

Success with the process standards requires practice!

The process standards are applied in every unit of study and are consistent across grade levels. The more independent students are with the process standards, the more confident they will be as learners.

We developed some strategies to help students understand, practice, and integrate these critical standards as they think about and apply what they learn.

The *Instructional Strategies Playlist for the Process Standards* is organized into two sections: tools to know (getting started) and ways to show (application). Choose a strategy based on the process standard and purpose you want students to practice. (Clicking on the strategy will take you directly to that page.)

These science-specific instructional strategies can be used with any unit of instruction or grade level!

### tools to know

process	purpose	routine/ strategy	
<b>plan, design, and implement investigations</b>	make and record observations	<a href="#">5 Senses</a>	
		<a href="#">Just the Facts</a>	
		<a href="#">Nine Squares</a> (only steps 1-2a: 5 facts/ observations)	
	ask well-defined questions	<a href="#">One Question Upside Down Pyramid</a>	
	formulate a hypothesis	<a href="#">Cause and Effect Thinking Stems</a>	
		<a href="#">Draw Conclusions Thinking Stems</a>	
	write/follow procedures	<a href="#">Mystery Sequence/ Re-sequence</a>	
		<a href="#">Flow Map</a>	
	<b>use appropriate tools and equipment</b>	understand scientific tools and their purpose	<a href="#">Card Sort</a>
			<a href="#">Thought Bubbles</a>
<b>use scientific terms</b>	understand scientific vocabulary	<a href="#">Vocabulary Windows</a>	
		<a href="#">Vocabulary Dominoes</a>	

### ways to show

process	purpose	routine/ strategy
<b>construct/ interpret tables and graphs</b>	organize data	<a href="#">DRY MIX and TAILS</a>
		<a href="#">TALK</a>
		<a href="#">OPTIC</a>
	identify patterns	<a href="#">Justified List</a>
		<a href="#">Odd One Out</a>
<b>analyze data</b>	formulate explanations and communicate conclusions	<a href="#">CER</a>
		<a href="#">3-2-1 Summary</a>
		<a href="#">Nine Squares</a>
	predict trends	<a href="#">Predict Thinking Stems</a>
<b>use models</b>	represent aspects of the natural world	<a href="#">Tour of Knowledge</a>
		<a href="#">Brain in the Game</a>

## 5 Senses

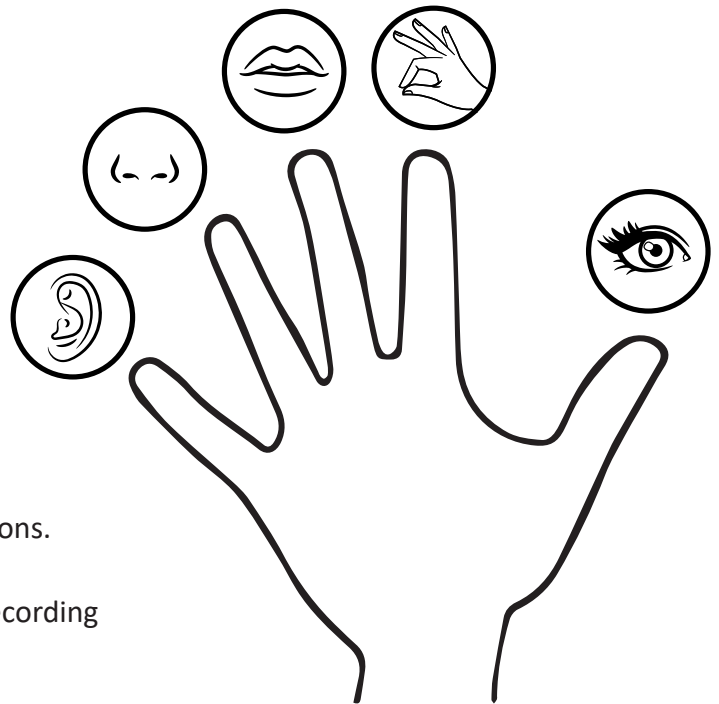
### Purpose

make and record observations

Data is collected through observations. Observations are collected using our five senses: sight, touch, taste, smell, and hearing.

