A Deeper Dive into the NYSSLS

Part 2

thewonderofscience.com

Workshop Agenda:

Day 1

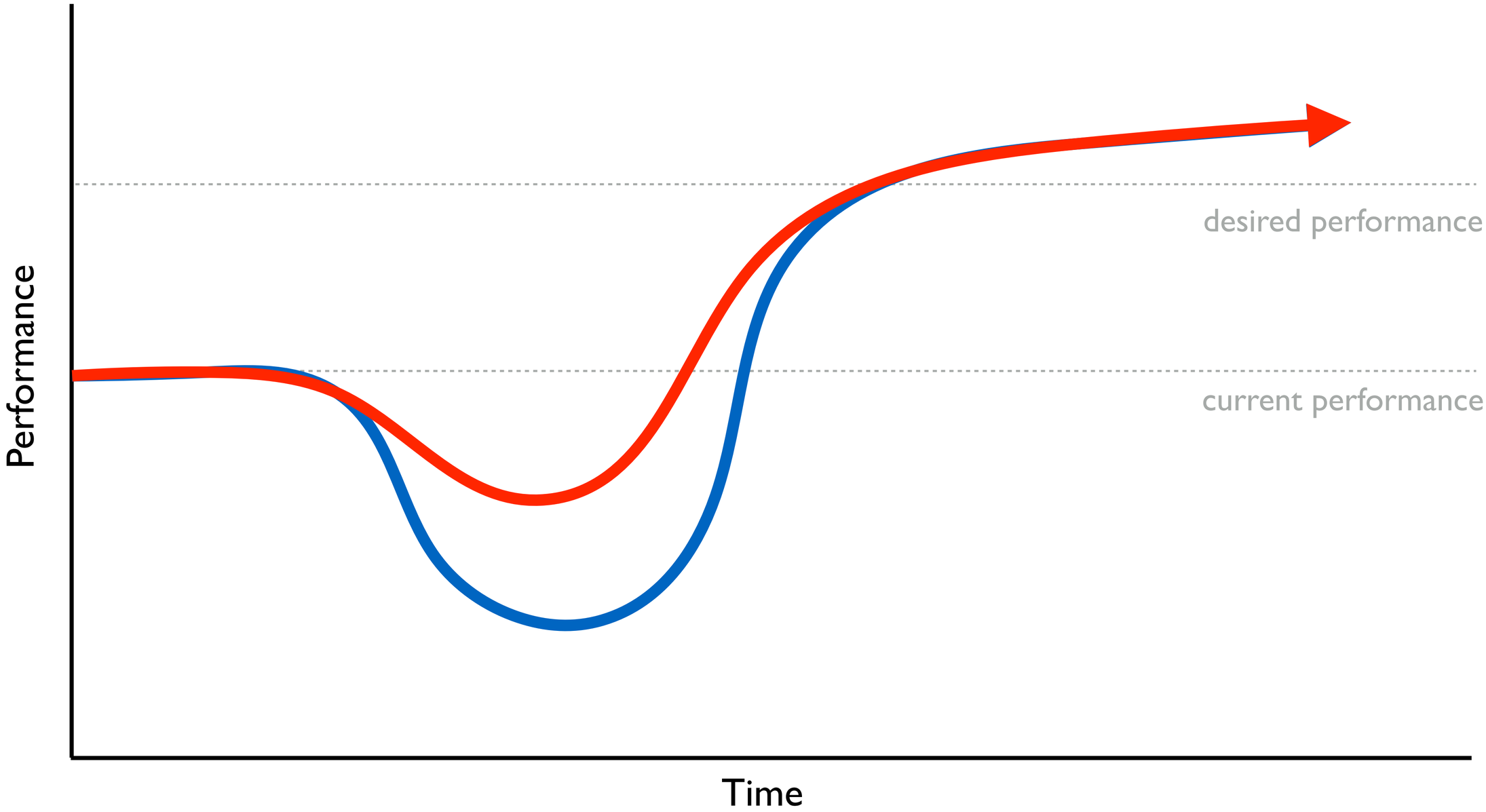
8:00-8:30	Registration and Breakfast
8:30-10:15	Session 1 - Primer on 3-Dimensional Best Practice, emphasis on CCC
10:15-11:30	Session 2 - Formative and Summative Assessment
11:30-12:00	Lunch
12:00-2:00	Session 3 - Formative Task Development/Refining
2:00-3:30	Session 4 - Phenomenon Hunt

Day 2

8:30-10:00	Session 5 - Unit Planning, Storyline Development, Protocol Introduction
10:00-11:30	Session 6 - 3D Unit Design Work Groups
11:30-12:00	Lunch
12:00-12:30	Session 7 - Feedback
12:30-3:30	Session 8 - 3-D Unit Design and Wrap-up

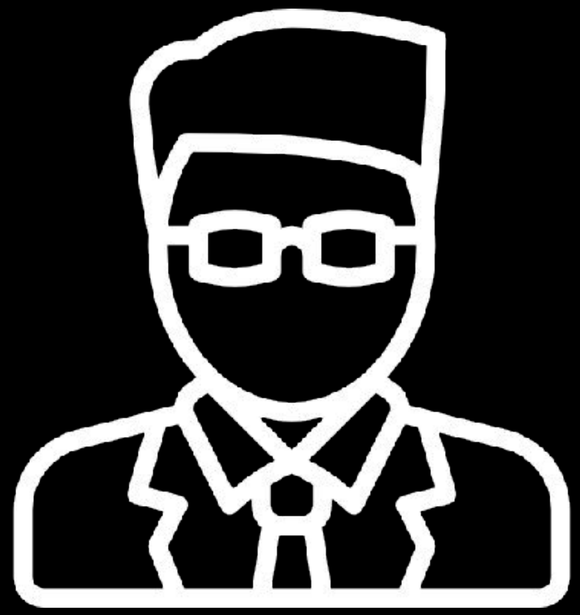
3-D Best Practice Assessment and Unit Design

Implementation Dip

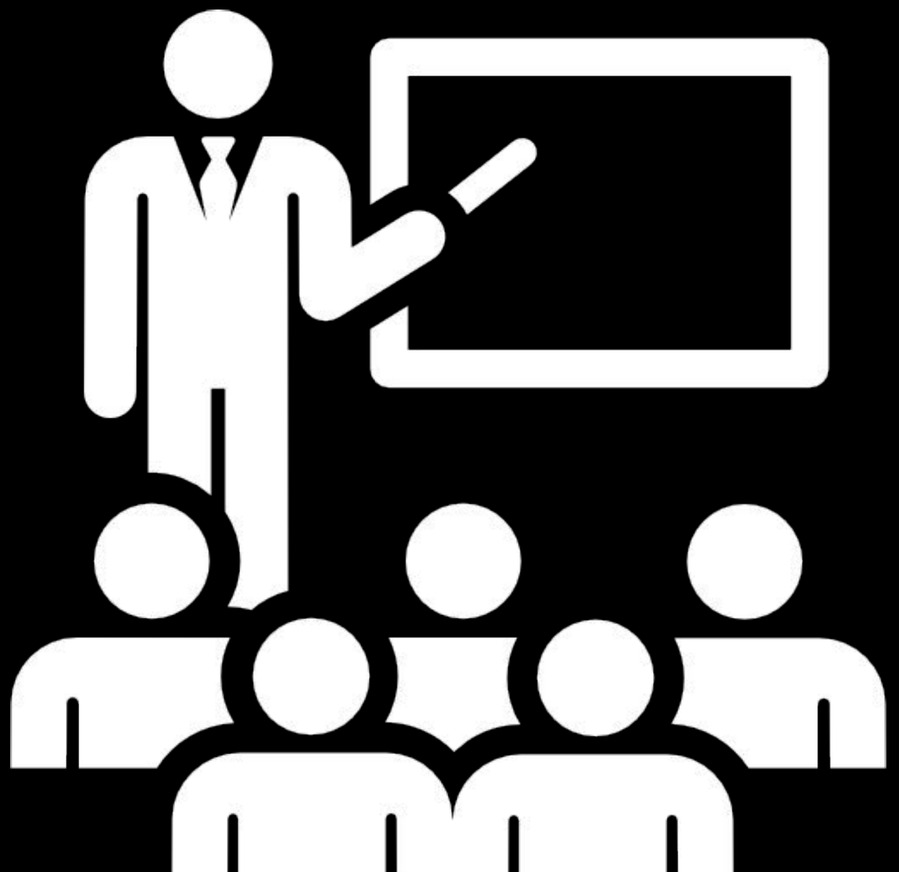


(Michael Fullan, 2006)

Teacher



Presenter



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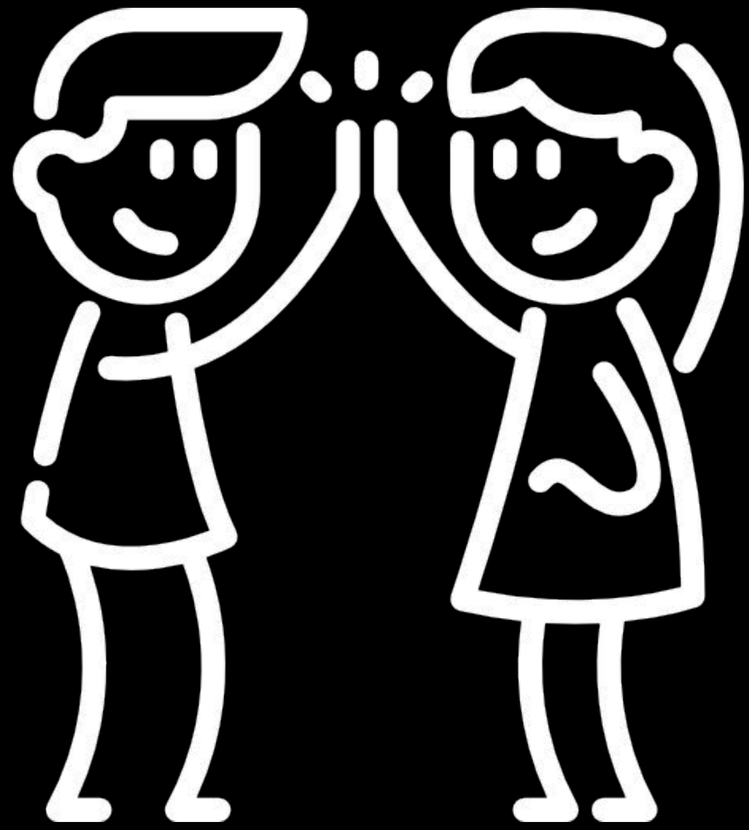
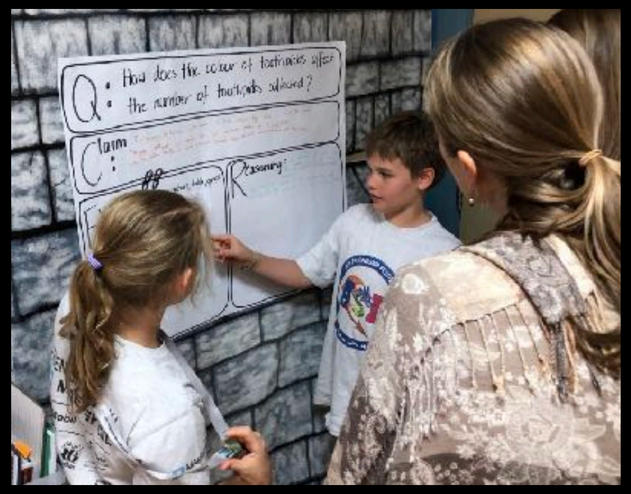
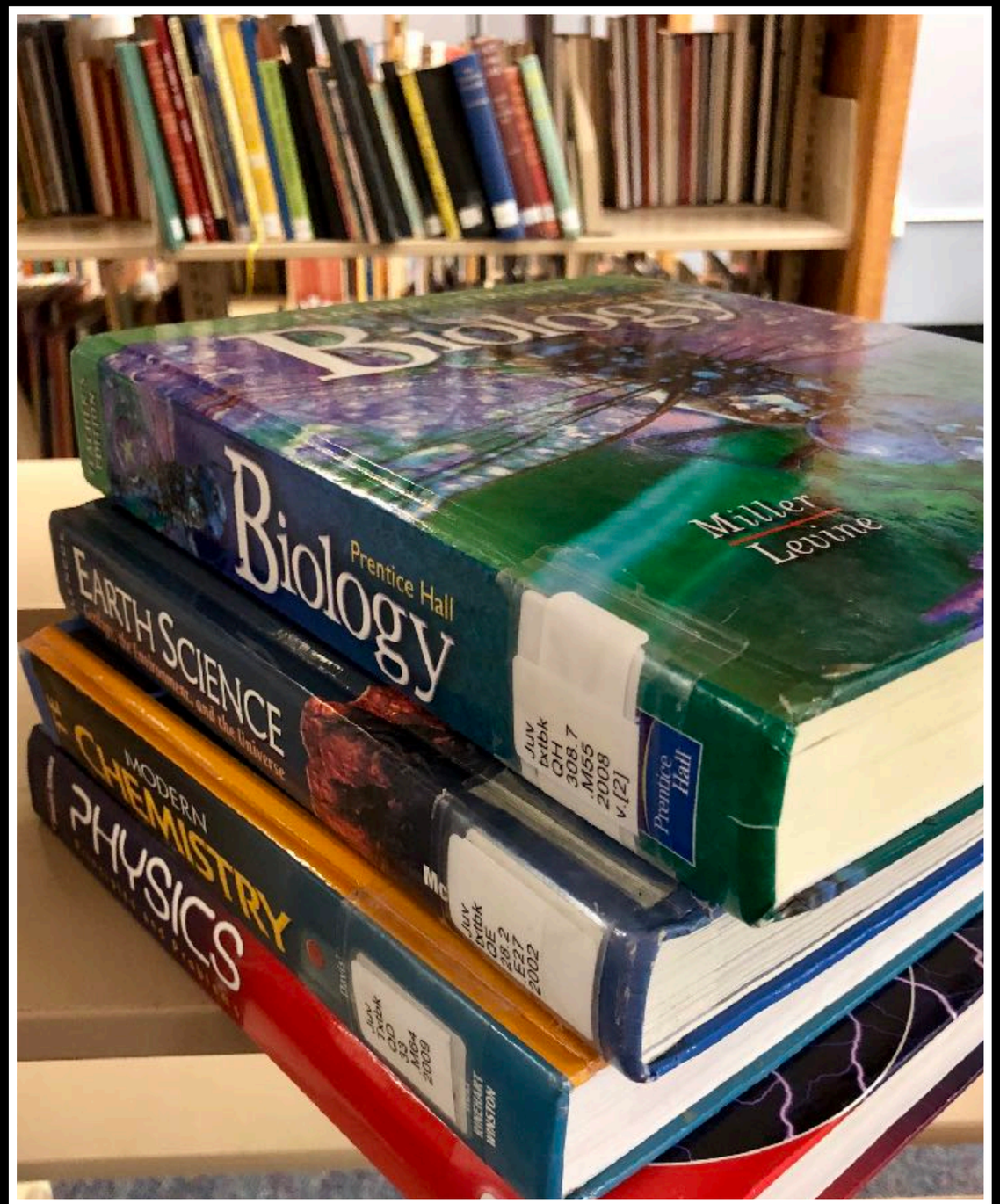


