


ALABAMA DEPARTMENT OF EDUCATION

Makes Sense Strategies Toolkit
applications for
Grades 9-12 Science

Part 1: Using *Smart Sheets* to teach high-frequency science topics

Part 2: Using *Smart Sheets* to science vocabulary

 Edwin Ellis, Ph.D.
University of Alabama

ALABAMA DEPARTMENT OF EDUCATION


Makes Sense Strategies Toolkit
applications for
Grades 9-12 Science

Part 1: Using *Smart Sheets* to teach high-frequency science topics

What are high-frequency science topics?

What are the types of knowledge is emphasized in science-learning?

What's the connection between high-frequency science topics, types of science knowledge, and using Smart Sheets?

 Edwin Ellis, Ph.D.
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Examples of how teachers have used Smart Sheets when teaching science

How to find various Makes Sense Strategies resources

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Science Content Standards

High-frequency science topics

- Abstract Concepts
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components
- Life Forms
- Procedures
- Problems

Highly likely that any given science lesson will be mostly about one of these topics

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Science Content Standards

High-frequency science topics

Concept – Features / Properties / Functions

Identify solutions in terms of components, solubility, concentration, and conductivity

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Science Content Standards

High-frequency science topics

Concept – Features / Properties / Functions

Identify solutions in terms of **components, solubility, concentration, and conductivity (FEATURES)**

Identify functions of carbohydrates, lipids, proteins, and nucleic acids in cellular activities

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Science Content Standards



High-frequency science topics

Concept – Features / Properties / Functions

Identify solutions in terms of **components, solubility, concentration, and conductivity (FEATURES)**

Identify **FUNCTIONS** of carbohydrates, lipids, proteins, and nucleic acids in cellular activities

Distinguish between transverse and longitudinal mechanical waves

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Science Content Standards

High-frequency science topics

Concept – Features / Properties / Functions
Identify solutions in terms of **components, solubility, concentration, and conductivity (FEATURES)**

Identify **FUNCTIONS** of carbohydrates, lipids, proteins, and nucleic acids in cellular activities

Distinguish between **transverse and longitudinal mechanical waves (PROPERTIES)**

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Science Content Standards

High-frequency science topics

Concept – Features / Properties / Functions

Processes
Describe the cell processes necessary for achieving homeostasis, including active and passive transport, osmosis, diffusion, exocytosis, and endocytosis

Describe physical and chemical changes in terms of endothermic and exothermic processes

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Science Content Standards

High-frequency science topics

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Describe physical and chemical changes in terms of endothermic and exothermic **processes**

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Science Content Standards



High-frequency science topics

Concept – Features / Properties / Functions

Processes

Classification systems
Differentiate classification systems between the previous five-kingdom and current six-kingdom

Categorizing elements as metals, nonmetals, metalloids, and noble gases

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Science Content Standards



High-frequency science topics

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Science Content Standards


High-frequency science topics...

Concept – Features / Properties / Functions

Processes

Classification systems

Famous people
Identify scientists who contributed to cell-theory
Examples: Hooke, Schleiden, Schwann, Virchow, von Leeuwenhock


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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
- Processes
- Classification systems
- Famous people**

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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
- Processes
- Classification systems
- Famous people
- Events / Phenomena**

Identify functions of organelles found in eukaryotic cells, including the nucleus, cell membrane, cell wall, mitochondria, chloroplasts, and vacuoles.

Example: mitochondria releasing energy for use in cellular respiration

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Science Content Standards

High-frequency science topics...

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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures**

Contrast the formation of ionic and covalent bonds based on the transfer or sharing of valence electrons

Classify animals according to types of skeletal structure, method of fertilization and reproduction, body symmetry, body coverings, and locomotion

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Science Content Standards

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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components**

Relate major tissues and organs of the skeletal, circulatory, reproductive, muscular, respiratory, nervous, and digestive systems to their functions.

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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components
- Life Forms**

Contrast autotrophs and heterotrophs

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Science Content Standards

High-frequency science topics...

- Concept – Features / Properties / Functions
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components
- Life Forms
- Procedures**

Select appropriate laboratory glassware, balances, time measuring equipment, and optical instruments to conduct an experiment

Use nomenclature and chemical formulas to write balanced chemical equations

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Science Content Standards





Types of knowledge that tends to be emphasized...