### Instructions






1. Clearly identify safety protocols for the investigation *before* students collect data using their five senses (e.g., wafting when smelling something, taste and touch only with teacher permission, etc.).
2. Have students use their senses to make observations.
3. As individuals, groups, or whole class, record the observations using the 5 Senses data collection recording sheet.



### Materials

- 5 Senses data collection recording sheet

## 5 Senses – Data Collection Recording Sheet

sight	touch	taste	smell	hearing
				

## Just the Facts

### Purpose

make and record observations

### Instructions

1. Students read a selected passage or text associated with the content or investigation.
2. Individually, students deepen their understanding about observations by recording a cool fact, an interesting fact, a wow fact, a useful fact, a new fact, and a most important fact.
3. Partner students using **Musical Mix-Freeze-Group** or other movement and discourse strategy.
4. With their partner, students justify how their selected facts/observations satisfy the criteria of being cool, interesting, wow, useful, new, or important.
5. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

- Text associated with the content or investigation
- Just the Facts recording sheet

## Just the Facts – Recording Sheet

Read the assigned text related to the content or investigation and write a fact in each of the boxes below.

cool fact

interesting fact

wow fact

useful fact

new fact

most important fact

Inference from one or more facts above

From the \_\_\_\_\_ fact above, I can infer that \_\_\_\_\_

\_\_\_\_\_ because \_\_\_\_\_

## Nine Squares

### Purpose

make and record observations

### Instructions

1. Students read data/text or view an image, visual, or stimulus.
2. Students analyze the data, text, image, visual, or stimulus and write the following:
  - a. 5 facts/details about what they observe (What does it say or what do you see?)[the remaining steps may be completed during “ways to show”]

### Materials

- Nine Squares recording sheet

## Nine Squares Recording Sheet

List 5 facts/details (What does it say or what do you see?)


