Standard #: SC.912.N.1.1

Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:

1. **Pose questions about the natural world,** (Articulate the purpose of the investigation and identify the relevant scientific concepts).
2. **Conduct systematic observations,** (Write procedures that are clear and replicable. Identify observables and examine relationships between test (independent) variable and outcome (dependent) variable. Employ appropriate methods for accurate and consistent observations; conduct and record measurements at appropriate levels of precision. Follow safety guidelines).
3. **Examine books and other sources of information to see what is already known,**
4. **Review what is known in light of empirical evidence,** (Examine whether available empirical evidence can be interpreted in terms of existing knowledge and models, and if not, modify or develop new models).
5. **Plan investigations,** (Design and evaluate a scientific investigation).
6. **Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),** (Collect data or evidence in an organized way. Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration, technique, maintenance, and storage).
7. **Pose answers, explanations, or descriptions of events,**
8. **Generate explanations that explicate or describe natural phenomena (inferences),**
9. **Use appropriate evidence and reasoning to justify these explanations to others,**
10. **Communicate results of scientific investigations, and**
11. **Evaluate the merits of the explanations produced by others.**

General Information

Subject Area: Science

Grade: 912

Body of Knowledge: Nature of Science

Idea: Level 3: Strategic Thinking & Complex Reasoning

Standard: The Practice of Science -
A: Scientific inquiry is a multifaceted activity; The processes of science include the formulation of scientifically investigable questions, construction of investigations into those questions, the collection of appropriate data, the evaluation of the meaning of those data, and the communication of this evaluation.

B: The processes of science frequently do not correspond to the traditional portrayal of "the scientific method."

C: Scientific argumentation is a necessary part of scientific inquiry and plays an important role in the generation and validation of scientific knowledge.

D: Scientific knowledge is based on observation and inference; it is important to recognize that these are very different things. Not only does science require creativity in its methods and processes, but also in its questions and explanations.

Date Adopted or Revised: 02/08

Content Complexity Rating: Level 3: Strategic Thinking & Complex Reasoning - More Information

Date of Last Rating: 05/08

Status: State Board Approved

Assessed: Yes

Test Item Specifications

Also Assesses:
SC.912.N.1.4 Identify sources of information and assess their reliability according to the strict standards of scientific investigation.

SC.912.N.1.6 Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.

SC.912.L.14.4 Compare and contrast structure and function of various types of microscopes.

LA.910.2.2.3 The student will organize information to show understanding or relationships among facts, ideas, and events (e.g., representing key points within text through charting, mapping, paraphrasing, summarizing, comparing, contrasting, or outlining).

LA.910.4.2.2 The student will record information and ideas from primary and/or secondary sources accurately and coherently, noting the validity and reliability of these sources and attributing sources of information.

MA.912.S.1.2 Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment.

MA.912.S.3.2 Collect, organize, and analyze data sets, determine the best format for the data, and present visual summaries from the following:

- bar graphs;
- line graphs;
- stem and leaf plots;
- circle graphs;
- histograms;
- box and whisker plots;
- scatter plots; and
- cumulative frequency (ogive) graphs.

Clarification :
Students will design and/or evaluate a scientific investigation using evidence of scientific thinking and/or problem solving.

Students will interpret and analyze data to make predictions and/or defend conclusions.

Students will compare and/or contrast the structure and function of the compound microscope, dissecting microscope, scanning electron microscope, and/or the transmission electron microscope.

Students will evaluate the merits of scientific explanations produced by others.

Students will assess the reliability of sources of information according to scientific standards.

Students will describe how scientific inferences are made from observations and identify examples from biology.

Content Limits :
None specified
Stimulus Attributes :
Scenarios will be placed in the context of experimental design, experiment(s), scientific investigation(s), or scientific observation(s) in the field of biology.
Response Attributes :
None specified
Prior Knowledge :
Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.N.1.1, SC.6.N.1.2, SC.6.N.1.3, SC.6.N.1.4, SC.6.N.1.5, SC.7.N.1.1, SC.7.N.1.2, SC.7.N.1.3, SC.7.N.1.4, SC.7.N.1.5, SC.7.N.1.6, SC.7.N.1.7, SC.8.N.1.1, SC.8.N.1.2, SC.8.N.1.3, SC.8.N.1.4, SC.8.N.1.5, and SC.8.N.1.6.