- Concept – Features / Properties / Functions**
- Main idea
- Critical features } **Definition**
- Examples of the concept
- Non-examples of the concept } **Manifestations & Applications**
- Relationships to other concepts
- Factors that affect the concept
- Things the concept affects } **Relational understanding**
- Comparison to other concepts
- Concept as reflected in specific components or steps

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Science Content Standards


Types of knowledge that tends to be emphasized...

- Concept – Features / Properties / Functions**
- Main idea
- Critical features } **Hierarchic** 
- Examples of the concept
- Non-examples of the concept
- Relationships to other concepts
- Factors that affect the concept
- Things the concept affects } **Cause / Effect** 
- Comparison to other concepts } **Compare / Contrast** 
- Concept as reflected in specific components or steps } **Sequence** 

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Science Content Standards

Types of knowledge that tends to be emphasized...

- Concept – Features / Properties / Functions**
- Main idea
- Critical features } **Definition**
- Hierarchic structure** 

Identify functions of carbohydrates, lipids, proteins, and nucleic acids in cellular activities

Main idea & features of what a **carbohydrate** is

Main idea & features of what **lipids** are

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Science Content Standards Hierarchic Info
Concepts (Main Idea & Distinctive Features)

Organizer SMART levels

- Hierarchic** (Main Idea, 2 Main Ideas, 3 Main Ideas, 4 Main Ideas, 5 Main Ideas, 6 Main Ideas)
- Organizational** (Main Idea, Main Concepts, Main & Secondary Concepts, Main & Double Connections)
- Cause / Effect** (2 Causes, 3 Causes)
- Sequence** (Steps, Cycles, Sequences of Events)

Essential Understandings SMART levels

- Literature** (Story Grammar & Sequence, Character Analysis, Literary Analysis, Story Problem, Questions Inferences, Predictions, Text/Purview)
- Writing** (Level 1, Level 2, Level 3, Level 4, Level 5, Resources, Supplemental, Narrative, Descriptive, Expository, Persuasive)
- Vocabulary** (Jokes, Word Cards, Semantic Tables, Word Comparisons, Word Connections, Features Analysis, LINC5 annotations, Scavenger Hunts, Multiple Meanings)
- History & Science Generative Ideas** (Process, Source, Place, Event, Process, Theory, Ideology, Debate, Issue, Policy, Conflict, Problem, Invention, Object)
- Math** (Mathematical Concepts, Computational Processes, Skills/Themes)
- Social / Motivation** (Behavioral Strategy, Character Building, Perspective Taking, Self-control, Goal Setting & Self-advocacy, Behavior Analysis)
- Project Based Learning** (Planning Investigations, Conducting Investigations, Making Presentations, Evaluating Project Processes & Outcomes)

SMART Applications for Features

- Behavioral Design** (Content Area Units & Lessons, Literacy/Strategy Units & Lessons, Anticipation Guides, scaffolding Tactics, Reflective Reviews)
- SMART Applications for Exports**
- MSCS Implementation Resources** (Articles, www.MakesSenseStrategies.com, Acknowledgments)

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Science Content Standards Hierarchic Info
Concepts (Main Idea & Distinctive Features)

3 Details Web

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Features... Function... Source...

Carbohydrates **Lipids**

Proteins **Nucleic acids**

Cell processes necessary for achieving homeostasis

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Science Content Standards Hierarchic Info
Concepts (Main Idea & Distinctive Features)

Physical science: Identify the characteristics of gravitational, electromagnetic, and nuclear forces

Forces (to about...)

Characteristics of three types of forces

Gravitational forces	Electromagnetic forces	Nuclear forces

So what? What is important to understand about this?

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Science Content Standards Hierarchic Info
Classification Systems (Main Idea & Distinctive Features)

Classification of Plants (to about...)

Classifying plants into categories of similar and different characteristics

Main Idea: Vascular plants have xylem and phloem. Tubes for transporting water, nutrients and food to the various plant parts.

- About 12,500 species
- Typically spread using underground stems
- Reproduce using spores

Main Idea: Nonvascular plants do not have tubes for transporting fluids.

- Tend to live in damp places near the ground
- About 12,000 species
- Range in size
- Have no roots
- Reproduce using spores in swellings on fronds
- Mosses and liverworts
- About 24,000 species
- Small, green land plants
- Reproduce using spores made in capsules

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Structures

Rock sandstone, Quartz conglomerate, Mudstone

Detrital sedimentary rocks are made of pieces of preexisting rocks.