# One Question Upside-Down Pyramid

## Purpose

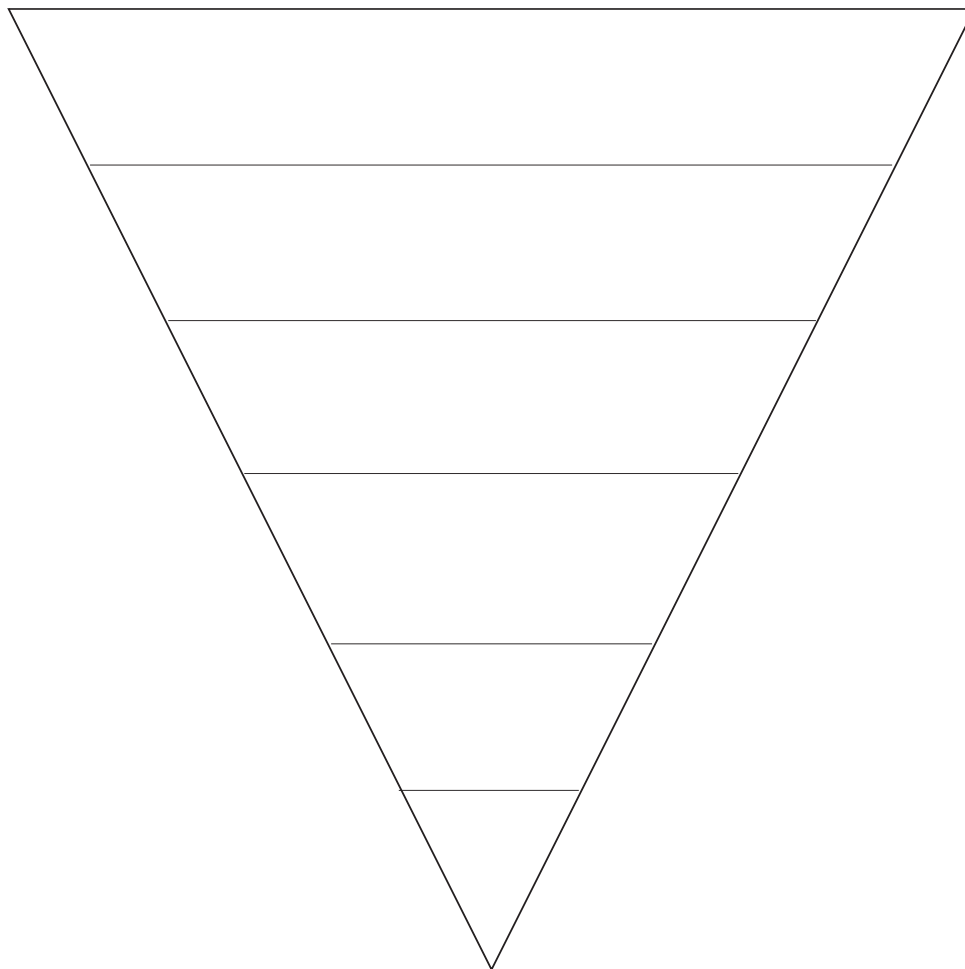
ask well-defined questions

## Instructions

1. Students create an upside-down pyramid by writing important information to gather and/or questions to answer on the first line.
2. On the next line, students synthesize the information and trim extraneous details/variables.
3. Continue this process until the bottom line represents one well-defined question for investigation.

## Materials

none





# Cause and Effect Thinking Stems

## Purpose

formulate a hypothesis

## Instructions

1. Teacher determines how thinking stems will be used (e.g., responding independently or with a partner, orally and/or in writing, combined with a movement and discourse strategy, as a standalone activity, etc.).
2. Students use thinking stems to communicate cause and effect relationships.
3. Teacher sees and hears students’ thinking and clarifies/verifies as appropriate.

## Materials

- Cause & Effect thinking stem

	Cognate
The cause of _____ is/ was _____ because _____.	causa
The effect of _____ is/was _____ because _____.	efecto
There are/were many causes for _____ including _____.	causas incluyendo
There are/were many effects of _____ including _____.	efectos incluyendo
The cause(s) of _____ was/were _____, and the effect(s) was/were _____.	causas efectos
The most significant cause of ____ is/was ____ and the most significant effect is/was ____.	causa significativa/efecto significativo

# Draw Conclusions Thinking Stems

## Purpose

formulate a hypothesis

## Instructions

1. Teacher determines how thinking stems will be used (e.g., responding independently or with a partner, orally and/or in writing, combined with a movement and discourse strategy, as a standalone activity, etc.).
2. Students use thinking stems to communicate conclusions being drawn.
3. Teacher sees and hears students’ thinking and clarifies/verifies as appropriate.

## Materials

- Draw Conclusions thinking stem

Draw Conclusions	I conclude _____ is correct/incorrect because _____.	<b>Cognate</b> concluyo, correcto/incorrecto
	I imagined _____, but now I think _____.	imaginé
	One conclusion I can make is _____ because _____.	conclusión
	With this new information, I can now state _____.	información
	Based on my reflection, I conclude _____ because _____. _____ is significant/reasonable in this case because _____.	Basado en, la reflexión, concluyo significativo, en este caso, razonamiento

# Mystery Sequence/Re-sequence

## Purpose

write/follow procedures

## Instructions

1. Organize students into groups of 2-4.
2. Provide each group a handout with steps in a process in random, mixed-up order (or ask students to create cards representing steps in the process).
3. Students cut the handout into separate cards.
4. Students collaborate to sequence the cards in the appropriate order.
5. Groups compare sequences and justify, rethink, or stand their ground.
6. Students then examine each step in greater depth through buddy reading, online research, video clips, jigsaw structures, teacher instruction, etc.
7. Students re-sequence their cards based on the new information learned.
8. Teacher sees and hears the students’ thinking and clarifies/verifies as appropriate.

## Materials

- Mystery Sequence/Re-sequence template (for handout)

## Think It Up

Teacher asks students to respond to a Sequence Thinking Stem as an exit ticket.

Sequence / Order		Cognate
	_____ happened before/after _____.	
	The order of events begins/terminates with _____.	orden de eventos, termina
	A vital step in the process is _____ because _____.	vital, proceso
	Considering _____, it is not a surprise that _____ occurred.	considerando que, sorpresa, ocurrió
	It would be important to _____ before/after _____.	importante
	If all the steps are complete, _____ will occur.	completos, ocurrirá

## Mystery Sequence/Re-sequence

Cut apart the cards and sequence them into a logical order. (Add or subtract boxes as needed.)