Sample Test Items (1)

Test Item #: Sample Item 1
Question:
An osmosis investigation was conducted using chicken eggs to represent cells with semipermeable membranes. The mass of each egg was measured to determine how much water diffused into or out of the eggs. The eggs were first soaked in vinegar to dissolve the shell. Each egg was then placed in one of three different solutions for 24 hours. The table below shows the results of the investigation.

OSMOSIS IN CELLS

Solution	Average Mass of Eggs Before Soaking (grams)	Average Mass of Eggs After Soaking (grams)	Difference in Average Mass (grams)	Percent Change in Average Mass
Vinegar (95% water)	71.2	98.6	27.4	+38.5
Corn syrup (5% water)	98.6	64.5	34.1	-34.6
Distilled water (100% water)	64.5	105.3	40.8	+63.3

Based on this experiment, which of the following should be inferred about cells with semipermeable membranes?

Difficulty: N/A
Type: MC: Multiple Choice

Related Courses

Course Number	Course Title
2000350:	Anatomy and Physiology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000360:	Anatomy and Physiology Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001350:	Astronomy Solar/Galactic (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2020910:	Astronomy Solar/Galactic Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000310:	Biology 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000320:	Biology 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000330:	Biology 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 - 2022 (current), 2022 and beyond)

2000430:	Biology Technology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
3027010:	Biotechnology 1 (Specifically in versions: 2015 and beyond (current))
3027020:	Biotechnology 2 (Specifically in versions: 2015 and beyond (current))
2000370:	Botany (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003340:	Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003350:	Chemistry 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003360:	Chemistry 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001310:	Earth/Space Science (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001320:	Earth/Space Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000380:	Ecology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001340:	Environmental Science (Specifically in versions: 2015 - 2022 (current), 2022 and beyond)
2002480:	Forensic Science 1 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2002490:	Forensic Sciences 2 (Specifically in versions: 2014 - 2015, 2015 - 2017, 2017 - 2022 (current), 2022 and beyond)
2000440:	Genetics Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002400:	Integrated Science 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002410:	Integrated Science 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002420:	Integrated Science 2 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002430:	Integrated Science 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002440:	Integrated Science 3 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002450:	Integrated Science 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000390:	Limnology (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2002500:	Marine Science 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002510:	Marine Science 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002520:	Marine Science 2 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002530:	Marine Science 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003400:	Nuclear Radiation (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2020710:	Nuclear Radiation Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003310:	Physical Science (Specifically in versions: 2015 - 2022 (current), 2022 and beyond)
2003320:	Physical Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003380:	Physics 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003390:	Physics 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003410:	Physics 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003600:	Principles of Technology 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003610:	Principles of Technology 2 (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2002540:	Solar Energy Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002550:	Solar Energy 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2002330:	Space Technology and Engineering (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2000410:	Zoology (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000800:	Florida's Preinternational Baccalaureate Biology 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003800:	Florida's Preinternational Baccalaureate Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002340:	Experimental Science 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002350:	Experimental Science 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002360:	Experimental Science 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002370:	Experimental Science 4 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
1700300:	Research 1 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
1700310:	Research 2 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
1700320:	Research 3 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
7920011:	Access Chemistry 1 (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
7920015:	Access Biology 1 (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
7920020:	Access Earth/Space Science (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
7920025:	Access Integrated Science 1 (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
2000315:	Biology 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000500:	Bioscience 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000510:	Bioscience 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2000520:	Bioscience 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002405:	Integrated Science 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2002425:	Integrated Science 2 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2002445:	Integrated Science 3 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2003345:	Chemistry 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003385:	Physics 1 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2003500:	Renewable Energy 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
7920030:	Fundamental Integrated Science 1 (Specifically in versions: 2013 - 2015, 2015 - 2017 (course terminated))
7920035:	Fundamental Integrated Science 2 (Specifically in versions: 2013 - 2015, 2015 - 2017 (course terminated))
7920040:	Fundamental Integrated Science 3 (Specifically in versions: 2013 - 2015, 2015 - 2017 (course terminated))
2003836:	Florida's Preinternational Baccalaureate Physics 1 (Specifically in versions: 2015 - 2022 (current), 2022 and beyond)
2003838:	Florida's Preinternational Baccalaureate Physics 2 (Specifically in versions: 2015 and beyond (current))