Organic sedimentary rocks are made of the remains of organisms (plants and animals).

Inorganic sedimentary rocks are made of mineral crystals.

Compositions of Sedimentary Rocks

Skeletal limestone, Peat, Coal, Gypsum, Halite (Rock salt), Hematite (ironstone)

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Science Content Standards Hierarchic Info
(Main Idea & Distinctive Features)

Systems & Components

The Muscular System is about...
A complex system and major component of an animals' body that provides movement and proper organ function.

- Skeletal Muscle**
- Smooth Muscle**
- Cardiac Muscle**

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Science Content Standards Hierarchic Info
(Main Idea & Distinctive Features)

Life forms

Infectious Diseases is about...
Illnesses that are caused by bacteria, viruses, or protozoa in the body.

Chickenpox Caused by virus Skin rash, fever, discomfort Vaccine	Influenza Caused by virus Chills, fever, body aches Vaccines	Malaria Caused by protozoa Attack of chills, high fever Mosquito control	Plague Caused by bacteria Swelling of legs, high fever, rapid heart beat Vaccine (not very effective)
Rabies Caused by virus Burning of bite site, muscle spasms Vaccinate all dogs and cats	Rubella (German measles) Caused by virus Runny nose, rash, tender lymph nodes Vaccine - MMR	Yellow Fever Caused by virus Fever, yellow skin, stomach bleeds Vaccine and control mosquitoes	West Nile Virus Caused by virus Headaches, chills, vomit, coma, death Control mosquito population

So what? What is important to understand about this?
Infectious diseases can be harmful to your body, but can also be prevented. Take care of yourself and practice good hygiene.

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Science Content Standards Hierarchic Info
(Main Idea & Distinctive Features)

Processes

Plants develop structures to benefit them in harsh environments.
Animals use camouflage to blend in with the habitat. This is helpful for both predators and prey.
Animals develop structures to help them obtain food within their habitat.

Surviving in Different Environments

Reproductive Adaptations
Plants use bright colors or strong scents to attract insects to carry out pollination.
Courtship behavior of animals.
Animals provide care for their young to ensure survival. Species produce many offspring to ensure survival.

Adaptations
An adaptation is a trait that enables an organism to survive & reproduce in its environment.

As the environment changes, the organism's ability to adapt can change for the positive or negative.
Positive: if an animal has the ability to consume many foods, one food dies out the animal continues to survive.
Negative: if an animal has a limited diet, the loss of a food can cause the animal to die out.

Adaptation and Environmental Change

Inherited Traits and Survival
Most adaptations are traits or characteristics that offspring inherit from their parents.
Offspring adaptations are determined by genes.
Some animal behaviors are adaptations that are instinctive, or learned.

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Science Content Standards

KINDS of science knowledge that tends to be emphasized....

- Concept – Features / Properties / Functions**
 - Main idea
 - Critical features
 - Examples of the concept
 - Non-examples of the concept
- Relationships to other concepts**
 - Factors that affect the concept
 - Things the concept affects
- Comparison to other concepts**
- Concept as reflected in specific components or steps**

Hierarchic (tree diagram)

Cause / Effect (green box to blue box)

Compare / Contrast (Venn diagram)

Sequence (stack of books)

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Science Content Standards

KINDS of science knowledge that tends to be emphasized....

- Abstract Concepts
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- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components
- Life Forms
- Procedures
- Problems

Cause / Effect

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Science Content Standards Cause / Effect

Organizer SMARTsheets

- Hierarchic
- Compare / Contrast
- Cause / Effect

Essential Understandings SMARTsheets

- Literature
- Writing
- Vocabulary
- Math
- Social Motivation
- SMARTplanners for Teachers
- SMARTplanners for Leaders

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Science Content Standards Cause / Effect

Concepts

Physical science: Describe factors that affect solubility and rate of solution, including nature of solute and solvent, temperature, agitation, surface area, and pressure on gases

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Science Content Standards Cause / Effect

Concepts

Physical science: Describe factors that affect solubility and rate of solution, including nature of solute and solvent, temperature, agitation, surface area, and pressure on gases

Factors that affect solubility and rate of solution

HOW / WHY?

- Nature of solute
- Temperature
- Surface area
- Natures of solvent
- Agitation
- Pressure on gases

HOW / WHY?