Three-Demensional Best Practice

Teaching Science

Doing Science





Science

- Life Sciences
- Physical Sciences
- Earth Space Sciences

Phenomenon

Life Sciences

Physical Sciences

Earth Space Sciences

What Students Learn

Phenomenon

Life Sciences

Physical Sciences

Earth Space Sciences

What Students Learn

Phenomenon

Engineering Technology

Life Sciences

Physical Sciences

Earth Space Sciences

What Students Learn

Phenomenon

Engineering Technology

Life Sciences

Physical Sciences

Earth Space Sciences

What Students Learn

Phenomenon Practices

How Students Learn

Phenomenon Practices

How Students Learn

Phenomenon Practices

How Students Learn

Asking Questions

Developing and Using Models

Planning and Carrying Out Investigations

Obtaining, Evaluating, and Communicating Information

Engaging in Argument from Evidence

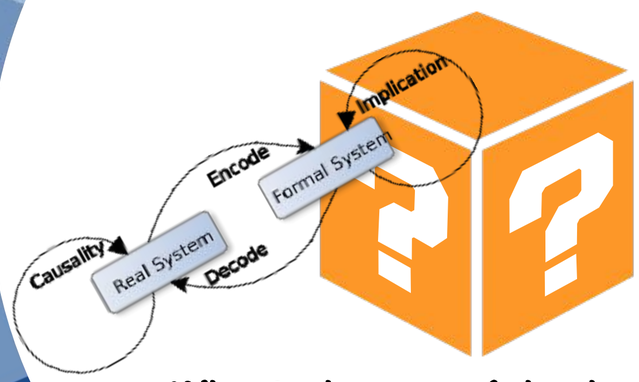
Constructing Explanations

Mathematics and Computational Thinking

How does it work?

Under what conditions will it fail?

How can I replicate the phenomenon?



What is the cause of the phenomenon?

What is the energy source?

Will it ever stop?

Phenomenon Practices

How Students Learn

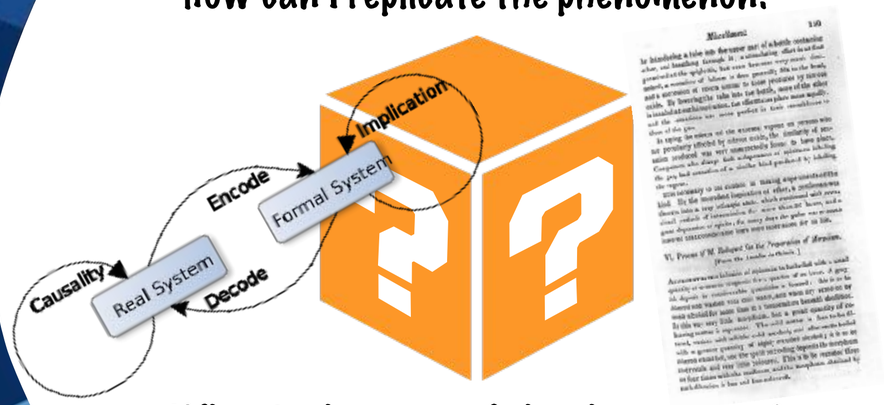
Asking Questions

How does it work?

Under what conditions will it fail?

How can I replicate the phenomenon?

Obtaining, Evaluating, and Communicating Information



Engaging in Argument from Evidence

What is the cause of the phenomenon?

What is the energy source?

Will it ever stop?

Constructing Explanations

Planning and Carrying Out Investigations

Analyzing and Interpreting Data

Mathematics and Computational Thinking

Phenomenon Practices

How Students Learn

Developing and Using **Models**

Planning and Carrying Out **Investigations**

Analyzing and Interpreting **Data**

Mathematics and Computational Thinking

Constructing **Explanations**

Engaging in **Argument** from Evidence

Obtaining, Evaluating, and Communicating **Information**

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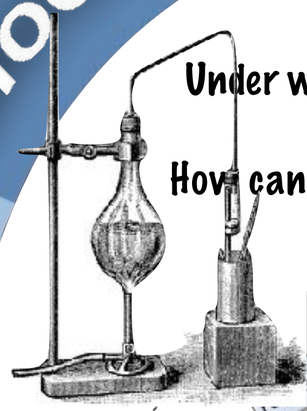
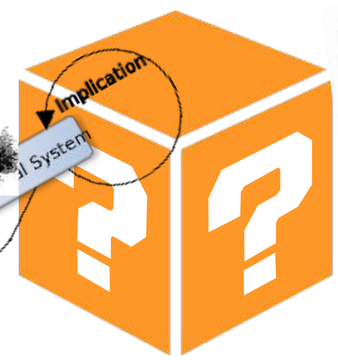




What is the cause of the phenomenon?

What is the energy source?

Will it ever stop?