7920022:	Access Physical Science (Specifically in versions: 2016 - 2018, 2018 and beyond (current))
2001341:	Environmental Science Honors (Specifically in versions: 2016 - 2022 (current), 2022 and beyond)
2001330:	Meteorology Honors (Specifically in versions: 2016 - 2019, 2019 - 2022 (current), 2022 and beyond)

Related Access Points

Access Points Number	Access Points Title
SC.912.N.1.In.1:	Identify a problem based on a specific body of knowledge, including life science, earth and space science, or physical science, and do the following: 1. Identify a scientific question 2. Examine reliable sources of informtion to identify what is already known 3. Develop a possible explanation (hypothesis) 4. Plan and carry out an experiment 5. Gather data based on measurement and observations 6. Evaluate the data 7. Use the data to support reasonable explanations, inferences, and conclusions.
SC.912.N.1.Su.1:	Recognize a problem based on a specific body of knowledge, including life science, earth and space science, or physical science, and do the following: 1. Recognize a scientific question 2. Use reliable information and identify what is already known 3. Create possible explanation 4. Carry out a planned experiment 5. Record observations 6. Summarize results 7. Reach a reasonable conclusion.
SC.912.N.1.Pa.1:	Recognize a problem related to a specific body of knowledge, including life science, earth and space science, or physical science, and do the following: 1. Observe objects and activities 2. Follow planned procedures 3. Recognize a solution.

Related Resources

3D Modeling

Name	Description
Carrying Cargo - 3D Boat Design and Modeling:	This MyStemKits.com model-eliciting activity (MEA) will help students tackle real-world problems as they balance constraints with finding the optimal design, all while overcoming unforeseen circumstances that may change the procedure students use to determine the best solution. In the end, students are challenged to design and test their own boats, using Tinkercad to model a 3D-printable boat.

Educational Software / Tool

Name	Description
Density: Sea Water Mixing & Sinking:	This is an excellent resource for teachers and students that provides student sheets, data graphs, vocabulary, and teacher notes as well as Big Ideas, Essential Questions, Data Tables, Formative Assessment questions - extremely teacher friendly who need assistance on this Big Idea and Concept. (The Preconceptions were helpful to my students.)

Lesson Plans

Name	Description
Citizen Science:	Citizen science is a critical component to many different scientific studies, and gives citizen scientists the opportunity to better understand the research and the process. In some studies, citizen scientists assist in major scientific discoveries that can change or create legislature. Students will participate in ongoing citizen science projects to learn more about the scientific method.
How Big Is a Mole? Do We Really Comprehend Avogadro's Number?:	The unit "mole" is used in chemistry as a counting unit for measuring the amount of something. One mole of something has 6.02×10^{23} units of that thing. The magnitude of the number 6.02×10^{23} is challenging to imagine. The goal of this lesson is for students to understand just how many particles Avogadro's Number truly represents, or, how big is a mole. This lesson is meant for students currently enrolled in a first or second year chemistry course. This lesson is designed to be completed within one approximately 1 hour class; however, completion of optional activities 4 and 5 may require a longer class period or part of a second class period.
Do You See What I See:	The student will be able to describe the process of human development including major changes that occur in each trimester of pregnancy. Students will become scientists and explore the major changes that occur during embryo development. First, students will work in groups and correctly match the fetal development picture cards with the appropriate description. Next, students compare and share their findings with other groups and record this data. Finally, students will act as physicians as they investigate a medical case study of a pregnant woman and determine what trimester she is in by analyzing ultrasound reports detailing certain makers of the stages of development. Students will use a claim, evidence, rationale style activity using the ultrasound pictures and learned content to support their answers. The lesson culminates with students sharing their findings through a gallery walk.
The Last Supper: Identifying Macromolecules:	The students will solve a mystery using laboratory tests for different types of macromolecules. They will use argumentation to justify and communicate their claim. They will construct explanations and communicate with one another to determine which macromolecule would be best to eat in different scenarios. Students will be able to identify the structure and functions of the four main types of macromolecules. The students will use laboratory testing to determine the identity of an unknown. They will fill in a chart about the structures, functions, and examples for each macromolecule type and then they will practice their knowledge by answering short response questions relating the macromolecules to the real world. Finally, they will review using a whole-class cooperative activity and take a quiz about the structures and functions of macromolecules.
Eukaryotic Cells: The Factories of Life:	Students will be able to identify the main parts of a cell and to describe the basic function of each part. The students will match parts of a cell to parts of a city that have functions that are analogous to each cell part. They will then develop their own analogy and present it to the class. Finally, they will practice their knowledge using a computer-based review game.
	In this lesson, students will analyze an **informational text** intended to support reading in the content area. The