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Science Content Standards Cause / Effect

Concepts

Physical science: Explain how thermal energy is transferred by radiation, conduction, and convection

Transferring thermal energy

How thermal energy is transferred from source to objects

- How thermal energy is transformed by **radiation**
- How thermal energy is transformed by **conduction**
- How thermal energy is transformed by **convection**

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Science Content Standards Cause / Effect

Concepts

Force and Motion

Force and work causing the motion or movement of objects.

When... Force is applied to an object...

Then... Motion occurs in that object.

A force is a push or pull, and can change how an object moves.

A force can change the direction and the speed of an object.

You need to use different amounts of force to move different objects.

The heavier the object is, the more force you need to move it.

Motion happens when an object changes position in relation to other objects.

A moving object might change directions or travel a farther distance.

Motion can be measured by speed, fast or slow, and speed depends on the amount of force that was used.

Work is done when a force results in motion.

So what? What is important to understand about this?
Force can cause motion, different types of force cause different types of motion, and work is only done if force results in motion.

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Science Content Standards Cause / Effect

Process

Physical and Chemical Changes in Matter

The two ways that matter can change form.

When... This occurs...

- You combine ice cream and milk...
- You cut a piece of wood...
- You leave the bread in the Toaster too long...
- You mix a food-aid packet and water...
- You squeeze oranges...
- Fireworks are lit with fire...
- The food is left out all night...
- You dissolve salt into water...
- You cut the grass with a lawn mower...
- You leave your bike out in the rain...

Then... It results in...

- A milkshake
- You now have two pieces.
- Your toast burns
- You get Kool-aid
- You make orange juice
- The fireworks explode
- The food spoils
- You made salt water
- Shorter blades of grass
- A rusted bike

So... Is it a chemical or physical change?

- This is a physical change.
- This is a chemical change.
- This is a physical change.
- This is a chemical change.
- This is a physical change.
- This is a physical change.
- This is a chemical change.
- This is a physical change.
- This is a chemical change.

So what? What is important to understand about this?
We need to understand that changes in matter are all around us all the time.

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Science Content Standards Cause / Effect

Process

Plate Tectonics and Life on Earth

The ability of living things to respond to changes in the environment

This ... Caused this ... Which then caused this ...

- Movement of plates causes changes in climate & geographic features → Living things respond to changes in order to survive → Diversity Increases or Decreases
- As plates move toward or away from equator, environment changes → Cooler environments = less food, more fat & hair needed for warmth → Animals & plants that can adapt to new environments survive, those that can't, die out
- When landmasses join together → Big landmasses: animals can easily move to suitable places avoiding more challenging environments → Diversity Decreases
- When landmasses split apart → Small landmasses: animals adapt to local conditions, & are cut off from competitors & enemies → Limits the types of living things with which a species can interact, Diversity increases
- Genetic mutations constantly occur in all living things → If changes from mutations match changes in environment, animal more likely to survive → If changes from mutations mismatch changes in environment, animal more likely to die out

So what? What is important to understand about this?
The evolution of Earth's living things is strongly linked to movement of the lithospheric plates

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Science Content Standards Cause / Effect

Events / Phenomena

During a new moon or a full moon, the sun, moon and earth are in a straight line.

When they are aligned, the gravitational attraction of the sun reinforces the gravitational attraction of the moon.

This compound gravitational attraction of the sun and moon causes the tides to be at their highest point.

These high tides are called **spring tides**.

This shows the effect of the moon phases on Earth's oceanic tides.

At quarter moons, the sun and moon are at right angles.

The gravitational attraction of the sun works in opposition to the gravitational attraction of the moon.

This oppositional gravitational attraction causes the tides to be at their lowest point.

These low tides are called **neap tides**.

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Science Content Standards Cause / Effect

Events / Phenomena

This is about what happens when these two things interact to produce new things.

Plants and **Carbon Dioxide** interact to produce **Carbohydrates**.

Plants remove carbon dioxide from the air and use it to make carbohydrates.

Carbohydrates are eaten and used by other organisms.

The carbon from the carbohydrates is returned to the atmosphere through respiration, combustion, and decay.

After the carbon is returned to the atmosphere, the cycle begins again.

Carbon can follow several different paths through the carbon cycle.

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Science Content Standards Cause / Effect

Events / Phenomena

Bacteria

- Microbes responsible for much of the decay and spoilage of the plant and animal tissues in foods.
- Bacteria causes food poisoning and food infection.
- Food poisoning results when toxins are secreted as waste materials by the bacteria.