## Flow Map

### Purpose

write/follow procedures

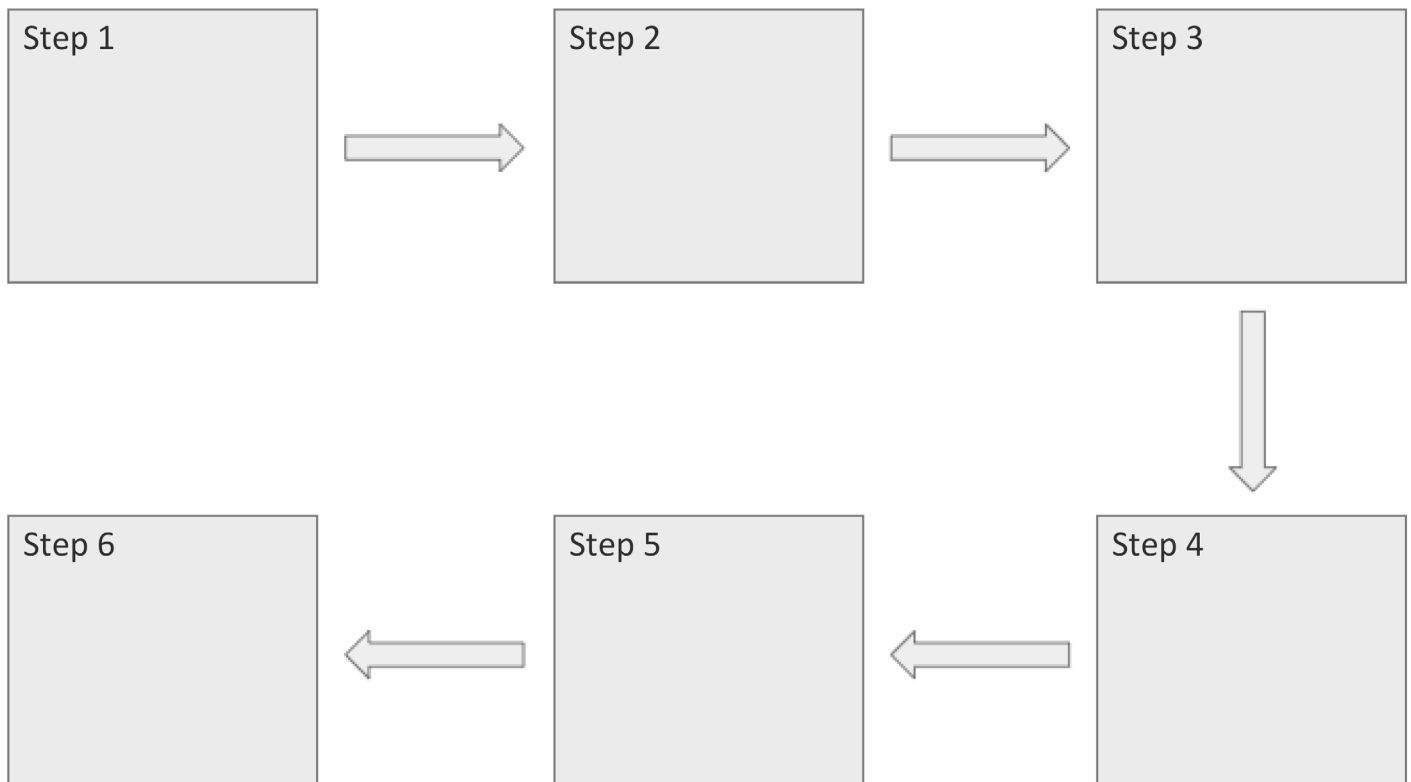
The Flow Map is useful for helping students identify and break down all the necessary steps when designing an investigation. The arrows between the boxes represent the order of the steps in the investigation.

### Instructions

1. Students write a step in each box.
2. Students add or remove boxes as needed until all steps are listed.
3. Teacher sees students' thinking and clarifies/verifies as appropriate.