Languages: Barriers to Global Science?:	research article discusses different languages as barriers to the transfer of knowledge within the scientific community and then provides potential resolutions to aid in the reduction of language barriers. This lesson includes a note-taking guide, text-dependent questions, a writing prompt, answer keys, and a writing rubric.
Determining Relative Salinity of Estuaries:	Students will help their teacher figure out where her water samples came from by determining their relative salinity. With this information and a picture map of areas of the Intercoastal Waterway, they will locate possible sources of the samples.
Genetics, Genetics, and More Genetics:	Students will use appropriate tools (Punnett squares) and techniques to gather, analyze, and interpret data.Students will explore various modes of inheritance through a hands-on activity creating offspring of a fictitious organism. Students will complete Punnett Squares for various genetic crosses, and analyze and interpret the results of those crosses. Students will be able to predict the genotype and phenotype of P1 and F1 generations using Punnett Squares. Students will be able to identify complex patterns of inheritance such as co-dominance and incomplete dominance.
Artificially Sweetened Foods and Drinks Can't Fool Your Brain:	In this lesson, students will study an **informational text** that describes how researchers at the University of Sydney have discovered a correlation between artificial sweeteners, like sucralose, and an increased appetite. There are estimates that over 4,000 types of food contain sucralose. Billions of people around the world consume artificial sweeteners in hopes of losing weight, and until this study, little has been known about how these sweeteners affected the brain. This lesson is designed to support reading in the content area; it includes a note-taking guide, text-dependent questions, a writing prompt, answer keys, and a writing rubric.
Sensoring Data:	In this follow up lesson, students will explore data collection using the weather station sensor and perform statistical analysis of the data. Students will use a scientific method of inquiry to plan an investigation of their own. This activity is meant to allow students to use a variety of skills they have acquired throughout a statistics unit in a personally meaningful way.
Research Project: Sensing Nature:	In this week-long, open-ended activity, students will observe their local environment, devise and pose a testable research question, conduct observations using sensors, and use mathematics skills for quantitative analysis and plotting. To communicate results, students will summarize their findings on a custom poster that explains their work.
STEM Engineering Design Challenge: Yeast Fermentation:	Students will design an experiment to measure the effect of various macromolecules on fermentation rates of yeast. Students will imagine, plan, and implement their designs in a collaborative manner and then will improve their experiment after the first results. The ultimate goal is for students to be able to discuss the role of anaerobic respiration in living things and develop their scientific thinking skills as they solve a problem within a small group. This is an inquiry-based lab that is to be facilitated by the teacher but will provide the students the opportunity to test and defend their own thinking as they design their experiment and analyze their results.
The Ups and Downs of Populations:	Students will analyze population graphs, collect data to generate their own population graph, and experience limiting factors and their impact on carrying capacity in a small deer population. Students will be able to identify, explain, and evaluate the impact that different limiting factors have on the population of organisms including food, water, shelter, predation, human interference, changes in birth and death rate, changes in immigration and emigration, disease, and reproduction.
A Whole New World: The Search for Water 5E Lesson:	In this lesson, students will run a variety of tests on different liquids. During their experimentation, students will collect data, graph data, collaborate and discuss their findings, compare their findings to known characteristics of water, make a claim, provide evidence and justification to support their claim, and create an advisory report of their findings. Students will run various tests on several different liquids and compare those characteristic to those of water. Students will gain an understanding that water is unlike other liquids in the way that it moderates temperature, in its cohesive strength, in its ability to expand upon freezing, in its pH neutrality, and in its designation as the "universal solvent."
Enzymes in Action 5E Lesson:	Students will predict, investigate, observe, and report on the effects that pH, concentration, and temperature have on catalase enzyme reactions. Students will conduct an experiment in which they will alter the pH, concentration, and temperature of the environment in which catalase enzyme reactions are taking place. Students will be able to describe how changes in these environmental conditions affect the action of the enzymes in living things.
Engineering Design Challenge: Exploring Structures in High School Geometry :	Students explore ideas on how civil engineers use triangles when constructing bridges. Students will apply knowledge of congruent triangles to build and test their own bridges for stability.
Easy Enzymes:	In this lesson, students will learn how important enzymes are by functioning as a catalyst in most all biological processes. In learning about the functions of enzymes, they will also see how they are related to things they come across in everyday life. Students will observe the breakdown of hydrogen peroxide by catalase from potatoes.
Investigating Rulers of the Reef: Coral Reef Parasites :	This lesson uses an NSF article to inform the reader about the influence of parasites on damselfish, a coral reef species. The author explains how his team determined the reason for the consistent behavior of damselfish leaving their aggressively guarded territory each morning to go to a cleaning station. He also explains how more questions arose throughout his investigation, questions like "Do these parasites carry other parasites that infect fishes?" and "Do these gnathiid parasites infect other species of fish?" This first-person account creates an interesting view of how marine research is done, including field work, lab work, and collaborating with other scientists. This lesson is designed to support reading in the content area. The lesson plan includes a note-taking guide, text-dependent questions, a writing prompt, answer keys, and a writing rubric.
Yeast Fermentation Inquiry - Predict, Observe, Explain:	Using the Predict, Observe, and Explain model, students will be able to identify the basic function of cellular respiration. Students will predict what is needed for yeast fermentation, why they do it and what gas is being released. With a teacher led debrief, students will then decide what factors allow fermentation to occur and finally explain why it's happening.