Molds

- Microbes that aid in the breakdown of plant and animal tissues.
- Molds appear as fine, hairy filaments on the surfaces of food such as bread.
- Molds need oxygen to live & are generally found on the surface of foods. Most grow at 77°-86°.

Yeasts

- Microbes that can be helpful and harmful.
- Yeasts may cause food spoilage by growing and reproducing on food.
- Yeasts cause problems if growth is abundant.

Food Spoilage

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Science Content Standards

KINDS of science knowledge that tends to be emphasized....

Concept – Features / Properties / Functions

- Main idea
- Critical features
- Examples of the concept
- Non-examples of the concept

Relationships to other concepts

- Factors that affect the concept
- Things the concept affects

Comparison to other concepts

Concept as reflected in specific components or steps

Hierarchic (tree diagram)

Cause / Effect (flow diagram)

Compare / Contrast (Venn diagram)

Sequence (stacked blocks diagram)

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Science Content Standards

KINDS of science knowledge that tends to be emphasized....

- Abstract Concepts
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components
- Life Forms
- Procedures
- Problems

Comparison

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Science Content Standards Compare / Contrast

Organizer SMARTsheets

- Compare / Contrast** (highlighted)
- Sequence

Essential Understandings SMARTsheets

- Literature
- Writing
- Vocabulary
- History & Science
- Math
- Social Motivation
- Project-based Learning
- SMARTplanners for Teachers
- SMARTplanners for Leaders
- MIS Implementation Resources

MAKES SENSE STRATEGIES
Edwin Ellis v10.1

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Science Content Standards Compare / Contrast

Physical science
Contrast the formation of ionic and covalent bonds based on the transfer or sharing of valence bonds

	Formation of Ionic bonds	Formation of Covalent bonds
Transfer of valence bonds		
Sharing valence bonds		
CONCLUSION		

SO WHAT?
What is important to understand about this?

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Science Content Standards Compare / Contrast

Life Forms

Plant Cells

Different

- Have Chloroplasts- make food for the cells
- Have cell walls- supports and protects a plant cell

Animal Cells

Different

- Unlike plant cells, animal cells do not have anything unique to only animal cells.
- Everything they have is common to plant cells.
- Have mitochondria

Same

- Have a nucleus
- Have chromosomes
- Have cell membranes
- Have cytoplasm
- Have vacuoles

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Science Content Standards Compare / Contrast

Structures

Intrusive Igneous Rocks

VS

Extrusive Igneous Rocks

Where the igneous rock is formed	Intrusive igneous rocks are formed within the earth.	<p>Similar</p> <p>All igneous rocks are formed when hot, molten magma or lava cools.</p>	Extrusive igneous rocks form at the earth's surface after they are ejected (as lava) through volcanoes.
How rate of cooling affects the rock formation	Because intrusive rocks cool slowly , crystals within the rock have time to form.		Extrusive rocks cool very quickly and so crystals do not have time to form.

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Science Content Standards Compare / Contrast

Events / Phenomena

El Nino

Causes

Ocean Temperatures

Effects on Weather Globally

Effects on U.S.

La Nina

Causes

Ocean Temperatures

Effects on Weather Globally

Effects on U.S.

Comparing

Details	Weaker than normal trade winds	Stronger than normal trade winds
Details	Warming of the ocean temperatures in the east-central equatorial region	Ocean temperatures that are 1-2° C cooler than average in the east-central equatorial region.
Details	More hurricanes in the Pacific, added rainfall in Ecuador and Peru, Indian monsoon rainfall very below normal	Increased Atlantic hurricane activity, Indian monsoon weaker, decreased rainfall in tropical Pacific.
Details	Stormy weather for the South during the winter months, warmer in the northwast	Warmer and drier in Southeast, colder over Alaska.

So what? What is important to understand about this?
Even changes of ocean temperatures on a different side of the world, can have an effect on the weather in my state.