### Materials

none



## Card Sort

### Purpose

understand scientific tools and their purpose

### Instructions

1. Give students (or have them create) a set of cards reflecting various vocabulary terms, visuals, statements, or assessment items.
2. Students work cooperatively to sort the cards into various categories, for example:
  - + (know it)    ✓ (kind of know it)    – (don't know it)
  - Always true    Sometimes true    Never true
  - Closed Sort: teacher provides content/concept categories
  - Open Sort: students create their own categories

### Materials

- Cards with terms, visuals, statements, or assessment items  
(students can often create their OWN card sets to save teacher prep time)

# Thought Bubbles

## Purpose

understand scientific tools and their purpose

## Instructions

1. Students write or draw the tool(s) for investigation associated with the big idea of the lesson in the center of a page.
2. Throughout the lesson, students add “thought bubbles” as they make connections to the tool.  
For example, connections to:
  - the tool’s purpose
  - key words
  - various visuals
  - previous lessons
  - a type of thinking
  - a skill
  - steps in a process
3. Teacher analyzes students’ thought bubbles and clarifies/verifies as appropriate.

## Materials

- Student notebooks or pieces of paper

# Vocabulary Windows

## Purpose

understand scientific vocabulary

## Instructions

1. Provide each student with a Vocabulary Windows graphic organizer with vocabulary words and their definitions.
2. Students complete each “window” by illustrating the word.
3. As the unit progresses, students illustrate the context in which they learned the word or the concept to which it belongs.

## Materials

- Vocabulary Windows graphic organizer with vocabulary words and their definitions



## Vocabulary Windows Graphic Organizer


# Vocabulary Dominoes

## Purpose

understand scientific vocabulary

## Instructions

1. Organize students into groups of 2-3 students.
2. Give each group a set of prepared paper Vocabulary Dominoes with important terms/tools/concepts. The terms/tools/concepts can be a word, a visual representation, or combination.
3. Students place the paper dominoes face down and mix them up.
4. Each student draws 3-4 dominoes.
5. Place a domino (from the draw pile) face up in the center as the “spinner” to begin the game.
6. Each player takes a turn matching one of their vocabulary dominoes with a domino on the board, explaining how the two terms are related to each other.
7. Students continue taking turns and making connections until all dominoes are played.
8. Teacher sees and hears students’ thinking and clarifies/verifies as appropriate.

## Materials

- Vocabulary Dominoes with important terms/tools/concepts (words and/or visuals) created by teacher or students. NOTE: The dominoes can be created with only one term/visual or two unrelated terms/visuals (one at each end).

## DRY MIX and TAILS

### Purpose

organize data (when creating line and bar graphs)

When conducting research and using the scientific method, it is common practice to change only one variable at a time. This changed variable is referred to as the manipulated, or *independent*, variable. All other conditions must be kept completely identical. These conditions are called controls or constants. The effect that the manipulation has on the other variables is known as the responding, or *dependent*, variable. The acronym DRY MIX can be used to help distinguish between these two types of variables.

### Instructions

1. Explain how the acronym DRY MIX can be used to help distinguish between independent and dependent variables.
  - D** dependent
  - R** responding
  - Y** y-axis
  
  - M** manipulated
  - I** independent
  - X** x-axis
2. Identify the parts of a graph using the acronym TAILS.
  - T** title      A graph title should include the independent/manipulated variable and the dependent/responding variable.
  - A** axis      The independent/manipulated variable should be on the x-axis and the dependent/responding variable should be on the y-axis.
  - I** interval    The interval is appropriate for the scale. What are you counting by?
  - L** labels      The x-axis and y-axis are labeled with the variables and units.
  - S** scale      The minimum and maximum values are appropriate.
3. Students use their understanding of DRY MIX and TAILS to create their graphs and analyze data.
4. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

none

# TALK

## Purpose

organize/analyze data (graphs and charts)

## Instructions

1. Explain how the acronym TALK can be used to organize/analyze data.
  - T title
  - A all labels
  - L look for trends
  - K key
2. Provide students with a graph or chart.
3. Ask students the following questions:
  - What is the **title**?
  - Can you identify all the **labels**?
    - Chart (row and column labels)
    - Graph (x- and y-axis labels)
  - If a graph, What are the **trends**? Is the graph consistently increasing? Is there a pattern? etc.
  - Is there a **key** to help you decipher the information (color coded, etc.)?

