Content of this Standard	**Essential Skills and Processes**
Always use concepts from strand 1 (inquiry process) when teaching each unit.	
What are weathering and erosion (*slow process*)?	• Explain the causes and effects of **weathering** and **erosion**. • Describe how **currents** and wind cause erosion and land changes. (**Slow processes** that change the earth's surface.) • Describe and draw conclusion about how **environments** are affected by slow processes (drought, melting ice caps, greenhouse effect, and erosion).
How can earth's surface change rapidly (*rapid process*)?	• Relate how **rapid processes** change the Earth's surface. (*Rapid*-earthquakes, volcanoes, floods, tornado) • Describe and draw conclusions about how environments are affected by rapid processes (i.e.-fire, floods)
Compare and contrast rapid and slow processes that change the Earth's surface.	• Identify the earth events that cause changes in **atmospheric conditions** (e.g., volcanic eruptions, forest fires) • Compare and contrast how rapid and slow processes change the earth's surface. • Analyze evidence that indicates that life and environmental conditions have changed (tree rings, fish fossils, ice cores).
Changes in the Earth and sky?	• Understand characteristics of **weather** conditions and **climate**. • Identify and describe the sources of water within the environment (**ground water**, **surface water**, **atmospheric water**, **glaciers**) AND the distribution of water on the Earth's surface.
Measure changes in weather.	• Measure changes in weather • Classify weather instruments and determine how they are used. (e.g., **wind**

	vane, etc.) • Differentiate between weather and climate. • Interpret the **symbols** on a weather map (**fronts**, **precipitation**). • Compare weather conditions in various locations of the U.S.
What are our Earth's natural resources? *(from strand 4, concept 3)*	• Differentiate **renewable resources** from **nonrenewable resources** (natural gas, minerals). • Investigate ways in which resources can be **conserved** (**reducing**, **reusing**, and **recycling**). • Analyze the effect resources (or lack of) have on the environment
How have individuals contributed to scientific innovations?	• Research the various contributions of scientists in this field (i.e., James Hutton). • Describe how science and technology (solar panels, and wind turbines, etc) have improved the lives of many people. • Critique the benefits and risks (pollution, destruction of natural resources) related to the use of technology. • Investigate careers related to Earth and Space Science

Science Vocabulary

<u>Earth's Processes and Systems</u>

weathering (chemical and physical), erosion, deposition, landform, run-off, ground water, drought, rapid processes, slow processes, tectonic plates, fault lines, natural disasters (i.e., tornados, hurricanes, landslides, floods, volcanic eruptions, forest fires), environment, atmosphere, tree rings, fish fossils, ice cores

<u>Changes in the Earth and Sky</u>

ground water, aquifer, sources of water, surface water (salt and fresh water), run-off, atmospheric water, glaciers, water cycle (precipitation, condensation, evaporation, transpiration, precipitation, collection), temperature, wind speed, weather, fronts, weather instruments (e.g., barometer, anemometer, wind vane, thermometer, rain gauge)

<u>Organisms and Environments *(strand 4, concept 3)*</u>

renewable resources, non-renewable resources, conserve, reduce, reuse, recycle

Assessment

Formative	Summative
• Lesson checks- (e.g.- worksheets) • Center activities (teacher observation) • Science Journals	• Unit test (multiple choice, written response) • Performance assessment

Materials	**Resources**
• Foss Kits – "Earth Materials" kit, "Water" kit. • Fossweb.com	• TeacherPayTeachers • TEP – has booklets & activities (free for teachers) • Discovery Education • Khan Academy • Pearson Interactive Science Kit • Reading A-Z leveled readers • University of Arizona Project Wet • City of Tucson (Water and/or Recycling presentations) • Fieldtrips to landfill & recycling center • www.sciencekids.co.nz/earth.html

Amphitheater Elementary Science Curriculum Plan	
Grade: K-5	**Engineering Design Process**

Enduring Understandings (Big Ideas)

- Defining and Delimiting Engineering Problems
- Developing Possible Solutions
- Optimizing the Design Solution

Essential Questions

How might we define a simple design problem reflecting a need or a want?

What are the constraints/criteria?