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Science Content Standards Compare / Contrast

Events / Phenomena

Solar Eclipse

Subtopics

How often they occur

How long they last

How they look

What causes them

Lunar Eclipse

Subtopics

How often they occur

How long they last

How they look

What causes them

How often they occur	There are 5 a year.	<p>Similar</p> <p>Both occur every year, but you can see them only if the sky is clear</p>	There are 2 a year.
How long they last	They last no more than 7.5 minutes.		They last about 2 hours
How they look	during a total solar eclipse, the moon appears to completely cover the sun.	The sun has a key role in both.	An eclipsed moon looks like a dim red circle.
What causes them	A solar eclipse occurs when Earth passes through a new moon's shadow.	Both involve what you see (or don't see) due to a shadow	A lunar eclipse occurs when a lunar eclipse occurs when the full moon passes through Earth's shadow.

So what? What is important to understand about this?
They both occur when Earth, the Sun, and the Moon line up.

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Science Content Standards Compare / Contrast

Systems & components

	Tundra	Boreal Forest (Taiga)	Temperate Deciduous Forest	Tropical Rain Forest	Grassland	Desert
Terrain	It is flat and covered with snow most of the year. Bogs and marshes form in the ground from the ground frost.	Spotted with many lakes, much of the ground is marshy.	It ranges from flat to mountainous.	It is hilly, for the most part by thick vegetation.	It is flat, with very little or no hills.	It is flat, with either hills or sand covering the ground.
Climate	It is cold and dry with temperatures ranging from -70°F to 60°F.	Temperatures range from 10°F in the winter to 20°F in the summer.	There are four distinct seasons- fall, winter, spring, and summer, and rainfall is moderate.	It is warm and humid with more than 200 rainy days a year.	There are hot humid summers, and the temperatures are moderate.	It is dry, with less than 30 inches of rain falling each year. There are both hot and cold deserts.
Plants	There are mostly perennials because of the short growing season. Moss, arctic wildflowers, sedges, and dwarf trees are common.	There are mostly coniferous evergreen trees such as spruce and jack pine.	This is characterized by trees that lose their leaves in fall and winter.	There are four levels of unique plant life- emergent, canopy, understorey, and forest floor.	Grasses, wildflowers, and many few trees make up this biome.	Species here, like the cactus and the desert plant, are adapted to arid water.
Animals	Some live here year round, like the polar bear, while others, like the reindeer, migrate to warmer climates in winter.	Beaver, ducks, bears, and wolves are all inhabitants of the taiga.	Wild turkey, whitetail deer, and opossum are common in this biome in North America.	An hour half of Earth's species live here, including monkeys, parrots, snakes, and etc.	Many animals and small ground species such as prairie dogs are common in North America. Beavers are a common species in Alaska.	Most animals found here, including snakes and scorpions, are nocturnal.

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Science Content Standards Compare / Contrast

Systems & components

	Form	Function	Disorder
Subtopics	Features	Features	Features
Red Blood Cells	Red blood cells are round, disc shaped with a small indentation on each side.	Red blood cells deliver oxygen and food to other cells and organs in the body.	Sickle cell anemia: deformed red blood cells shaped like crescents... hard for them to get through the blood vessels, & do not carry oxygen well.
White Blood Cells	White blood cells are different shapes and sizes. They change according to the situation in which they work.	White blood cells are the protecting cells in your body that fight against germs and other invaders.	If white blood cells do not form correctly and their numbers increase too quickly, a person can develop a cancer called leukemias.
Platelets	Platelets are not complete cells. They are pieces of cells that float around in the blood.	Platelets form blood clots by clumping together and sticking to the edges of the cut, which helps a person stop bleeding.	A cluster of platelets that float throughout the blood is called an embolism, which can block a blood vessel cutting off circulation.

So what? What is important to understand about this?

All these cells work together each having a specific job that helps keep you healthy.

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Science Content Standards Compare / Contrast

Life forms

Features	Eagle	Crow	Seagull	Owl	Sparrow	Dove	Osprey	Bluebird	Martin
Topics									
Predator	X	X	X	X	X	X	X	X	X
Forms Pellets	X	X	X	X	X	X	X	X	X
On every continent except Antarctica	X	X	X	X	X	X	X	X	X
Has same mate for life	X	X	X	X	X	X	X	X	X
4 claws (talons) - breaks & crushes head of food	X	X	X	X	X	X	X	X	X
Nocturnal	X	X	X	X	X	X	X	X	X
Helps to balance Population of rodents	X	X	X	X	X	X	X	X	X
Used to symbolize certain characteristics	X	X	X	X	X	X	X	X	X
Steals other birds' food	X	X	X	X	X	X	X	X	X

Conclusion about the topic:

- Most of these birds eat more animals than insects
- 3 of every 10 birds eat pellets
- Not very many birds live all around the world
- Many birds like to keep the same mate for life
- The larger birds tend to have four talons
- Only the owl is nocturnal (hunts at night)
- Mainly big birds eat rodents
- People often use birds as symbols
- Our national bird (Bald Eagle) is a thief!!!