Crosscutting
Concepts

Asking
Questions

Developing
and Using
Models

Planning and
Carrying Out
Investigations

Analyzing
Interp

Engaging in
Argum
from Evide

tructing
ations

Patterns

Scale
Proportion
Quantity

Stability
Change

Energy

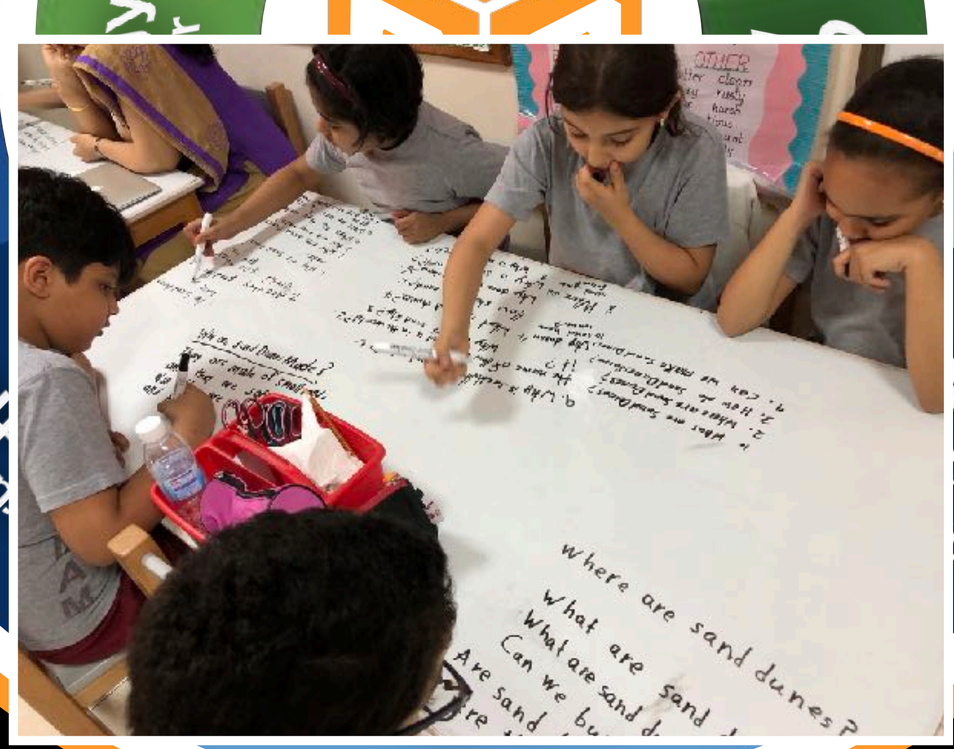
Cause

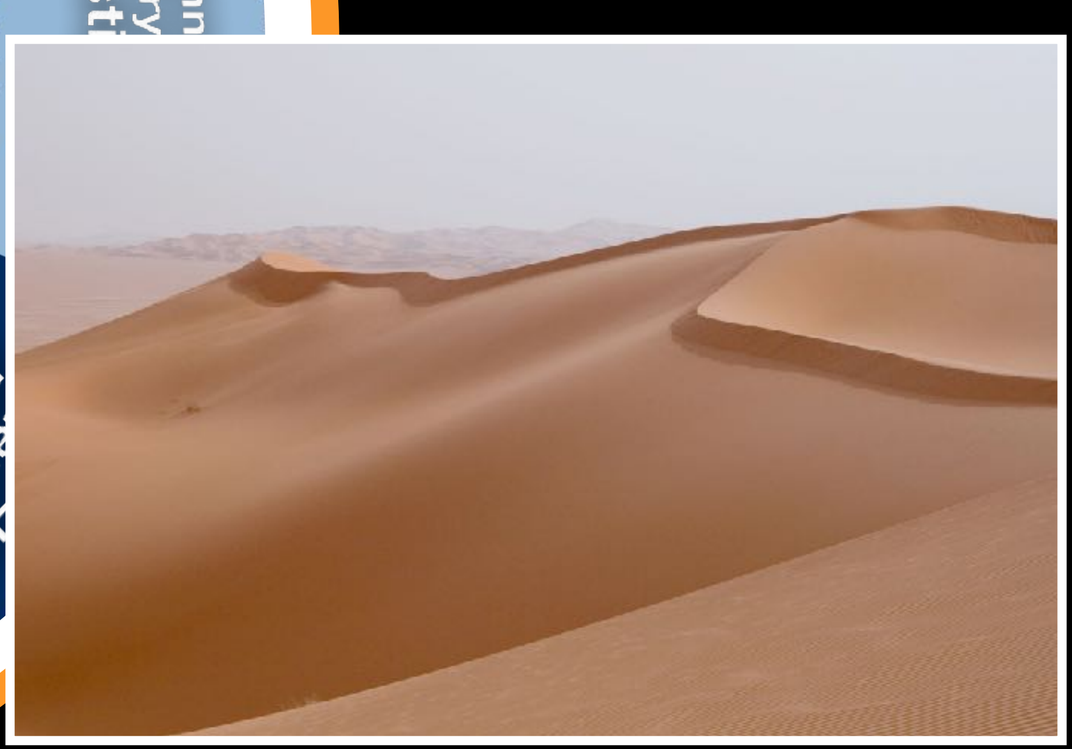
Three
Dimensional
Instruction

Phenomenon
Practices
Concepts

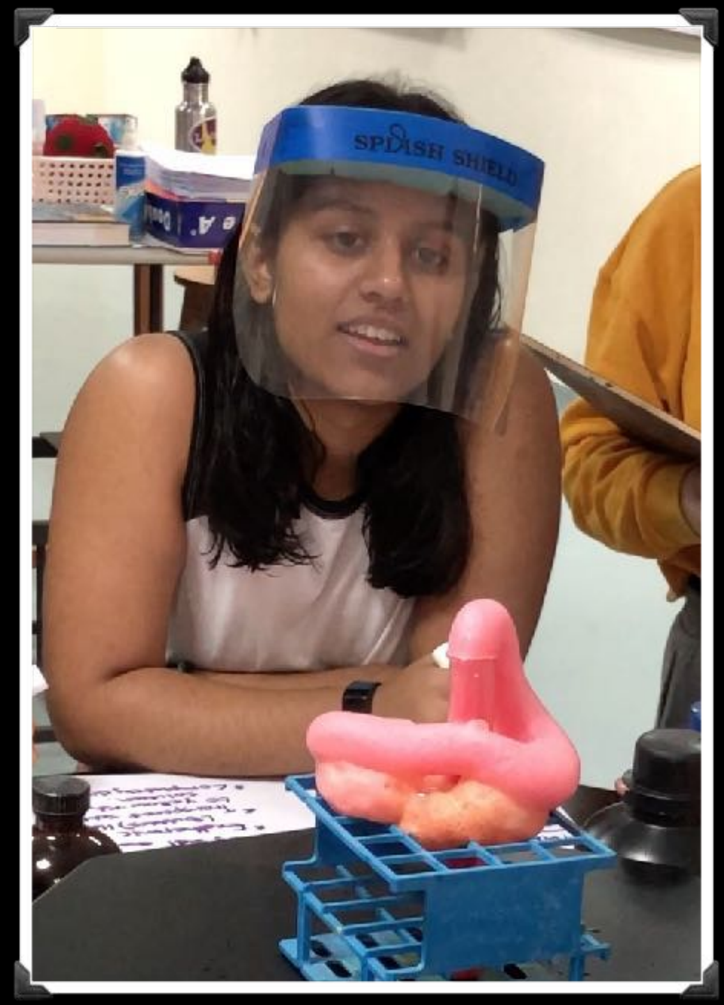
How Students
Think

Phenomenon
Practices
Concepts

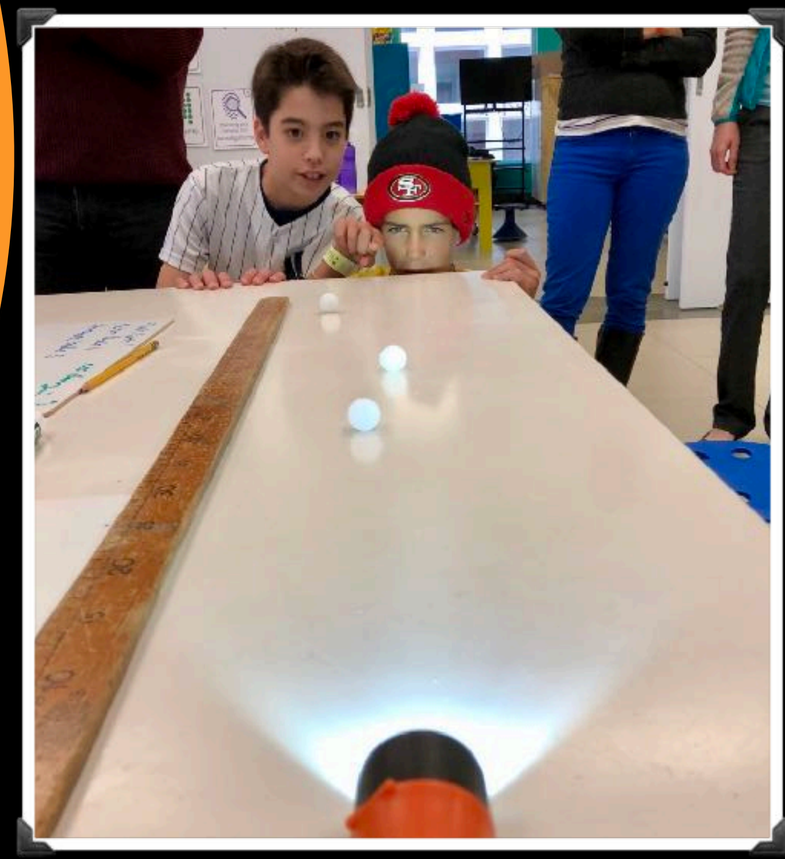




Phenomenon
Practices
Concepts



Phenomenon
Practices
Concepts



Engaging in **Argument** from Evidence

Constructing **Explanations**

Obtaining, Evaluating, and Communicating **Information**

Asking **Questions**

Developing and Using **Models**

Planning and Carrying Out **Investigations**

Analyzing and Interpreting **Data**

Patterns

Scale Proportion Quantity

Stability Change

Cause Effect

Structure Function

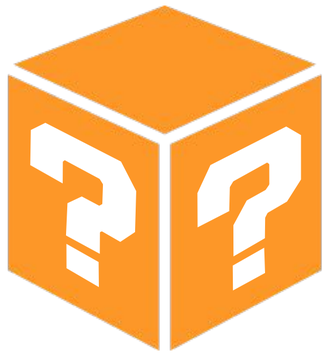
Systems System Models

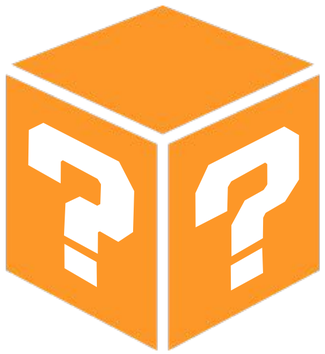
Energy Matter

Phenomenon
Practices
Concepts

Phenomenon
Practices
Concepts

Phenomenon



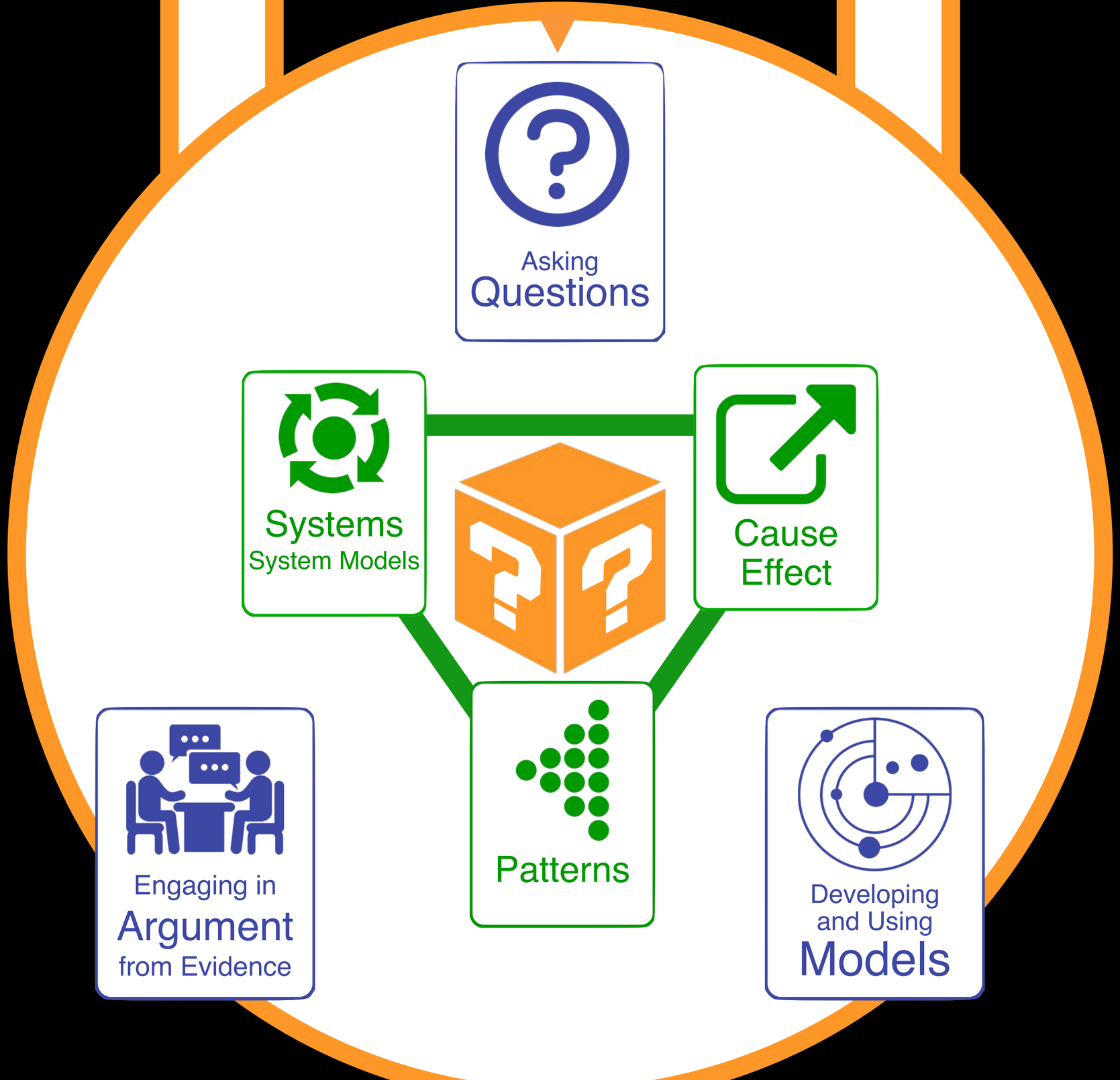


Phenomenon Practices

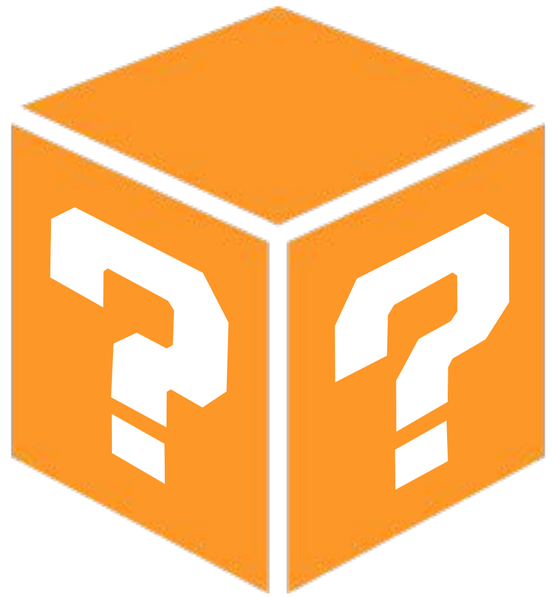
Phenomenon

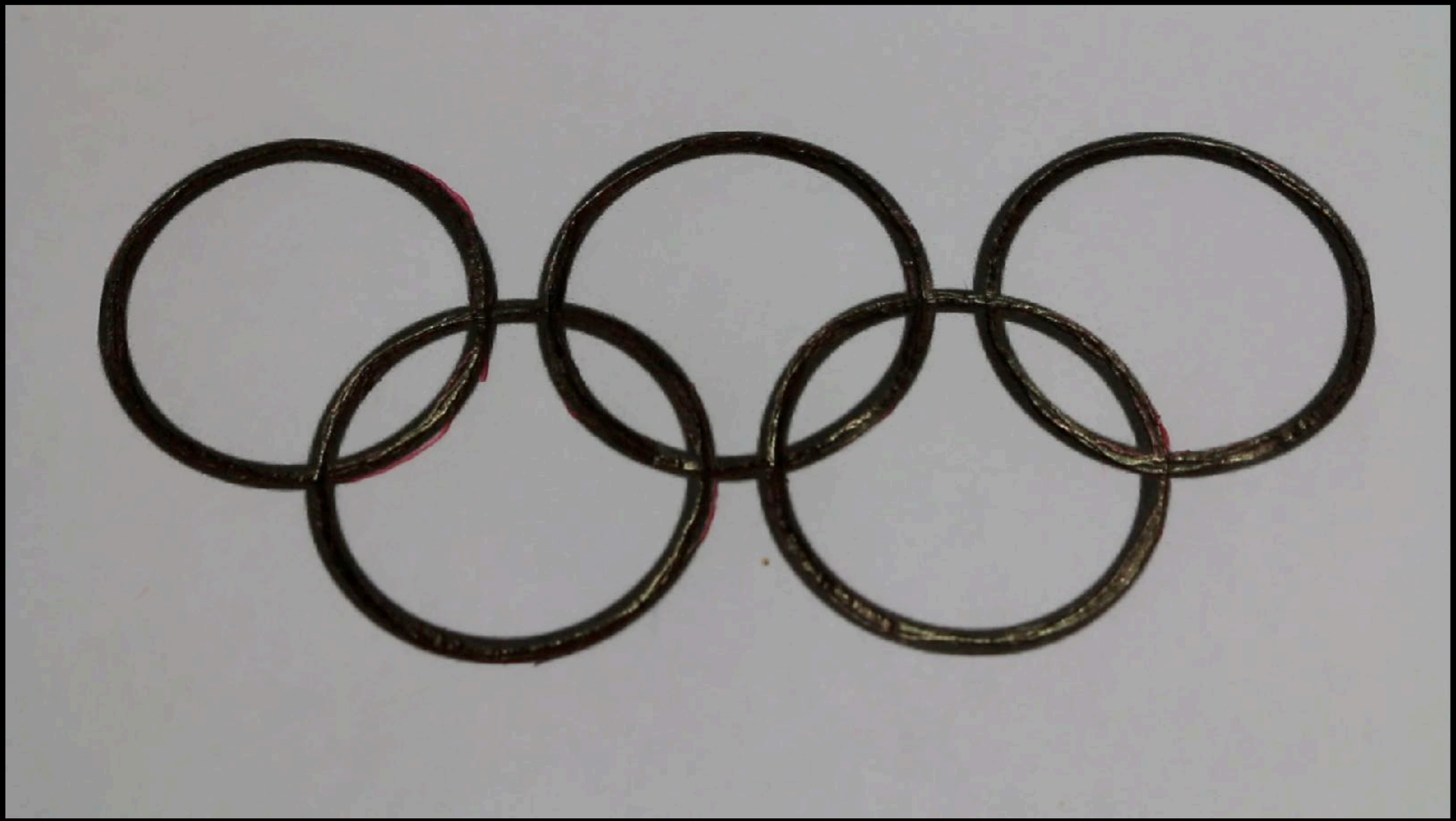
Practices

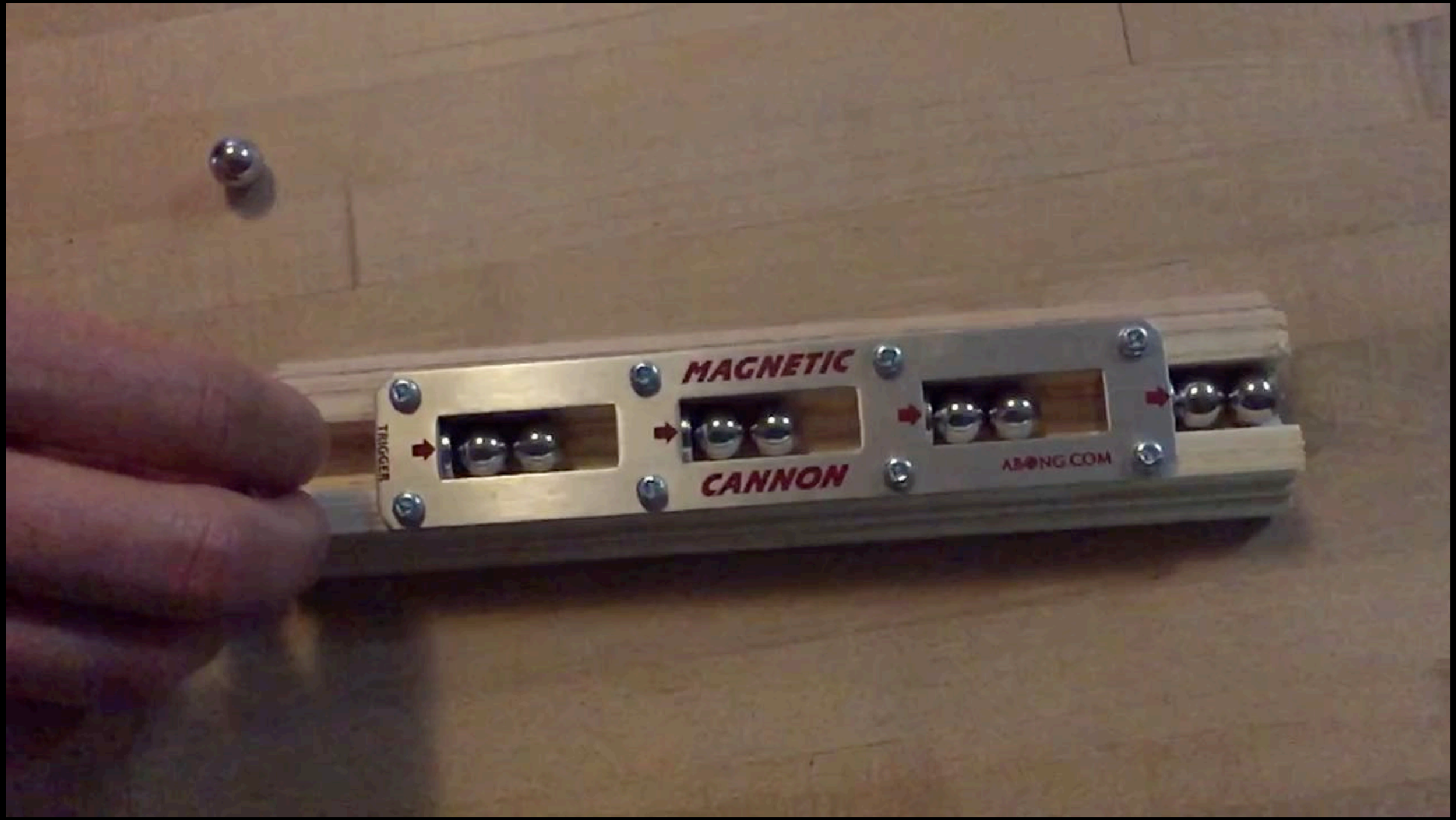
Concepts



Phenomenon



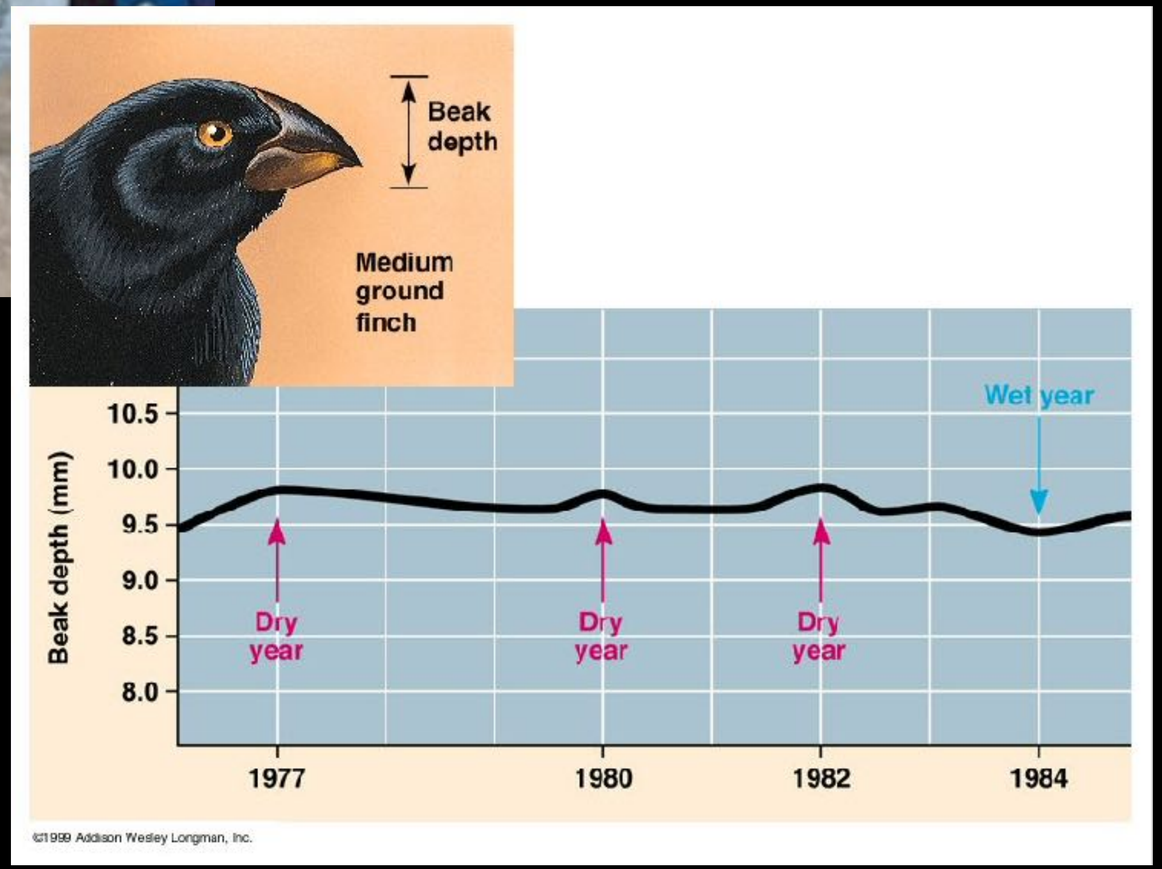


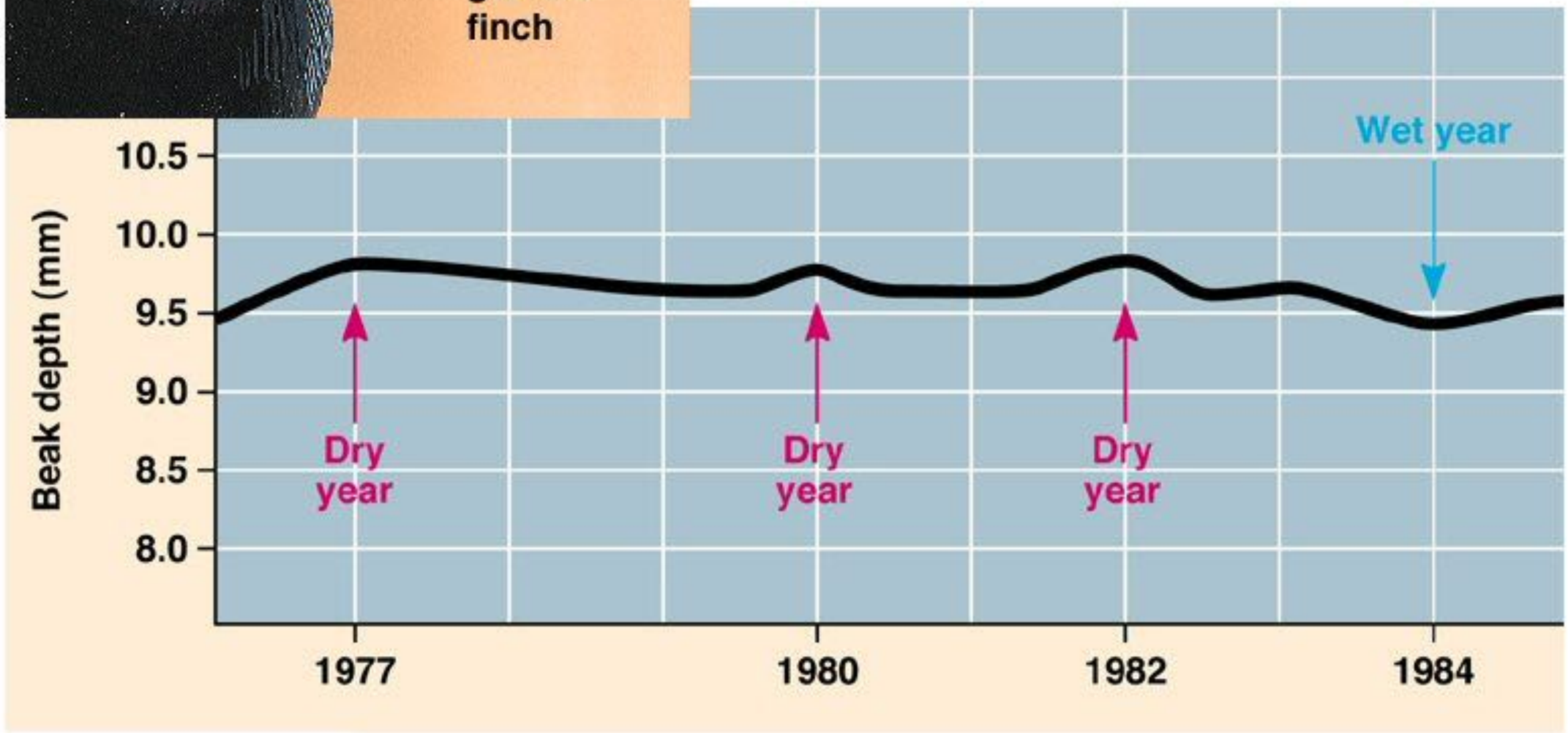

MAGNETIC
TRIGGER
CANNON
ABONG.COM

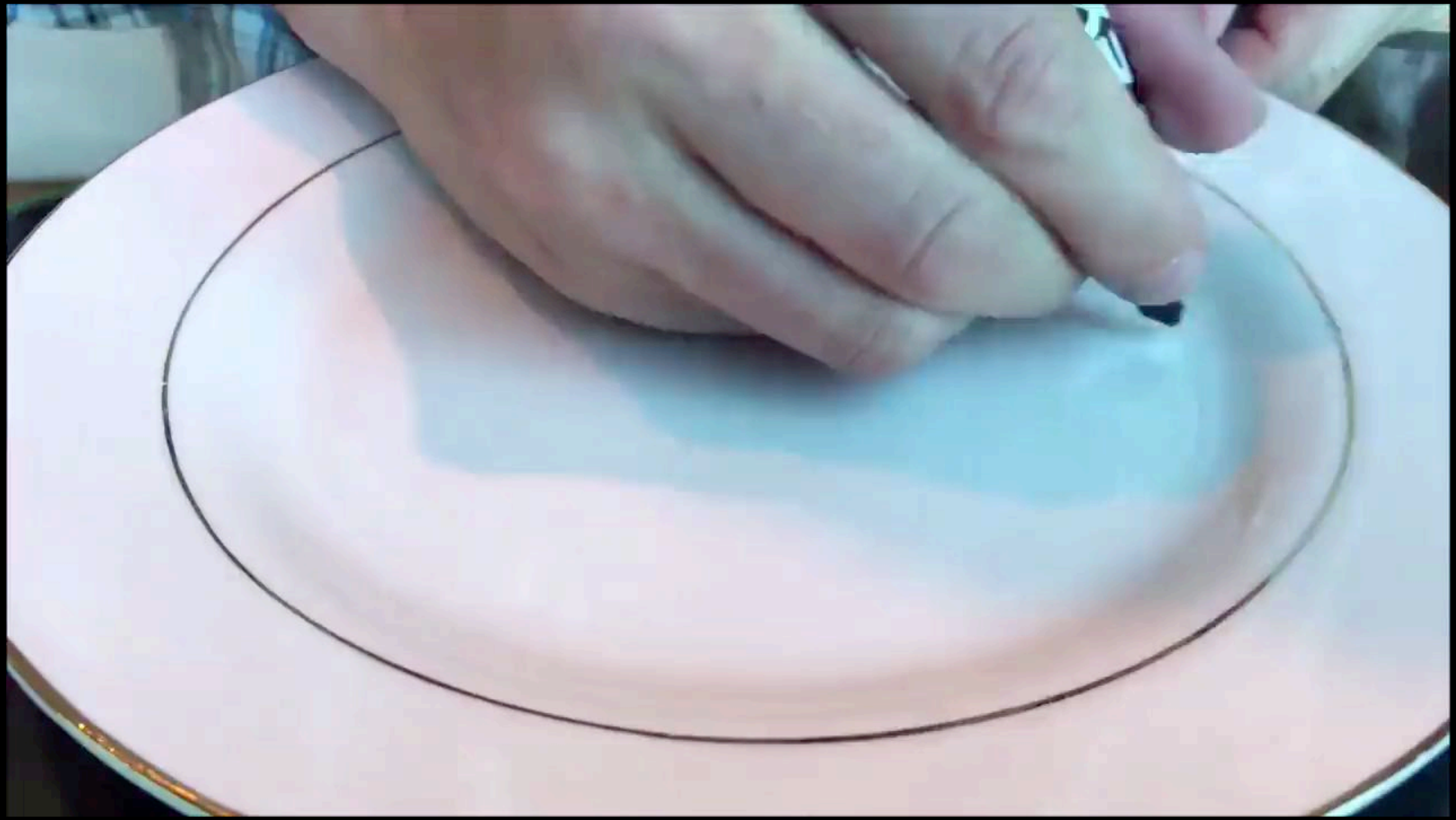
Night

Day


THINK







Research Question: How does ink color affect plate adhesion?

<u>Constraints</u>

1 plate

2 cups

Dry erase

Chemicals

Time

Research Question: How does ink color affect the ability to lift?

Research Question:
①

(Your question)

Claim:
④ (Answer the question)

Terms:
② (Define all the terms)

Evidence:
③
(Lab setup, observations and measurements)

Reasoning:
⑤
(Link the claim and evidence with a causal mechanism)

Explanation

Additional Questions:
⑥

Q: Do different liquids dissolve the pink marker ink?

16

Claim:

Pink marker ink only dissolves in Alcohol.

Terms:

Dissolve: when one material breaks down in a liquid.

Evidence:

	Dissolved	Did Not Dissolve
Alcohol:	X	
Water:		X
Salt water:		X

Reasoning:

Pink marker ink only dissolved in the Alcohol. Both the water and salt water lifted the pink marker off the plate but the dots drawn stayed intact.

Additional Questions:

Does this finding have to do with the polarity of the marker or Alcohol?

New York State Science Learning Standards

NEXT GENERATION SCIENCE STANDARDS

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3-D Best Practice Assessment and Unit Design

MS-LS1-2:

Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

MS-LS1-2: Cell Parts and Function

Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

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Science Practices

Developing and Using Models

Disciplinary Core Ideas

LS1.A: Structure and Function

Crosscutting Concepts

Structure and Function

MS-LS1-2: Cell Parts and Function

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Science Practices

Developing and Using Models

Disciplinary Core Ideas

LS1.A: Structure and Function

Crosscutting Concepts

Structure and Function

MS-LS1-2: Cell Parts and Function

Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

Science Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models	LS1.A: Structure and Function	Structure and Function

MS-LS1-2: Cell Parts and Function

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Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.

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EVIDENCE STATEMENT

Science Practices

Developing and Using Models

Disciplinary Core Ideas

LS1.A: Structure and Function

Crosscutting Concepts

Structure and Function

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a phenomenon, students develop a model in which they identify the parts (i.e., components; e.g., nucleus, chloroplasts, cell wall, mitochondria, cell membrane, the function of a cell as a whole) of cells relevant for the given phenomenon.	
2	Relationships		
	a	In the model, students describe the relationships between components, including:	
		i.	The particular functions of parts of cells in terms of their contributions to overall cellular functions (e.g., chloroplasts' involvement in photosynthesis and energy production, mitochondria's involvement in cellular respiration).
		ii.	The structure of the cell membrane or cell wall and its relationship to the function of the organelles and the whole cell.
3	Connections		
	a	Students use the model to describe a causal account for the phenomenon, including how different parts of a cell contribute to how the cell functions as a whole, both separately and together with other structures. Students include how components, separately and together, contribute to:	
		i.	Maintaining a cell's internal processes, for which it needs energy.
		ii.	Maintaining the structure of the cell and controlling what enters and leaves the cell.
		iii.	Functioning together as parts of a system that determines cellular function.
	b	Students use the model to identify key differences between plant and animal cells based on structure and function, including:	
		i.	Plant cells have a cell wall in addition to a cell membrane, whereas animal cells have only a cell membrane. Plants use cell walls to provide structure to the plant.
		ii.	Plant cells contain organelles called chloroplasts, while animal cells do not. Chloroplasts allow plants to make the food they need to live using photosynthesis.