Landing on Mars and Beyond – A 3D Printer Design Challenge:	Students will utilize a 3D printer to design a landing device simulating landing men and equipment on Mars safely. Once they have settled on a design, then they will move to designing a parachute that, when attached to the lander, provides a slow, low impact landing.
The Real Story of Where Babies Come From:	Students will observe, explore, and create a story about the main structures of the female/male reproductive systems, describing how these systems interact during the process of fertilization to a create human being.
The Penny Lab:	Students will design a collect data evidence, determine results, write a justification and make a presentation using U.S. pennies. Paired student teams will determine the mass of 50 U.S. pennies. Students will also collect other data from each penny such as minted year and observable appearance. Students will be expected to organize/represent their data into tables, histograms and other informational structures appropriate for reporting all data for each penny. Students will be expected to consider the data, determine trends and research information and make a claim to historically explain trends in data from minted U.S. pennies. Hopefully, student data reports will support the knowledge that the metallic composition of the penny has changed over the years. Different compositions can have significantly different masses. A sufficiently random selection of hundreds of pennies across the class should allow the students to discover trends in the data to suggest the years in which the composition changed.
Sensoring Data:	In this follow up lesson, students will explore data collection using the weather station sensor and perform statistical analysis of the data. Students will use a scientific method of inquiry to plan an investigation of their own. This activity is meant to allow students to use a variety of skills they have acquired throughout a statistics unit in a personally meaningful way.
Planting Science:	With this lesson, students are able to evaluate scientific inquiry firsthand by applying variables to their own enclosed ecosystems. With this experimental process they will also be able to personally devise their own experimental method and execute the process to the point of sharing their own data with their peers. The only limits to their discovery are the materials available. This can be done with anything from simple household products to the most advanced chemicals in the storeroom.
Why Do Apples Turn Brown?:	Students design an experiment to determine the effects of pH and temperature on enzyme activity in apples.
Crime Scene Measurements:	Using a crime scene scenario, students will measure length, mass, volume and temperature. They will calculate area and shoe size using a chart. Students will analyze soil samples using a microscope. Students will use the process of elimination based on their data to determine a suspect.
Investigating the pH of Soils:	In this activity students will conduct research then test the effects of adding products to soil. Students will learn about soil pH, what factors affect the pH of soil and how important it is to the growth of plants. Students will learn to use reputable resources to support their findings. Students will be expected to write a detailed lab report that thoroughly explores the concept while integrating the data from their investigation.
Distance and Displacement.:	• In this lesson students, will be able to identify frames of reference and describe how they are used to measure motion. • Identify appropriate SI units for measuring distances. • Distinguish between distance and displacement. • Calculate displacement using vector addition.
Camouflage in the Ocean:	In this lesson, students will complete two mini-labs to explore how colors change as you descend in an aquatic environment. Based on their observations they are challenged to design a camouflage pattern which could be used below the upper, sun-lit portions of the ocean, AND defend their design decisions in written form.
Conductors vs. Insulators: An Inquiry Lab:	This is a basic introduction to the difference between conductors and insulators when either is placed into a series circuit with a battery and a light bulb. This introductory activity is primarily used as a vehicle for students to better understand how to write a lab report with the appropriate sections and to integrate technology through Google Docs and a virtual lab simulation.
My 2 Cents:	Students predict how the mass of a penny changes over time, devise a method to test their prediction, collect/analyze data and determine the composition of a penny based on physical properties and calculations. This student-centered activity allows freedom from mistakes as they explore their learning in a supportive environment.
Virtually Possible:	This is a ray drawing activity to aid students in their understanding of how virtual images are formed by plane mirrors, and how the image size and distance from the mirror compare to those of the object.
Picture This!:	This is a short unit plan that covers position/time and velocity/time graphs. Students are provided with new material on both topics, will have practice worksheets, and group activities to develop an understanding of motion graphs.
Corn Conundrum:	The Corn Conundrum MEA provides students with an agricultural problem in which they must work as a team to develop a procedure to select the best variety of corn to grow under drier conditions predicted by models of global climate change. Students must determine the most important factors that make planting crops sustainable in restricted climate conditions for the client. The main focus of this MEA is manipulating factors relating to plant biology, including transpiration and photosynthesis.
Defining Problems and Planning Investigations:	This lesson, if well planned out and conducted properly, addresses every component of the benchmark it is intended to cover. It involves a whole-group segment, during which the teacher provides a demonstration for students to observe. It also involves a segment that requires the students consult other sources of information related to what they observed in making their hypothesis and planning their investigation. It also involves a group-learning segment, that can easily be adjusted to incorporate differentiated instruction to accommodate students with special needs, during which students conduct the investigation they planned. Finally, it also involves a segment that allows the students the opportunity to communicate the results of their investigation and to evaluate the results of investigations conducted by others. It may also involve another segment involving direct instruction of the components of the scientific method and practice opportunities for students to develop their understanding of these components if this is