## Materials

- Graph(s) or chart(s) for evaluation

# OPTIC

## Purpose

organize/analyze data (visuals)

## Instructions

1. Explain how the acronym OPTIC can be used to analyze visuals.
  - O** overview
  - P** parts
  - T** title
  - I** inference
  - C** conclusion
2. Provide students with a visual (table or graph).
3. Ask students the following questions:
  - Is there a **title**? (If there isn't one, create one at the end of the exercise.)
  - Analyze the **overview**. In general, what is going on?
  - Analyze the **parts**. What are all the details that you see?
  - What can you **infer** based on the “overview” and “parts”?
  - What can you **conclude** about the image?
4. If necessary, create a title for the visual.

## Materials

- Visual(s) for evaluation

## Justified List

### Purpose

identify patterns

### Instructions

1. Give each student a Justified List recording sheet. The recording sheet includes a visual (table/graph) to analyze and a list of both true and false facts/examples/statements associated with the visual.
2. Students place a check mark next to (or circle) all of the facts or positive examples and justify their responses.
3. Students then give a pattern, general rule, or generalization that can be made based on all the facts (positive examples).
4. Using **Musical Mix-Freeze-Group** or other movement and discourse strategy, students share and compare their responses by:
  - justifying the examples they checked
  - explaining why they did not check the other examples
5. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

- Justified List recording sheet

### Think It Up

Using a movement and discourse strategy, students:

- Compare/contrast their response with a peer and revise their list as they see fit
- Create/develop two more positive examples

## Justified List Recording Sheet

Place a check mark next to the statements that are true and an “X” next to the statements that are false. Justify your reasoning.

*(teacher-provided visual)*

Statements	Justification
<input type="checkbox"/> 1. <i>(true and false facts/examples/statements)</i>	
<input type="checkbox"/> 2.	
<input type="checkbox"/> 3.	
<input type="checkbox"/> 4.	
<input type="checkbox"/> 5.	
<input type="checkbox"/> 6.	

What pattern, general rule, or generalization can you make based on all the positive examples?

## Odd One Out

### Purpose

identify patterns

### Instructions

1. Organize students into groups of 4 and number off 1-2-3-4.
2. Give each student an Odd One Out recording sheet that includes 4 different visuals (tables and graphs).
3. Students move into expert groups and analyze their ONE assigned visual:
  - 1 = huddle with other 1s and become an expert on the box with visual #1
  - 2 = huddle with other 2s and become an expert on the box with visual #2
  - 3 = huddle with other 3s and become an expert on the box with visual #3
  - 4 = huddle with other 4s and become an expert on the box with visual #4
4. Student experts return to their home group and teach each other about the information that was in their expert group's box.
5. Students compare/contrast the four boxes, select one that is the Odd One Out, and justify their thinking.
6. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

- Odd One Out recording sheet



# Odd One Out Recording Sheet

Analyze the visuals below.

*(Examples and Non-Examples)*

Visual #1

Visual #2

Visual #3

Visual #4

Which visual seems to be the “odd one out” and does not fit the other three examples?  
Justify your thinking.

Visual # \_\_\_\_\_ is the “odd one out” because \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_.

## CER

### Purpose

formulate explanations and communicate conclusions

CER (Claim, Evidence, Reasoning) is a format for writing about science. It allows you to think about data in an organized, systematic manner.

- Claim: a conclusion about a problem or question
- Evidence: scientific data that is appropriate and sufficient to support the claim
- Reasoning: a justification that shows why the data counts as evidence to support the claim and includes appropriate scientific principles

### Instructions

1. Teacher explains the purpose of CER and how to use this process when writing about science.
2. Students use CER to write about an assigned topic.

Claim: a conclusion about a question or problem

Evidence: data that supports your claim

Evidence: data that supports your claim

Evidence: data that supports your claim

Reasoning: explains why the evidence supports your claim

Reasoning: explains why the evidence supports your claim

Reasoning: explains why the evidence supports your claim

## 3-2-1 Summary

### Purpose

formulate explanations and communicate conclusions

### Instructions

1. After analyzing the data, students write:
  - 3 things they discovered
  - 2 examples, applications, or explanations about what they found in the data
  - 1 conclusion they drew from analyzing the data
2. Students turn in their 3-2-1 Summaries as an exit ticket.
3. Teacher evaluates students' responses and clarifies/verifies as appropriate.

### Materials

- 3-2-1 Summary (change the 3-2-1 prompts as appropriate to the content)

## 3-2-1 Summary

After analyzing the data, 3 things I discovered/learned are:

1.