MS-LS1-2: Cell Parts and Function

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EVIDENCE STATEMENT

Science Practices

Developing and Using Models

Disciplinary [illegible]as

LS1.A: Structure and Function

Cro[illegible] Concepts

Structure and Function

K-2	3-5	6-8	9-12
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences. • Develop and model to repr	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model — based on evidence – to match what happens if a variable or component of a system is changed.	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing m re va ar na • I lir m pr m or m

K-2	3-5	6-8	9-12
Students observe the shape and stability of structures of natural and designed objects are related to their function(s).	Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions.	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.

K-2	3-5	6-8	9-12
All organisms have external parts that they use to perform daily functions.	Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction..	All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

Assessment and Unit Design

Storyline

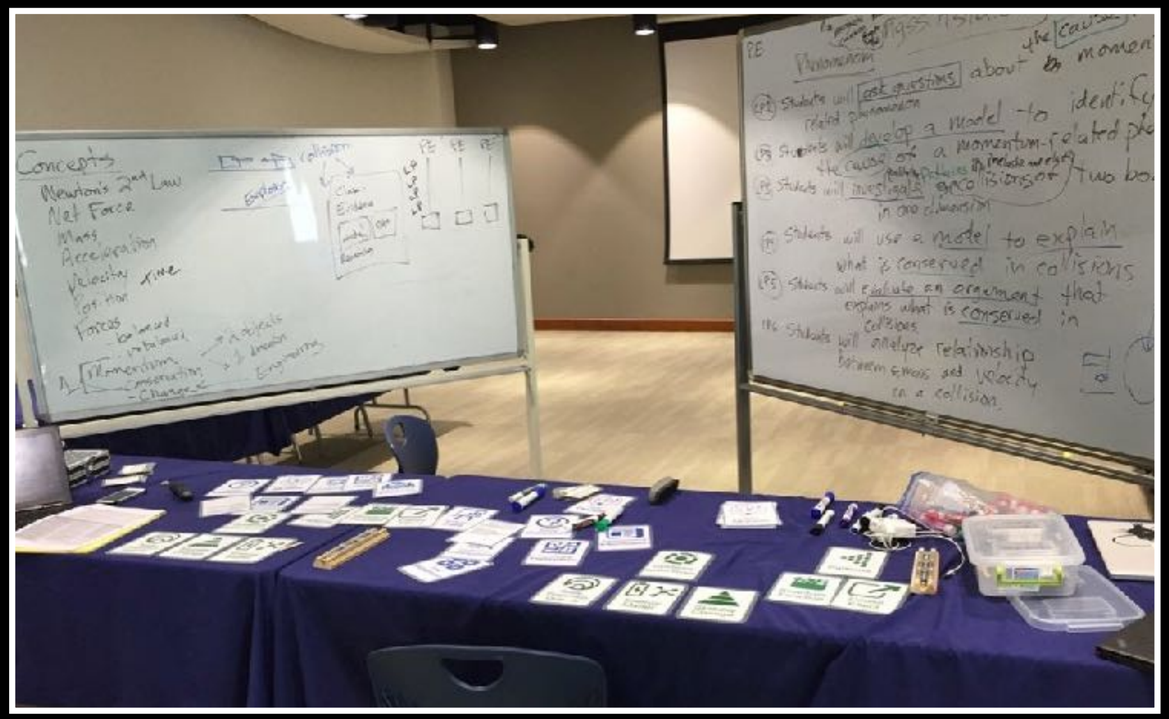
3D Unit Design:

Building an NGSS Unit with Learning Performances

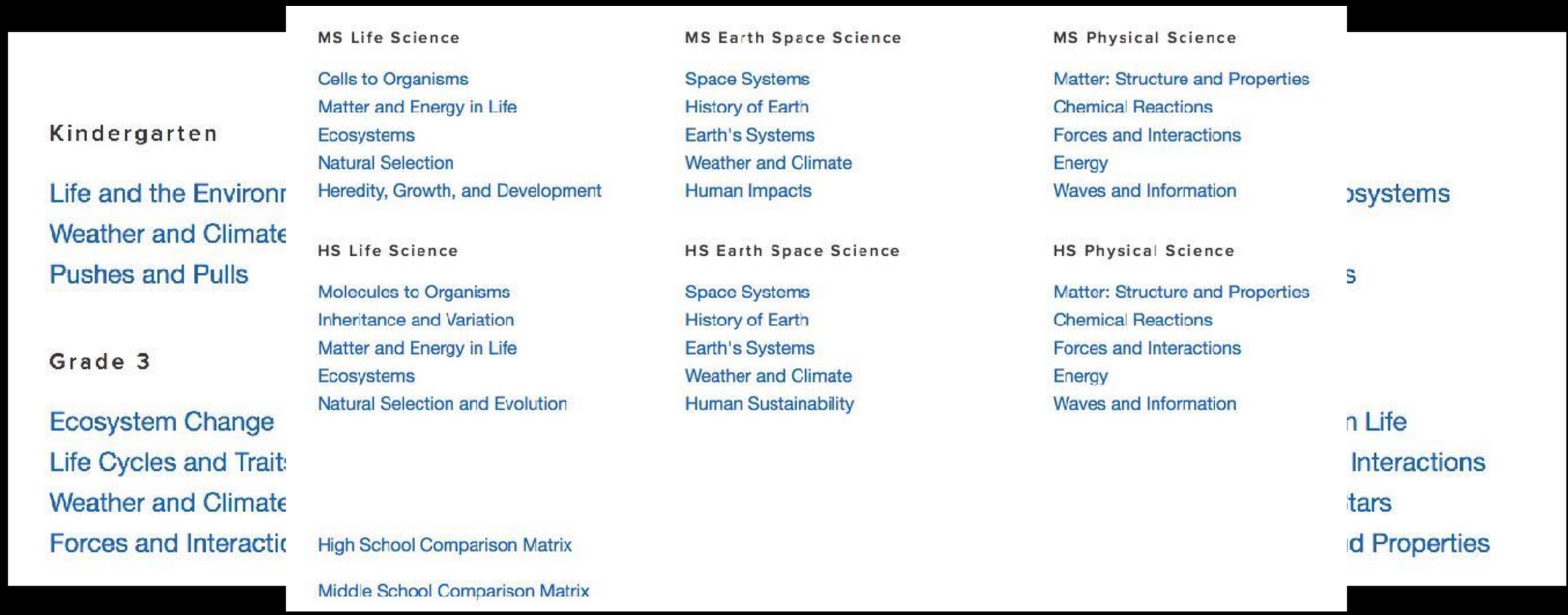
Materials:

Teachers
NGSS 3-D Planning Cards
Chart Paper or Whiteboards

Time



Identify all standards within the unit.



MS Life Science

Cells to Organisms
Matter and Energy in Life
Ecosystems
Natural Selection
Heredity, Growth, and Development

MS Earth Space Science

Space Systems
History of Earth
Earth's Systems
Weather and Climate
Human Impacts

MS Physical Science

Matter: Structure and Properties
Chemical Reactions
Forces and Interactions
Energy
Waves and Information

HS Life Science

Molecules to Organisms
Inheritance and Variation
Matter and Energy in Life
Ecosystems
Natural Selection and Evolution

HS Earth Space Science

Space Systems
History of Earth
Earth's Systems
Weather and Climate
Human Sustainability

HS Physical Science

Matter: Structure and Properties
Chemical Reactions
Forces and Interactions
Energy
Waves and Information

High School Comparison Matrix

Middle School Comparison Matrix

Kindergarten

Life and the Environr
Weather and Climate
Pushes and Pulls

Grade 3

Ecosystem Change
Life Cycles and Trait
Weather and Climate
Forces and Interactic

osystems
s
n Life
Interactions
tars
d Properties

Step 1

Build an
Anchor Chart

Conceptual model

Visual representation of concepts

For teachers - Not students

Build an Anchor Chart

LS1

From Molecules to Organisms

Vocabulary

Plant cells

Animal cells

Cell parts (structures)

- Nucleus
- Chloroplast
- Mitochondria
- Cell membrane
- Cell wall

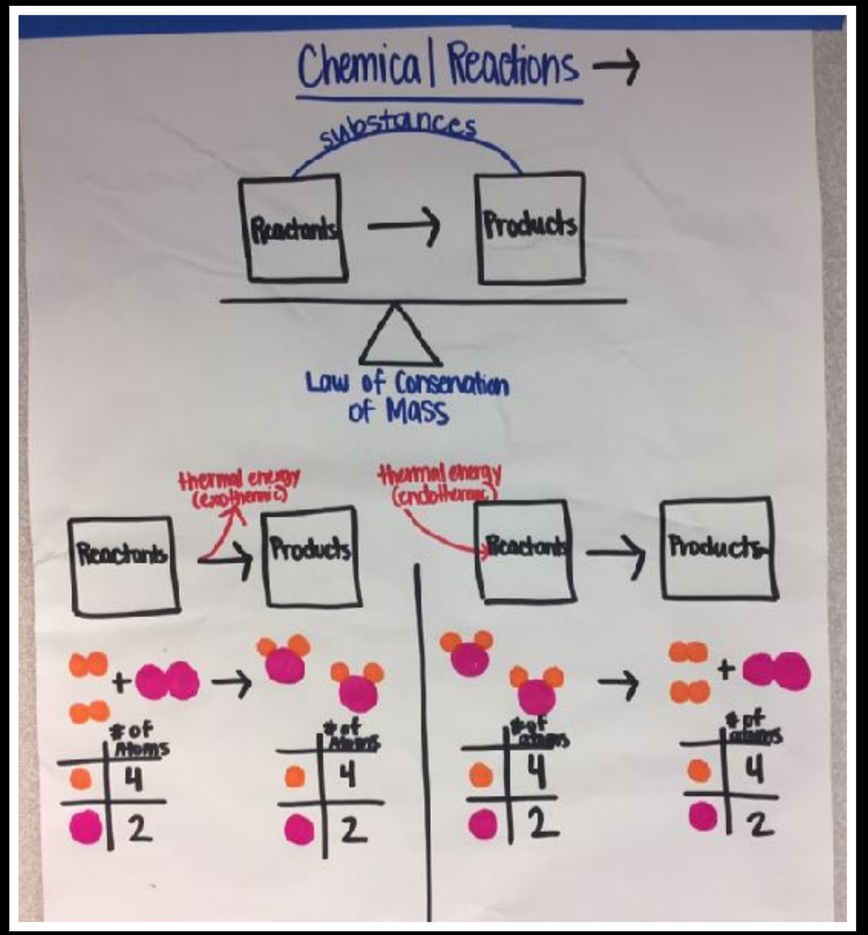
Cell function

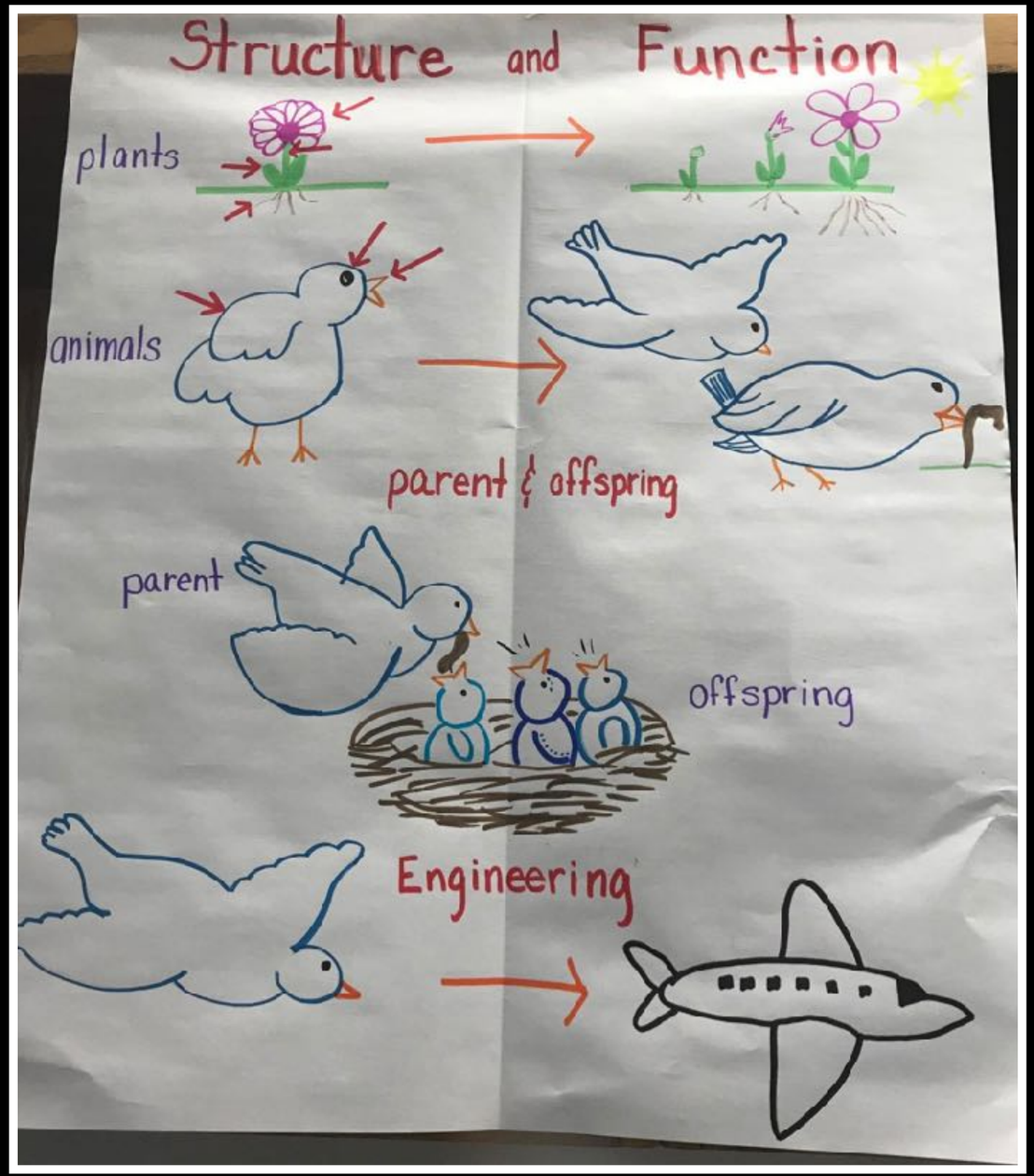
Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (Structure and Function)

