3-D Science Concept Organizer – High School Earth Science - Climate Patterns

Phenomena or anchoring event:

ENSO-neutral conditions are present and La Niña is favored to develop during the Northern Hemisphere summer 2016, with about a 75% chance of La Niña during the fall and winter 2016-17
Report Issued by Climate Prediction Center 2016

How will the El Nino and La Nina weather patterns impact the weather in Arizona in the coming year?

Big Idea(s):
The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.

Strand: 6 Concept(s): 2 Energy in the Earth System (both Internal and External) Understand the relationships between the Earth's land masses, oceans, and atmosphere. **Performance Objectives:** PO 9. Explain the effect of heat transfer on climate and weather. PO 10. Demonstrate the effect of the Earth's rotation (i.e., Coriolis effect) on the movement of water and air. PO 11. Describe the origin, life cycle, and behavior of weather systems (i.e., air mass, front, high and low systems, pressure gradients). PO 12. Describe the conditions that cause severe weather (e.g., hurricanes, tornadoes, thunderstorms).	**Grade Band Endpoints from Disciplinary core Ideas Learning Progression** • Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. A deep knowledge of how feedbacks work within and among Earth's systems is still lacking, thus limiting scientists' ability to predict some changes and their impacts. • The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.

PO 13. Propose appropriate safety measures that can be taken in preparation for severe weather. PO 14. Analyze how weather is influenced by both natural and artificial Earth features (e.g., mountain ranges, bodies of water, cities, air pollution). PO 15. List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).	• The foundation for Earth's global climate system is the electromagnetic radiation from the sun as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems and this energy's reradiation into space.

Strand 1 – Inquiry Process **Performance Objectives:**	**Grade Band Endpoints from Science and Engineering Practices Learning Progressions**
Concept 1: Observations, Questions, and Hypotheses Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources. PO 1. Evaluate scientific information for relevance to a given problem. PO 2. Develop questions from observations that transition into testable hypotheses. PO 3. Formulate a testable hypothesis. PO 4. Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring). **Concept 2: Scientific Testing (Investigating and Modeling)** Design and conduct controlled investigations. PO 1. Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry. PO 2. Identify the resources needed to conduct an investigation. PO 3. Design an appropriate protocol (written plan of action) for testing a hypothesis: • Identify dependent and independent variables in a controlled investigation. • Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes). • Determine an appropriate method for recording data (e.g.,	**Developing and Using Models** • Use a model to provide mechanistic accounts of phenomena. **Planning and Carrying Out Investigations** • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. **Analyzing and Interpreting Data** • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

notes, sketches, photographs, videos, journals (logs), charts, computers/calculators). PO 4. Conduct a scientific investigation that is based on a research design. PO 5. Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers. **Concept 3: Analysis, Conclusions, and Refinements** Evaluate experimental design, analyze data to explain results and propose further investigations. Design models. PO 1. Interpret data that show a variety of possible relationships between variables, including: positive relationship, negative relationship or no relationship PO 2. Evaluate whether investigational data support or do not support the proposed hypothesis. PO 4. Evaluate the design of an investigation to identify possible sources of procedural error, including: sample size, trials, controls, analyses **Concept 4: Communication** Communicate results of investigations. PO 1. For a specific investigation, choose an appropriate method for communicating the results. PO 2. Produce graphs that communicate data. PO 3. Communicate results clearly and logically. PO 4. Support conclusions with logical scientific arguments.	**Engaging in Argument from Evidence** • Construct an oral and written argument or counter-arguments based on data and evidence.

Unifying Concepts:	**Grade Band Endpoints from Crosscutting Concepts Learning Progressions**
Constancy, Change, and Measurement	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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Evolution and Equilibrium	**Energy and Matter** • Energy drives the cycling of matter within and between systems. **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. Feedback (negative or positive) can stabilize or destabilize a system.

Connections
Strand 2: History and Nature of Science S2C1PO1 – Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide. S2C2PO4 – Describe how scientists continue to investigate and critically analyze aspects of theories.
Strand 3: Science in Personal and Social Perspective S3C1PO2 – Describe the environmental effects of the following and/or human-caused hazards: flooding, drought, extreme weather
Other Content Standards: RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. WHST.9-12.1 Write arguments focused on discipline-specific content. WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

References	
Prerequisites or Co-requisite Performance Objectives (Background Knowledge)	Based on school or district curriculum: how the objectives are bundled, and the sequence objectives are taught.
Materials and Resources	Intro Video - http://www.sciencechannel.com/tv-shows/cheat-sheet/videos/el-nino-and-la-nina/ 1950 – 2015 data from the Oceanic Nino Index (ONI) to predict what years were El Nino and La Nina seasons. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml Article on El Nino - https://www.climate.gov/news-features/understanding-climate/watching-el-ni%C3%B1o-and-la-ni%C3%B1a-noaa-adapts-global-warming Article and Data - http://ggweather.com/enso/oni.htm NatGeo Article - http://www.nationalgeographic.com/elnino/mainpage.html
Assessments	School or district determined