How might we generate and compare possible solutions to a problem?

How might we plan and carry out fair tests?

How might we improve upon our design?

Understanding the Content of this Standard	Essential Skills and Processes
Students will be able to use the **Design Process.** *(italics denote K-2 language)*	**Design Process:** Students will understand how technology solves problems and makes work easier. Identify the problem (*Ask)* Do research Develop possible solutions *(Imagine)* Choose one solution Design and construct a prototype *(Plan and Create)* Test the prototype *(Test)* Evaluate and redesign *(Improve)* Communicate results
Identify the problem (*Ask)* ***Research*** Find a design problem, based on the fact that peoples' needs and desires change over time as well as their demand for new technologies.	• Identify & create a solvable **design problem/need/want** • Explain why that problem is relevant • Conduct research

Create or identify criteria for success and constraints.	• Understand & explain that there are **constraints** on **material**, **time** and **costs**
Develop possible solutions *(Imagine)* Generate and compare possible solutions to a problem.	• Work within the criteria while **generating** possible **solutions** • Judge solutions against constraints • Identify solution(s) that best fits problem
Design and construct a prototype *(Plan and Create)* Plan the model or prototype based on chosen solution(s). Create the model prototype.	• Design a **model**. • Communicate the design of a model (written on paper, whiteboard, or computer software, etc.) • Construct a model using available resources.
Test the prototype *(Test)* Design and conduct fair tests with controlled variables.	• Plan and conduct **fair tests** using **prototypes** • **Control variables** • Consider **failure points** found through testing
Evaluate and redesign *(Improve)* Evaluate & redesign model.	• Use failure points to identify parts of a model that can be improved • Make changes to the model (**redesign**). • Repeat testing process
Communicate results Communicate results.	• Explain your results using data • Gather input from peers • Describe successes and failures • Suggest improvements based on the criteria and failure points
History of Engineering and Innovation	
How have individuals contributed to engineering innovations?	• Research the various contributions of scientists and innovators in this field (e.g., Wilber and Orville Wright, Leonardo da Vinci, Thomas Edison, Benjamin Franklin, Steve Jobs, Bill Gates, Mary Anderson-windshield wiper, George de Mestral-velcro, Alan Turing-computer science/cryptologist, Hedy Lamarr- basis for wi-fi). • Describe how science, engineering and technology have improved the lives of people. • Critique the benefits and risks related to the use of technology. • Investigate careers related to engineering & design.
Science Vocabulary	
prototype, model, design, process, predict, evaluate, technology, record, research, create, problem, solution, design problem, want, need, individual, community, global, technology, criteria, constraints, materials, cost, generate, compare, options, reasonable, plan, blueprints, investigate, variable, fair test, control, failure points, redesign	

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<tr><td colspan="2">Assessment</td></tr>
<tr><td>Formative</td><td>Summative</td></tr>
<tr><td>Reflections
Center activities (teacher observation)
Engineering Journals</td><td>Performance assessment
Presentation of design</td></tr>
<tr><td>Materials</td><td>Resources</td></tr>
<tr><td>Engineering is Elementary Units
Various materials for making models and prototypes</td><td>Discovery Education
Reading Street Leveled Readers (on-line)
Reading A-Z leveled readers
Khan Academy
http://www.sciencekids.co.nz/engineering.html
www.teachengineering.org
http://www.childrensengineering.org/
http://www.childrensengineering.com/freeresources.htm
https://www.teachengineering.org/googlesearch_results.php
http://betterlesson.com/lesson/620237/the-wonderful-towers-of-watts-building-background-knowledge?grade=14&subject=2&from=bl_directory_no-keywords_second-grade_technology-and-engineering_mt-lesson_620237_title
http://www.engr.ncsu.edu/theengineeringplace/educators/k8plans.php
https://drive.google.com/folderview?id=0Bzm8D1yH2vdZXzlERWhDYTFFLXc&usp=sharing
YouTube videos
Nasa For Kids: Intro to Engineering
The Engineering Process: Crash Course Kid
National Science Foundation Resources: https://www.nsf.gov/news/classroom/engineering.jsp
Teachers Pay Teachers</td></tr>
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