Structure Function

Step 2

Anchor Chart





Step 2

Anchor Chart

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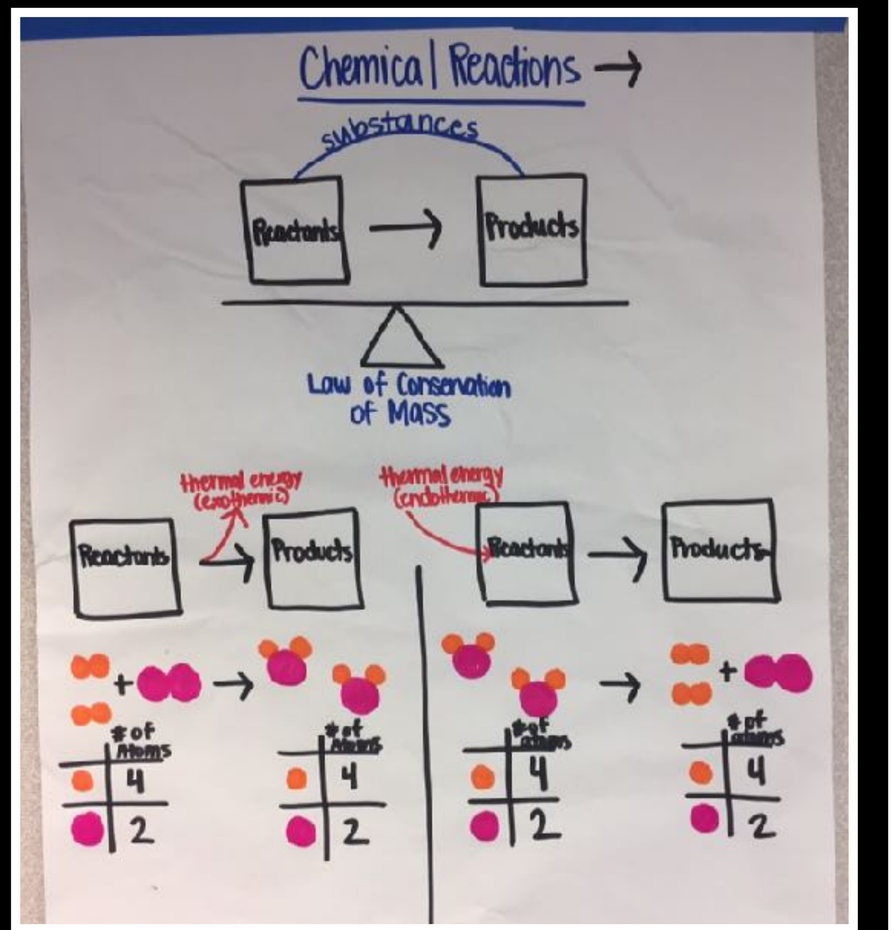
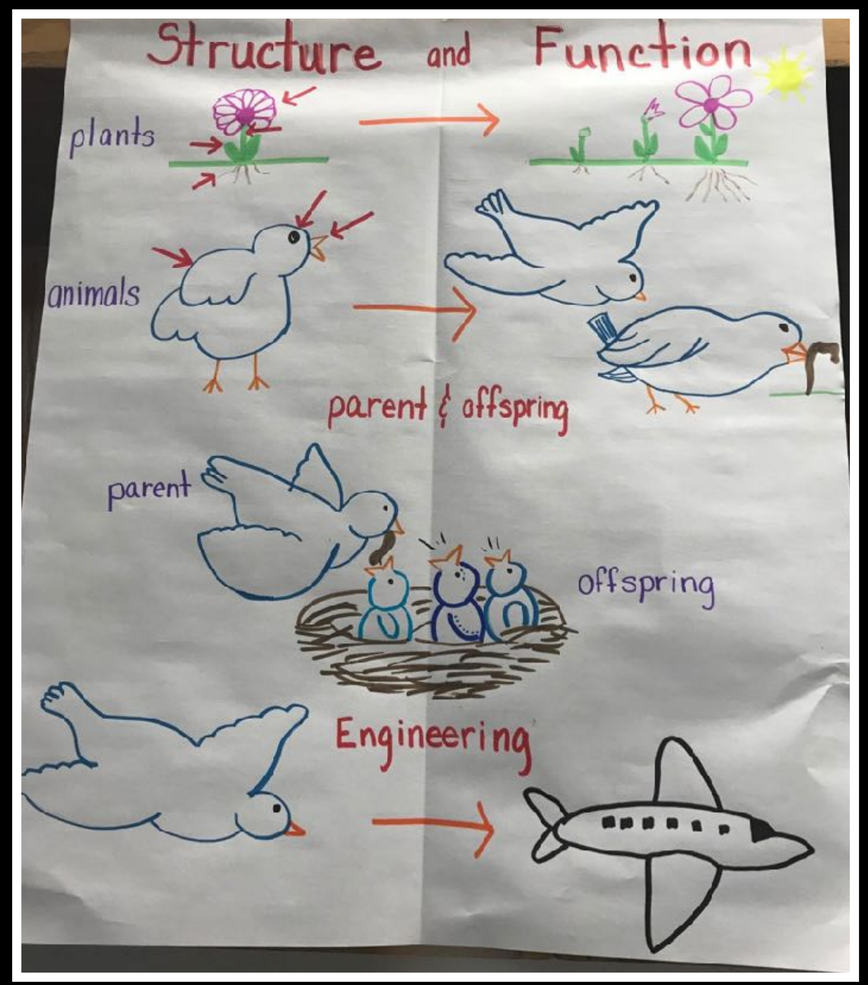


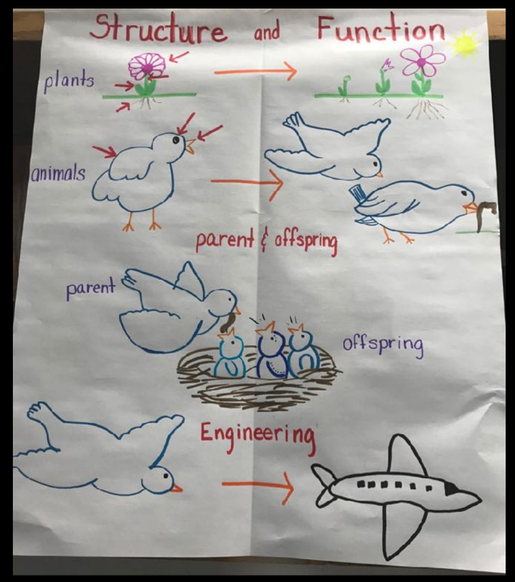


Identify 1-2
Enduring Understandings
Essential Questions

Step 3

Rename the Unit

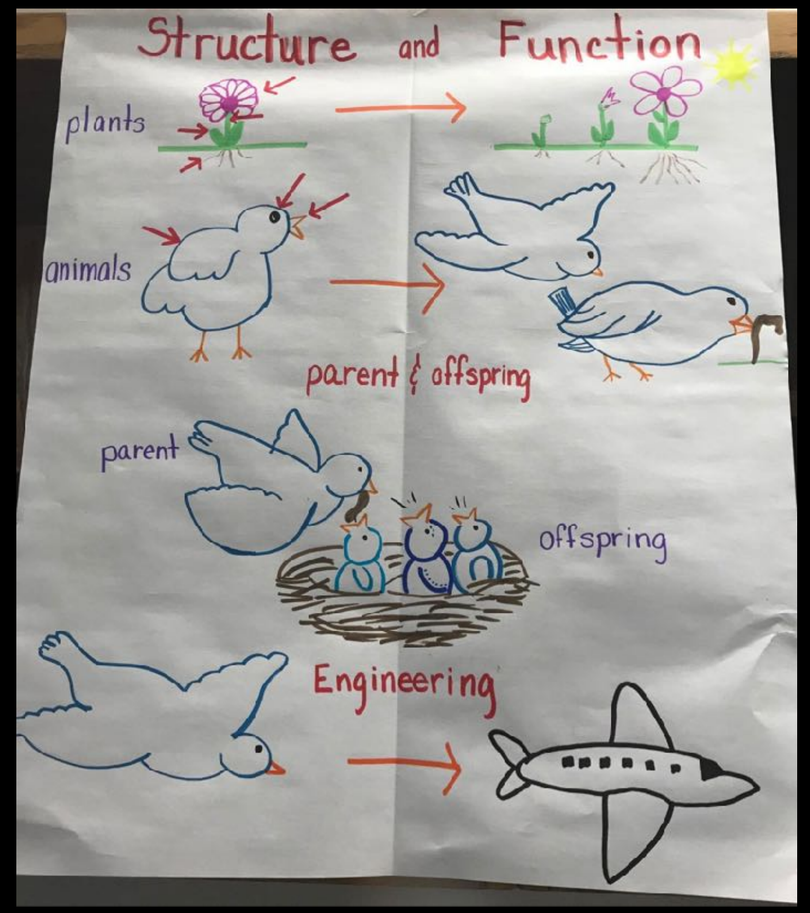
to reflect the heart of the learning ↘



Step 4

Determine the Order

strategically



Don't think like a science teacher

Step 5

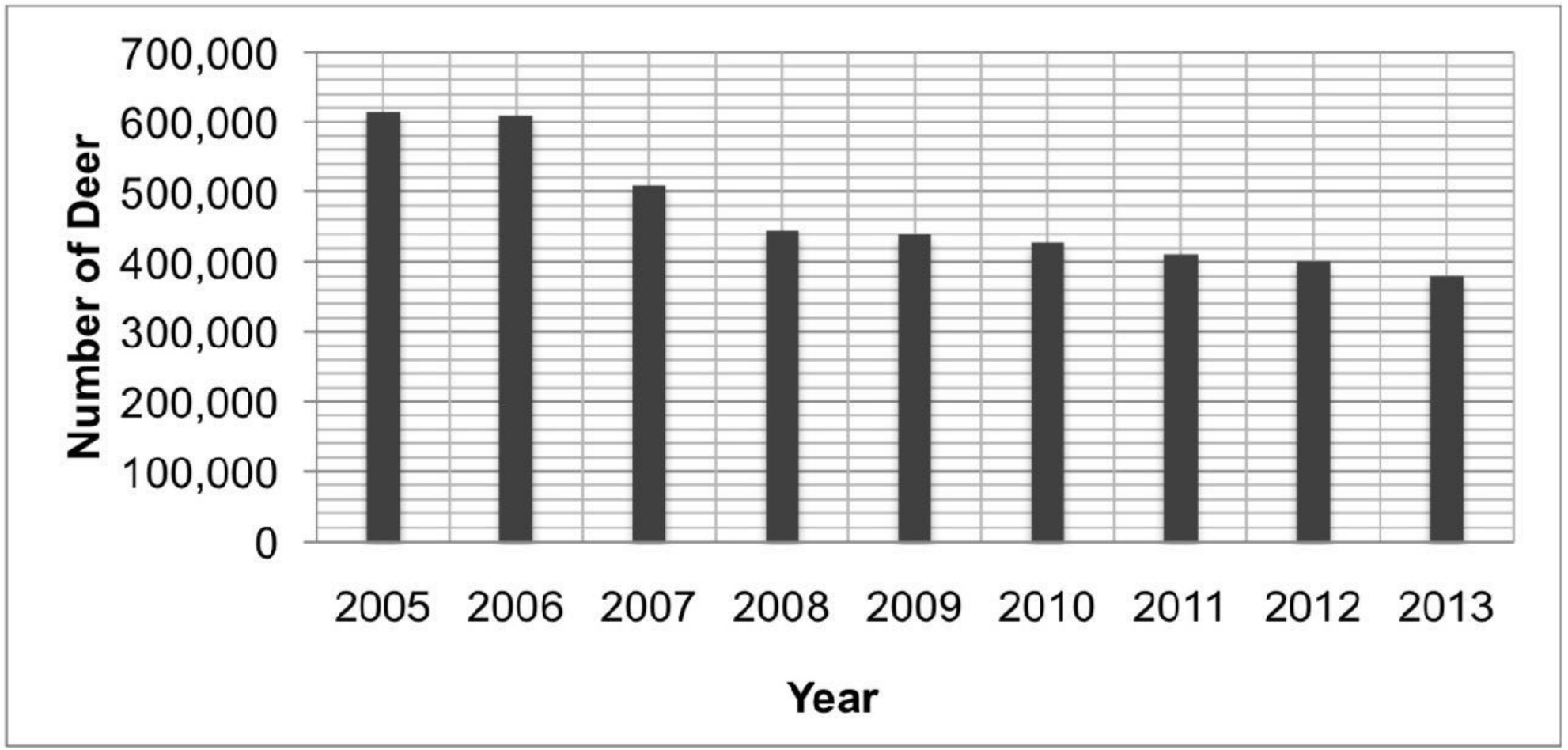
Review or Create Exemplar Assessments

Step 6

Introduction

Scientists have noticed a big change in the number of deer in Colorado. They have collected a lot of data related to this change. In this task you will look for patterns in the data and identify the possible causes for the change in the number of deer in Colorado.