	determined to be necessary based upon the results of the pre-lesson assessment.
Amusement Park Physics:	Students will research various types of amusement park rides and use their findings to design a feasible ride of their own. They will summarize their findings and present their ride design to the class. Each student will then write a persuasive letter to a local amusement park describing the reasons their ride design is the best.
Behavior of Gases: Disaster at Lake Nyos:	Students, through discussion and structured inquiry, will learn about the behavior of gases under various conditions. Students will be able to apply these concepts to everyday objects such as soda bottles, fire extinguishers, hot air balloons, propane tanks, and aerosol products.
Blood flow: A Student-Centered Inquiry:	This is set of related lessons including direct instruction, games, readings, small group work and an inquiry activity to model factors affecting the human circulatory system.
SMALL: Shape Memory Alloy Lab:	Shape Memory Alloys are metals that can return to or 'remember' their original shape. They are a cutting edge application for Chemistry, Physics, and Integrated Science. The activities in this lesson work well for the study of forces, Newton's Laws, and electricity in physics. They also lend themselves well to crystalline structures, heat of reaction, and bonding in chemistry. In addition, students could study applications for the materials in the medical and space industries.
Uncertainty of Measurement:	The students will learn the application of scientific notation, significant figures, accuracy and precision as they pertain to the collection of data (measurement).
Visualization of Social Networks with Node Graphs:	This lesson introduces the concept of node graphs for the purpose of visualizing social networks. The lesson is presented with an introductory physical activity where students create a living graph. Students, building on their existing knowledge regarding common graph types, learn how node graphs can be used to visualize data from social networks. Students will then participate in a simulated contagious infection event and will accurately record data about the transmission of the disease. These data will be used to construct a single computer file to be used to create a single node graph for describing the network. Students will then be responsible for understanding how to interpret the resulting network graph in the context of the activity.