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Science Content Standards Compare / Contrast

Main ideas	Life Science	Earth Science	Physical Science	Conclusions
Questions at the Microscopic Level	How do tiny bacteria invade the body and cause disease?	Why do some rocks last a million years & others are worn away in a matter of decades?	Why are some chemical compounds harmless while others are toxic?	Scientists in all three branches seek truths about the microscopic world around them.
Questions at Macroscopic Level	How do organisms in an area interact with other organisms & the environment?	What forces cause volcanoes to erupt, or earthquakes to occur in certain areas?	Why does it take a heavy weight car longer to stop than a light weight one?	Scientists in all three branches study the world of objects visible to the unaided eye.
Questions at the Global Level	How do pollutants in the air or water in one part of the world affect life in distant areas?	How can wind patterns throughout the atmosphere help predict weather?	What fundamental forces in nature govern all events in the universe?	Some of the questions scientists seek to answer have a world viewpoint.
Conclusions	LS attempts to answer questions dealing with living things and their parts & actions.	ES examines earth and its rocks, oceans, volcanoes, earthquakes, & atmosphere.	PS seeks to answer questions about matter & energy, and the make-up of substances.	

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Science Content Standards

KINDS of science knowledge that tends to be emphasized....

Concept – Features / Properties / Functions

- Main idea
- Critical features
- Examples of the concept
- Non-examples of the concept
- Relationships to other concepts
- Factors that affect the concept
- Things the concept affects
- Comparison to other concepts
- Concept as reflected in specific components or steps

Diagram illustrating relationships:

- Hierarchic**: Represented by a tree diagram.
- Cause / Effect**: Represented by a flow diagram with a red arrow.
- Compare / Contrast**: Represented by two overlapping circles.
- Sequence**: Represented by a stack of books.

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Science Content Standards

KINDS of science knowledge that tends to be emphasized....

- Abstract Concepts
- Processes
- Classifications
- Famous people
- Events / Phenomena
- Structures
- Systems & components
- Life Forms
- Procedures
- Problems

Sequence

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Science Content Standards Sequence

Organizer SMARTplanners

- Hierarchic**: Main Idea, 2 Main Ideas, 3 Main Ideas, 4 Main Ideas, 6 Main Ideas, 8 Main Ideas
- Compare / Contrast**: Venn Diagram, Matrix & conclusions, Matrix & double conclusions
- Cause / Effect**: Flowchart, Sequence of Events
- Sequence**: Sequence of Events

SMARTplanners for Teachers

- Instructional Designs
- Content/Units & Lessons
- Library/Strategy Units & Lessons

SMARTplanners for Leaders

- MIS Implementation Resources

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Science Content Standards Sequence

These are the steps to... **Changing Theories about Origins of the Moon**

Step 1
FISSION
 Hypothesis: The moon had once been part of Earth. Earth was spinning so fast during early formation that it blew apart & flew away.
 Details: FISSION WAS DISPROVED because it could not explain why the moon lacks iron, a common element on Earth.

Step 2
CO-FORMATION
 Hypothesis: The moon and Earth formed at about the same time out of the same debris ring that existed.
 Details: CO-FORMATION WAS DISPROVED when analysis of the energy and momentum required showed that they could not have been formed this way.

Step 3
CAPTURE
 Hypothesis: Moon, a celestial body on a path that took it past Earth, gravitationally captured the moon.
 Details: CAPTURE WAS DISPROVED when lunar rocks were found to have the same isotope composition as Earth rocks do.

Step 4
IMPACT
 Hypothesis: A planet-sized object struck & disrupted the other planet & released debris.
 Details: THIS THEORY IS CURRENTLY ACCEPTED TODAY.

Step 5
 What type of information might disprove the currently accepted IMPACT HYPOTHESIS?
 Details: New data might show that Earth could not have remained in tact after such a large collision.

Why are these ideas important?
 Scientific explanations must be supportable by evidence and be able to be tested in the natural world.