Figure 1: Change in Number of Deer in Colorado from 2005 to 2013



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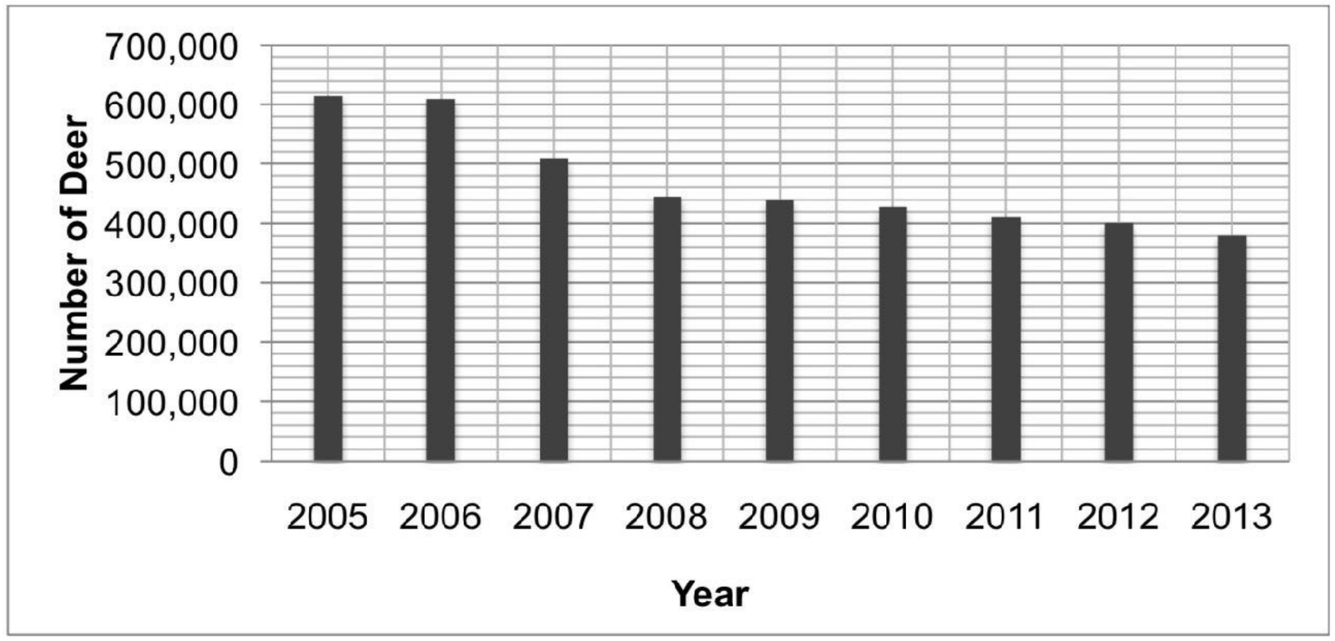

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   - Describe what is happening to the deer population.
   - Use numerical data from the graph to support your answer.

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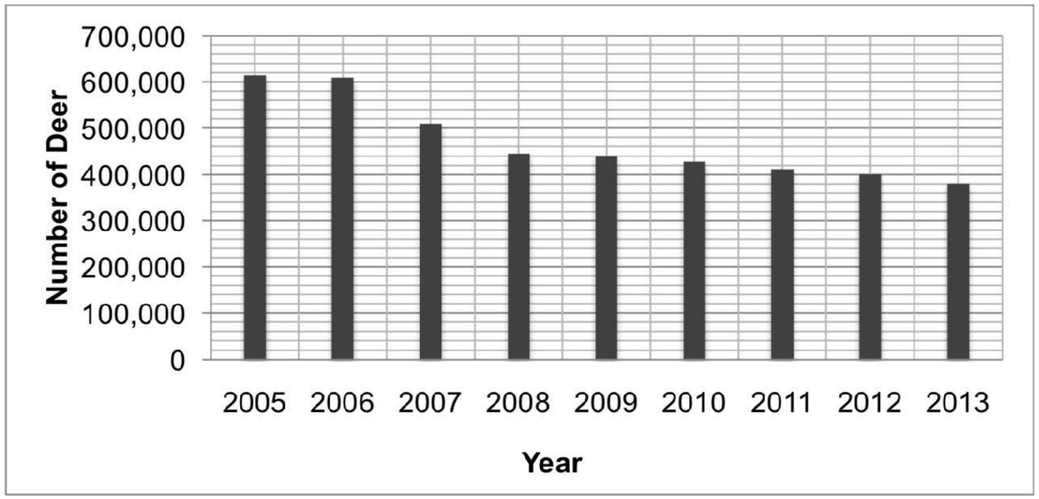

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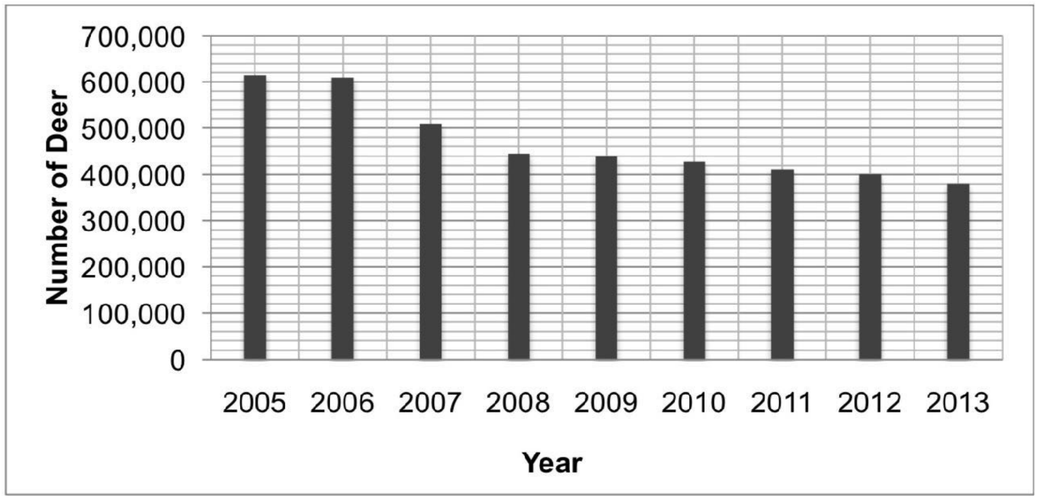

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Scientist measured the amount of rainfall each year and made the following graph.

- Look at the graph.
- Use numerical data from the graph to describe any patterns you observe.
- Record your answer on the Question 3 table for Figure 2.

Figure 2: Yearly Rainfall in Colorado from 2003 - 2012

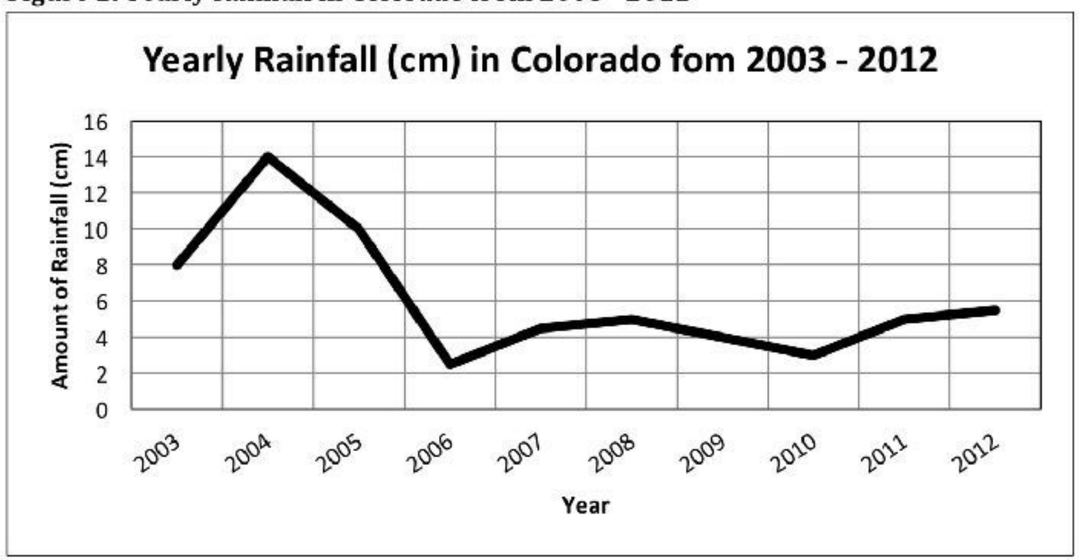


Figure 3: Amounts of Two Types of Grasses in Colorado

Type of Grasses	Year 2005 (square miles)	Year 2008 (square miles)	Year 2010 (square miles)	Year 2013 (square miles)
Cheatgrass	41,000	52,000	61,000	66,000
Sagebrush	185,000	140,000	110,000	100,000

Scientists have evidence that:

- Deer can only eat a native grass called Sagebrush. Sagebrush has always grown in Colorado.
- Elk can eat Sagebrush and Cheatgrass. Cheatgrass was introduced to Colorado from Europe and is an invasive species.

Sagebrush

Cheatgrass

3. Look at each figure (table or graph) on the next four pages. Describe the patterns you see in the data and predict a possible cause for the change in the deer population. Be sure to include numerical data from the figure to support your answer.

Figures	What patterns do you see?	Make a prediction for a possible cause for the change in deer population.
Figure 2: Yearly Rainfall		
Figure 3: Amounts of		

Performance Assessment Writing

Performance Assessment

Short (<30 minutes)
End of lesson sequence
New phenomenon
Authentic situation
Three dimensional
Rigorous

Identify performance expectations

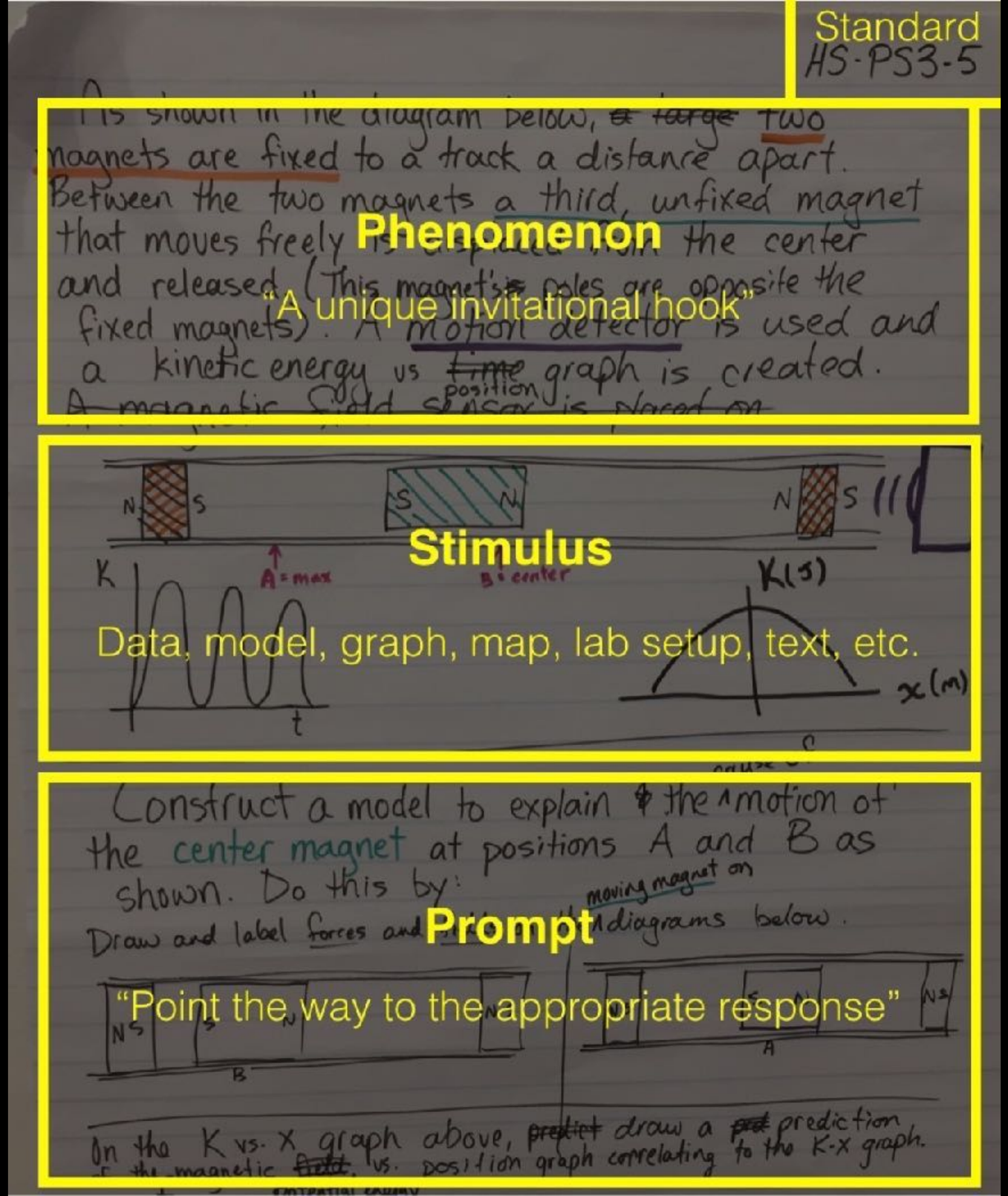
LS1

From Molecules to Organisms

Developing and Using Models

Structure Function

Develop task



Short (<30 minutes)

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New phenomenon

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Three dimensional

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Developing and Using **Models**

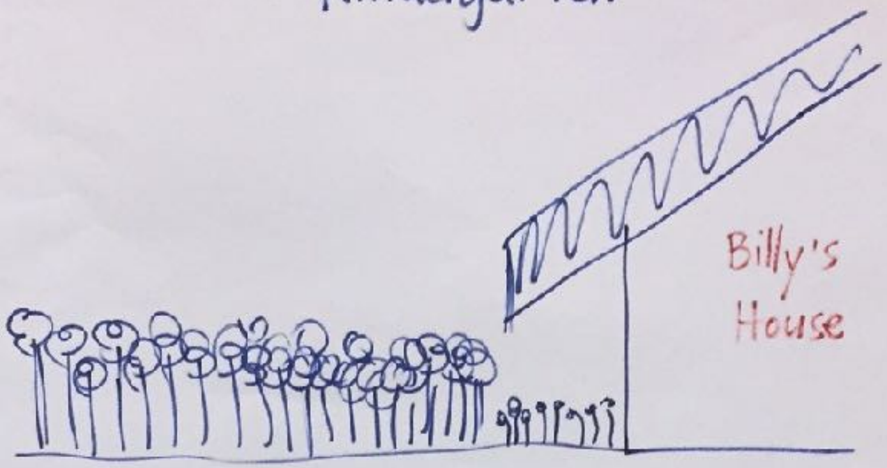
LS1

From Molecules to Organisms

Structure Function

SNAP Deer Activity

Grade Level: Kindergarten



Here is a picture of Billy's garden when he comes back from a long vacation. Some of Billy's plants are growing well and some aren't.

1. Circle the plants that are growing well.
2. Why are they growing well even though Billy was away and no-one was around to take care of them?
3. How did the plants get what they needed to grow? Draw your answer.
4. What can Billy do for the plants that aren't growing well? Explain how this will help.

Here Comes the Sun

K-ESS2-1

Phenomenon: weather conditions

We have been keeping track of weather conditions this month. Look at our calend decide which weather occurred most and least.

August

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Show me your work

Most

Least

What type of clothing would you need the most of for the month?