Lesson Study Resource Kit

Name	Description
Measurement Matters:	This Lesson Study Resource Kit is an introductory unit on measurement for a Chemistry I course.

Original Student Tutorials

Name	Description
Ecological Data Analysis:	See how data are interpreted to better understand the reproductive strategies taken by sea anemones with this interactive tutorial.
Ecology Sampling Strategies:	Examine field sampling strategies used to gather data and avoid bias in ecology research. This interactive tutorial features the CPALMS Perspectives video Sampling Strategies for Ecology Research in the Intertidal Zone.

Perspectives Video: Experts

Name	Description
Systematic Approach to Testing Pilot Equipment:	Air Force Test Pilot discusses the need for systematic testing and collection of data for new flight technologies. Download the CPALMS Perspectives video student note taking guide.
Testing New Designs: F-15 Experimental Aircraft:	F-15 Experimental Test Pilot discusses the importance of the iterative process of collecting data, analyzing data and communicating the findings when developing aircraft for the United States Air Force. Download the CPALMS Perspectives video student note taking guide.

Perspectives Video: Professional/Enthusiasts

Name	Description
Normal? Non-Normal Distributions & Oceanography:	What does it mean to be normally distributed? What do oceanographers do when the collected data is not normally distributed? Download the CPALMS Perspectives video student note taking guide.
Residuals and Laboratory Standards:	Laws and regulations that affect the public are being formed based on data from a variety of laboratories. How can we be sure that the laboratories are all standardized? Download the CPALMS Perspectives video student note taking guide.
KROS Pacific Ocean Kayak Journey: Training, Simulation, and Modeling:	Complex problems require complex plans and training. Get in shape to get things done. Related Resources: KROS Pacific Ocean Kayak Journey: GPS Data Set[.XLSX] KROS Pacific Ocean Kayak Journey: Path Visualization for Google Earth[.KML] Download the CPALMS Perspectives video student note taking guide.

Perspectives Video: Teaching Ideas

Name	Description
The Value of Marine Science Field Research Experiences for Teachers:	In this video, Angela Lodge describes the value of hands-on experiences gained from field research for transforming both teachers and their classroom practices. This research is made possible by a grant from the Gulf of Mexico Research Initiative (GoMRI/C-IMAGE II). This research is made possible by a grant from the NOAA Gulf of Mexico BWET program. Download the CPALMS Perspectives video student note taking guide.
Enhancing Teaching Practices through Watershed Research Outreach Programs:	Field experiences are powerful and capable of improving teachers' ability to impact students in the classroom. Watch as USF Outreach Coordinator Teresa Greely explains the experiences offered to teachers through the NOAA Bay Watershed Education and Training (B-WET) program. This research is made possible by a grant from the Gulf of Mexico Research Initiative (GoMRI/C-IMAGE II). This research is made possible by a grant from the NOAA Gulf of Mexico BWET program. Download the CPALMS Perspectives video student note taking guide.
Applying Marine Field Experiences to Classroom Practices: Susan Cullum:	In this video, science teacher Susan Cullum describes the impact of field research experiences on classroom teaching practices. This research is made possible by a grant from the Gulf of Mexico Research Initiative (GoMRI/C-IMAGE II). This research is made possible by a grant from the NOAA Gulf of Mexico BWET program. Download the CPALMS Perspectives video student note taking guide.
Applying Marine Field Experiences to Classroom Practices: Patty Smukall:	Listen as science teacher Patty Smukall recounts past and present marine field experiences and how they affect teaching practices back in the classroom. This research is made possible by a grant from the Gulf of Mexico Research Initiative (GoMRI/C-IMAGE II). This research is made possible by a grant from the NOAA Gulf of Mexico BWET program. Download the CPALMS Perspectives video student note taking guide.
Getting Started in Science with a Goldenrod Paper Inquiry:	This simple inquiry helps students learn about the scientific method while trying to unlock the mystery of goldenrod paper. Download the CPALMS Perspectives video student note taking guide.