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The are quite a few great resources in the **Makes Sense Strategies** Tool-kit for addressing these standards

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Organizer SMARTsheets

- Hierarchy:** Main Ideas 2 Main Ideas 3 Main Ideas 4 Main Ideas 6 Main Ideas 8 Main Ideas
- Compare / Contrast:** Venns, Matrix (simple), Matrix & conclusions, Matrix & double conclusions
- Cause / Effect:** CE Tables, CE webs
- Sequence:** Steps, Cycles, Sequence of Events

Essential Understandings SMARTsheets

- Literature:** Story Grammar & Sequence, Character Analysis, Literary Analysis, Story Problem, Questions Inferences, Predictions, Text/Persnal
- Writing:** Level 1, Level 2, Level 3, Level 4, Level 5, Resources, Supplemental: Narrative, Descriptive, Expository, Persuasive
- Vocabulary:** Word Cards, Semantic Tables, Word Comparisons, Word Connections, Features Analysis, LINC5 mnemonics, Scavenger Hunts, Multiple Meanings
- History & Science:** Generative Ideas, Person Group Place Event, Process Theory Ideology Debate Issue Policy Conflict Problem Invention Object
- Math:** Mathematical Concepts, Computational Processes, Rules / Theorems
- Social / Motivation:** Behavior Literacy, Character Building, Perspective Taking, Self-control, Goal Setting & Self-advocacy, Behavior Analysis
- Project-based Learning:** Planning Investigations, Conducting Investigations, Making Presentations, Evaluating Project Processes & Outcomes

SMARTplanners for Teachers

- Instructional Design:** Content-area Units & Lessons, Library/Strategy Units & Lessons, Anticipation Guides, Scaffolding Tactics, Reflective Reviews

SMARTplanners for Leaders

- MSS Implementation Resources:** School-wide Implementation Strategies, Articles, www.MakesSenseStrategies.com, Acknowledgments

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Essential Understandings SMARTsheets Projects

HOME

Planning Projects Conducting Investigations Making Presentations Evaluating Projects

Information Sources: COL/R, Back-line, COL/R, Back-line, COL/R, Back-line

TEST Plans: T, H, S, I, A, J, D, C

Hypothesis Testing: FIND research strategy, INVENT problem-solving strategy, TEST research strategy

TEST Strategy for Designing Experiments
Project-based Learning: Implementing Investigations
Name: _____ Date: _____

Target a question Ask a question that you hope your experiment or research will provide an answer to.

What happens to _____ when _____ is added or subtracted from _____?
 What do _____ know or think about _____?
 How will _____ work when trying to _____?
 How did _____ change over _____ amount of time?
 What are the parts of _____?
 How does _____ change when _____ and _____?
 What is the difference between _____ and _____?

Complete one of these questions or write a different question here.

Establish the kind of information you will need to answer the question if you plan to ...

- Hypothesis: guess something: What will be measured? _____ How will it be measured? _____
- Count the number of times something happens: When should the counting occur? _____ How often? _____
- Make a list of observations and then categorize them later: What will you be looking for during the observations? _____
- Survey people to get opinions: Who will be surveyed? _____ What will you ask them about? _____

Set a plan for collecting the data Note the steps you will follow from the beginning to the end of your experiment.

Tally the data Note the calculations that will need to be performed on the data to make sense of it.

- Subtract numbers from different categories to determine difference?
- Compute averages, means, or percentages?
- Clear calculations?

Show the results Decide how the data will be visually displayed.

Line graphs show differences over time. Bar graphs show differences in quantities. Pie charts show differences in percentages.

Example data table:
 Group | Jan | Feb | Mar | Apr
 A | 15 | 20 | 25 | 30
 B | 10 | 15 | 20 | 25
 C | 5 | 10 | 15 | 20

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Essential Understandings SMARTsheets Projects

HOME

Planning Projects **Conducting Investigations** Making Presentations Evaluating Projects

Information Sources

COLOR Black-line

TEST Plans

T	
E	
S	
I	

COLOR Black-line

Hypothesis Testing

COLOR Black-line

FIND
research strategy

INVENT
problem-solving strategy

TEST
research strategy

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Project-based Learning: Investigating Investigations

Hypothesis Testing

Name: _____

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We observed this ...

Specific observations

The observations led us to this hypothesis ...

Details of hypothesis

So then we tested the hypothesis by ...

Testing procedure

Results of the tests led us to conclude that ...

Details of conclusion