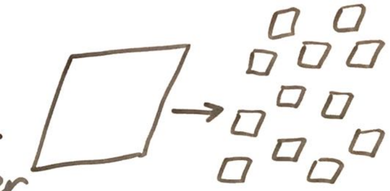
MS PS1-2 : Physical & Chemical Change

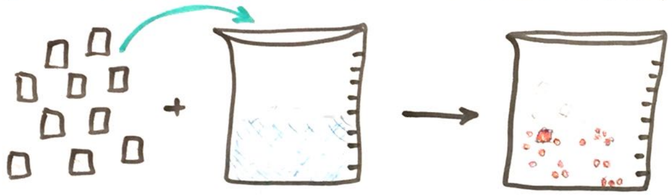
Sheila and Jerome are lab partners in science class. They have the following materials at their bench:

- 1 SQUARE of ALUMINUM FOIL
- 1 BEAKER of WATER
- 1 STIR ROD
- 1 SCOOP BLUE Copper II chloride SALT

Jerome adds all of the salt to the water and stirs. The crystals disappear and the liquid turns a clear blue.

Sheila tears up the foil into small pieces. Jerome dares her to toss them into his beaker.





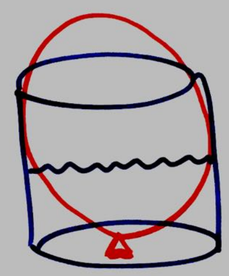
They see the edges of the foil pieces turn a rusty-orange color. As they stir, the beaker becomes warm to the touch and vapor rises from the surface of the liquid. Within a few minutes, the foil has disappeared and the liquid is now clear. The rusty-orange flakes are throughout the liquid.

Jerome claims that when the salt was added to the beaker changing it blue and when the foil changed to rusty-orange were examples of CHEMICAL CHANGES. Sheila disagrees. She says one is a PHYSICAL CHANGE and the other is a CHEMICAL CHANGE. Sheila also tells Jerome there are more than one example of each. PROVIDE EVIDENCE FROM THEIR OBSERVATIONS THAT SUPPORT SHEILA'S CLAIM.

MS PS1-4 Kinetic Theory - Thermal Energy

Billy placed a partially inflated balloon in a beaker containing hot water and watched the balloon get larger. When he removed the balloon from the beaker, the balloon slowly returned to its original size.

ORIGINAL BALLOON at Room Temperature



Beaker with hot water

(a) Construct a model to explain the phenomenon observed.

MODEL

(b) Predict what would happen when the room temperature balloon is then placed in ice water.

(c) Construct a model that aligns with your prediction.

(d) State a claim that relates particle motion to thermal energy using evidence from the scenario.

HS LS1-1 Central Dogma

Central Dogma (DNA to proteins)

Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

HS LS1-1

Cystic Fibrosis is a genetic disorder resulting from non-functioning transport channel found in the cellular membrane of certain cells. As a result these cells become coated in a thick mucous which leads to bacterial infections and illness.

The following sequence of DNA bases is a part of the code for the protein that acts as the transport channel.

ATGCAGAGGTCG

Determine the sequence of amino acids that could be produced from this series of bases.

Should students have an alternate sequence to consider on the disease sequence

Attach codon chart here

Use evidence to support a claim that a change in this protein would affect some cells in the body while other cells are unaffected. Explain your reasoning.

Grade Level: HS ESS3-1 Earth + Human Activity

Intro: Superstorm Sandy made landfall in NJ on Oct. 29, 2012, as a post tropical cyclone. The large storm's reach impacted Long Island's coastal areas as well. The effects of storms can be amplified as the astronomical tides are influenced by the moon's phases. During Sandy, the moon was in a full moon phase.

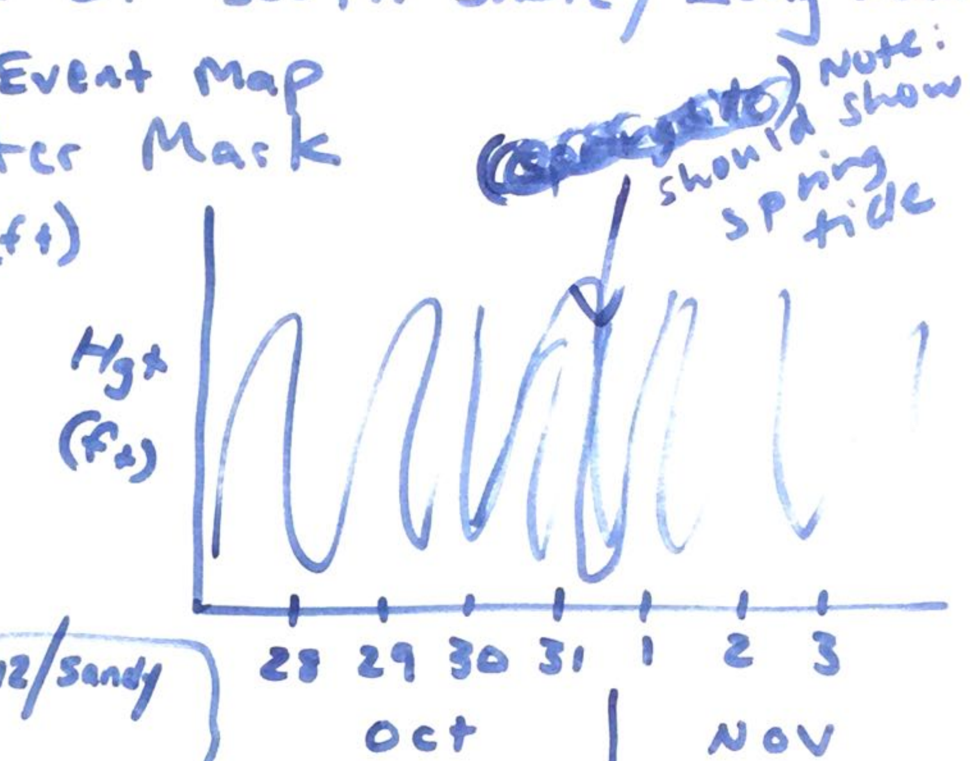
Insert 1: Topo map or DEM of South Shore/Long Beach

Superstorm Sandy Flood Event Map

Insert 2: Data Table High Water Mark

Location	Elevation (ft)
Lindenhurst	6.6
E. Massapequa	7.5
Heckscher State Park	5.7
Long Beach	12.7

Source water.usgs.gov/floods/events/2012/sandy/sandymapper.html



Source from tidesandcurrents.noaa.gov

Natural Resources, Natural Hazards, and Humans

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS ESS3-1

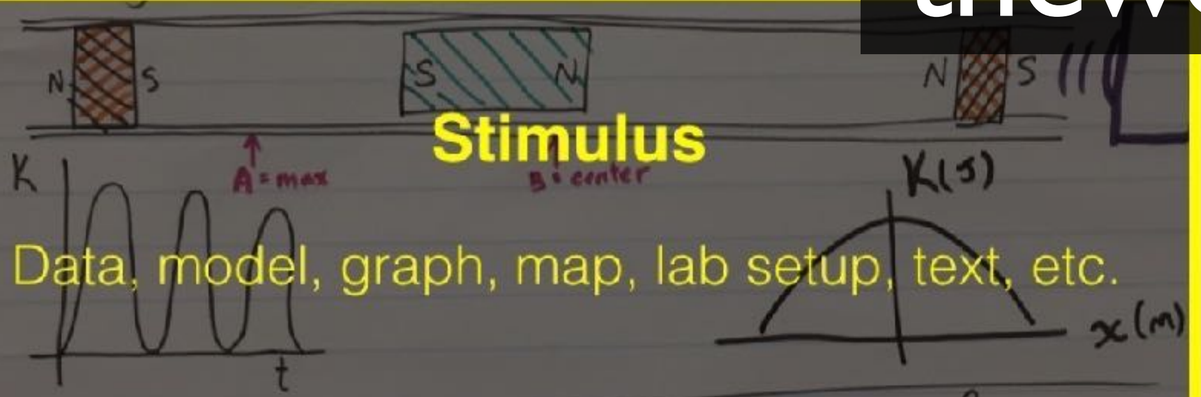
1. A hurricane is approaching L.I. Using the map and flood event data, predict which areas would be most affected by a storm surge of 7 feet.
2. How could the moon phase impact the amount of flooding during Hurricane Sandy?
3. Develop a plan to mitigate the effects of storm surge in coastal regions

Standard
HS-PS3-5

As shown in the diagram below, ~~a~~ ~~target~~ two magnets are fixed to a track a distance apart. Between the two magnets a third, unfixed magnet that moves freely is displaced from the center and released. (This magnet's poles are opposite the fixed magnets). A motion detector is used and a kinetic energy vs ~~time~~ position graph is created. A magnetic field sensor is placed

Phenomenon

"A unique invitational hook"

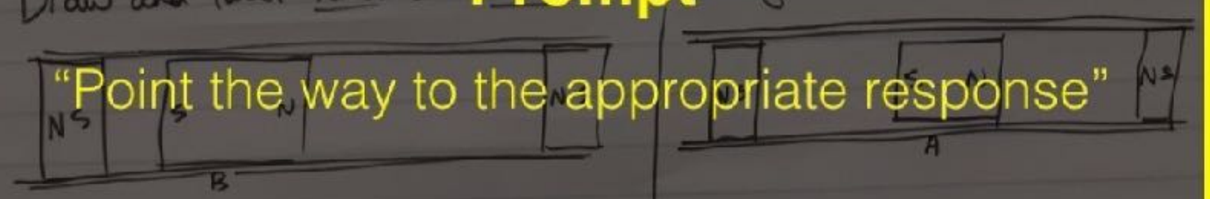


Stimulus

Data, model, graph, map, lab setup, text, etc.

Construct a model to explain the motion of the center magnet at positions A and B as shown. Do this by:

Draw and label forces and moving magnet on diagrams below.



On the K vs. X graph above, ~~predict~~ draw a ~~red~~ prediction of the magnetic ~~field~~ vs. position graph correlating to the K-X graph.

Prompt

"Point the way to the appropriate response"

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Developing and Using **Models**

LS1

From Molecules to Organisms

Structure Function

Assessment Writing

Brainstorm a list of

Phenomenon

Step 7

Phenomena

(3)

Sugar plant explosion (Georgia)
Lose weight while you sleep
Bubbles in water weed
Bacterial mats in hot springs (geysers)
Screaming gummy bear
van Helmont exp.
Man who lived on a scale
How to live in space stations
Measuring basal metabolic rate
CO_2 levels and plant growth
Russia loves global warming
Lactic acid & muscles
Making beer - fermentation
Calories - burning energy
Carbon sequestration
Eutrophication
Mangroves — natural desalination
Bioremediation
~~Tetanus~~
Teraniums (long term)
Biosphere ~~tube~~ II - Living on Mars?
Carbon ~~foot~~ print
Isotopes & ancient diet
C_3 / C_4 / CAM plants
Sulfur bacteria
Hydrothermal vents

Dubai cinema temp. regulation

Phenomenon

1 - Absolute zero
2 - Rail gun (mag
3 - ~~Magnet~~ Nuclear bomb / ~~energy~~ power station
4 - Stretched Spring
5 - Coupled Pendula
6 - ~~Heated~~ Dead ball bouncy ball
7 - Brass ball & Ring
8 - Solar Panels
9 - Geothermal
10 - Wind turbines
11 - Nuclear fusion / sun
K - Van de Graaf generator / Cannon firing

Thermal
Steam
13 Trebuchet
14 Hydroelectric
15 Wireless charging
16 Energy storage in train cars
17 Cycling
18 Fireplace
19 Hurricanes
20 Big Bang!

Create 3-Dimensional

Learning Performances

Step 8

LP1: Students will ask questions about energy transfer within a particle's motion, thermal energy, insulation phenomenon.

LP2: Students will develop a model to demonstrate energy transfer and particle motion within a particles, motion, thermal energy, insulation phenomenon.

Sub-Phenomenon: Feeling and Measuring materials in the school

LP3: Students will observe and analyze the temperature and feeling of an object/material and how it feels. (energy and matter)

Step 8

Add multiple

Learning Experiences

Step 9

Learning Experiences

Anchoring Phenomena: Particles, motion, thermal energy, insulation

- Eco-cooler (WWW/service learning & thinking like an engineer)
- Collapsing train car***
- Dipping Bird
- Global Warming (connection to weather unit)

LP1: Students will ask questions about energy transfer within a particle's motion, thermal energy, insulation phenomenon.

- Gather questions
- Sort/classify questions
- Prompt them toward asking energy transfer questions ("How is it possible for this massive train car to collapse with nothing crushing it?")
- Save questions for later reflection (notebooks or wonder wall)

LP2: Students will develop a model to demonstrate energy transfer and particle motion within a particles, motion, thermal energy, insulation phenomenon.

- Individual modeling on whiteboards
- Gallery walk and edit own models
- Come up with a group or classroom consensus model, record in notebooks

Sub-Phenomenon: Feeling and Measuring materials in the school

LP3: Students will observe and analyze the temperature and feeling of an object/material and how it feels. (energy and matter)

- Touch and make qualitative descriptions about the temperature of objects around the school, indoors to eliminate variables.
    - 1 to 10 scale (1 is frozen, 10 is pulling your hand away because it's too hot)
- Go back to measure with IR Thermometers
- Graph and compare quantitative vs qualitative observations (should be a flat line)

Note: we are leaving this discrepant event unanswered to distinguish between human feel and actual temperature.

Step 9

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PEARSON

Supporting Grade 5-8 Students in Constructing Explanations in Science

The Claim, Evidence, and Reasoning Framework for Talk and Writing

...atherine L. McNeill Joseph Kr...

PEARSON PROFESSIONAL DEVELOPMENT

What's Your Evidence?

Engaging K-5 Students in Constructing Explanations in Science

Carla Zembal-Saul Katherine L. McNeill
Kimber Hershberger

Argument-Driven Inquiry in BIOLOGY

LAB INVESTIGATIONS for GRADES 9–12

...on, Patrick Enderle, Leeanne Gleim,
...ooms, Melanie Hester,
...erland, and Kristin Wilson

NSTA press
National Science Teachers Association

Argument-Driven Inquiry in PHYSICAL SCIENCE

LAB INVESTIGATIONS for GRADES 6–8

Jonathon Grooms, Patrick J. Enderle,
Todd Hutner, Ashley Murphy, and Victor Sampson

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