Project

Name	Description
Transpirational Design Lab:	This is an inquiry design lab for students to understand transpirational pull of plants. Like all inquiry labs, it is open for more designs than the one presented in the PowerPoint example. The example in the PowerPoint is the easiest to implement in the classroom. It requires a growlite (a bulb that produces the UV light plants need to grow), a fan, a light source with a 100 Watt bulb, Ziplock bags, rope, and plants that are the same (I use petunias).

Teaching Ideas

Name	Description
An Ecological Field Study with Statistical Analysis of Two Populations:	Students will design an investigation that compares a characteristic of two populations of the same species. Students will collect data in the field and analyze the data using descriptive statistics.
Showdown at Crayfish Corral-SeaWorld Classroom Activity:	Students will be able to describe the concept of dominance and hierarchy displayed by other animals after observing dominance behavior displayed by crayfish.
All Numbers Are Not Created Equal:	Although a sheet of paper is much thinner than the divisions of a ruler, we can make indirect measurements of the paper's thickness.

Text Resources

Name	Description
Languages Are Still a Major Barrier to Global Science:	This informational text resource is intended to support reading in the content area. The article describes a Google Scholar survey, focusing on environmental issues, as the basis for presenting an argument that language is a barrier to global communication in the scientific community. The recognized barriers are two-fold: the limitation of knowledge transfer and the inability of local policy makers to make decisions based on existing knowledge. The article provides possible solutions to the problem, including the "multilingualization" of texts through changes in journal requirements.
Why Artificial Sweeteners Can Increase Appetite:	This informational text resource is designed to support reading in the content area. The text describes how researchers at the University of Sydney have discovered a correlation between artificial sweeteners, like sucralose, and an increased appetite. There are estimates that over 4,000 types of food contain sucralose. Billions of people around the world consume artificial sweeteners in hopes of losing weight, and until this study, little has been known about how these sweeteners affected the brain.
Parasites: Rulers of the Reef:	This informational text resource is designed to support reading in the content area. The text informs readers about the influence of parasites on damselfish, a coral reef species. The author explains how his team determined the reason for the consistent behavior of damselfish leaving their aggressively guarded territory each morning to go to a cleaning station. Through the scientist describing how his research lead to new observations that lead to new questions and research, the text is a good example of how scientific investigations are conducted, including working collaboratively and communicating important results.
	This informational text resource is intended to support reading in the content area. Most students are familiar with the

Ultracold Atoms:	four most common states of matter, but what about the 5th state of matter, the Bose-Einstein condensate (BEC for short)? This article explains what a BEC is and how researchers are exploring this unique state of matter.

Tutorial

Name	Description
Scientific Method Tutorial and Virtual Experiment:	Site takes the student through a tutorial, then a virtual experiment designed to test the affect of various environmental variables on the rate of chirping in crickets. The steps in the tutorial and the experiment are - Define the Problem, Collect Information, Formulate a Hypothesis, Test the Hypothesis, and Draw a Conclusion.

Video/Audio/Animation

Name	Description
Will an Ice Cube Melt Faster in Freshwater or Saltwater?:	With an often unexpected outcome from a simple experiment, students can discover the factors that cause and influence thermohaline circulation in our oceans. In two 45-minute class periods, students complete activities where they observe the melting of ice cubes in saltwater and freshwater, using basic materials: clear plastic cups, ice cubes, water, salt, food coloring, and thermometers. There are no prerequisites for this lesson but it is helpful if students are familiar with the concepts of density and buoyancy as well as the salinity of seawater. It is also helpful if students understand that dissolving salt in water will lower the freezing point of water. There are additional follow up investigations that help students appreciate and understand the importance of the ocean's influence on Earth's climate.

Virtual Manipulative

Name	Description
Mesquite - Phylogenetic Trees:	Students use software to create evolutionary trees by comparing and contrasting physical traits. This activity demonstrates the complexity of creating evolutionary trees when multiple traits are being analyzed. The use of the software simplifies the analysis without compromising the learning objectives.

Student Resources

Original Student Tutorials

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Parent Resources

Perspectives Video: Teaching Idea

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