2.

3.

2 examples, applications, or explanations about what I found in the data are:

1.

2.

1 conclusion I can draw from my analysis is (It's important to know this because \_\_\_\_\_) :

1.

## Nine Squares

### Purpose

formulate explanations and communicate conclusions

### Instructions

1. Students read and analyze data/text or view an image, visual, or stimulus.
2. Students analyze the data, text, image, visual, or stimulus and write the following:
  - 5 facts/details about what they observe (What does it say or what do you see?)
  - 2 inferences (What does it mean?)
  - 2 valid conclusions (Why does it matter?)

Note: Students may use the lead4ward thinking stems to help them write their inferences and conclusions.
3. Students cut apart their 9 squares, trade with another student, and sort their partner's cards into the 5 facts, 2 inferences, and 2 conclusions.
4. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

- Nine Squares recording sheet

### Think It Up

Adaptation: Teacher provides answers in random order in the 9 squares, students cut apart the answer cards and categorize them into 5 facts, 2 inferences, and 2 conclusions.

## Nine Squares Recording Sheet

- 5 facts/details (What does it say or what do you see?)
- 2 inferences (What does it mean?)
- 2 valid conclusions (Why does it matter?)


# Predict Thinking Stems

## Purpose

predict trends

## Instructions

1. Teacher determines how thinking stems will be used to make predictions about trends from the data (e.g., responding independently or with a partner, orally and/or in writing, combined with a movement and discourse strategy, as a standalone activity, etc.).
2. Students use thinking stems to communicate their predictions.
3. Teacher sees and hears students’ thinking and clarifies/verifies as appropriate.

## Materials

- Predict/Estimate thinking stem

Predict/Estimate	I predict/estimate _____ because _____ is/are _____.	<b>Cognate</b> predigo
	I think _____ will repeat because _____ is/are _____.	repito
	I predict/estimate _____. My reasons for this include _____.	predigo , las razones, incluyen
	In my opinion, _____ will happen next because _____.	en mi opinión
	In light of _____, I predict _____.	predigo
	In consideration of the text/information given, I believe _____ will occur.	en consideración a/al, texto, información

## Tour of Knowledge

### Purpose

represent aspects of the natural world

### Instructions

1. Teacher places posters representing various models around the room.
2. Organize students into groups of 3-4.
3. Give each group a different colored marker.
4. Groups have 3-4 minutes at each station to:
  - Record what they know about the model
  - Put a check mark beside information they agree with from another group
  - Put a question mark beside any ideas they think may be incorrect
  - Add new ideas
5. At the teacher's signal, groups rotate to the next "tour of knowledge" poster and repeat step 4.
6. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

- Posters representing various models (chart paper or butcher paper works well)
- Markers

### Think It Up

Adaptation: Include 3D models when possible



## Brain in the Game

### Purpose

represent aspects of the natural world

### Instructions

1. Students analyze the model(s) of the natural world by:
  - a. Analyzing and describing the model(s)
  - b. Identifying 3-5 important vocabulary terms related to the model(s)
  - c. Predicting what concept the model(s) are associated with (e.g., properties of atoms, organisms, etc.)
2. Partner students using **Musical Mix-Freeze Group** or other movement and discourse strategy.
3. Students compare, discuss, justify, or rethink their responses.
4. Teacher sees and hears students' thinking and clarifies/verifies as appropriate.

### Materials

- Model(s) representing the natural world
- Brain in the Game recording sheet

### Think It Up

Adaptation: Include 3D models when possible

## Brain in the Game Recording Sheet

<p style="text-align: center;">model #1</p> <ol style="list-style-type: none"> <li>1. Analyze and describe the model:</li> <li>2. Identify 3-5 important vocabulary terms related to the model:           <ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul> </li> <li>3. Predict what concept the model is associated with:</li> </ol>	<p style="text-align: center;">model #2</p> <ol style="list-style-type: none"> <li>1. Analyze and describe the model:</li> <li>2. Identify 3-5 important vocabulary terms related to the model:           <ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul> </li> <li>3. Predict what concept the model is associated with:</li> </ol>
<p style="text-align: center;">model #3</p> <ol style="list-style-type: none"> <li>1. Analyze and describe the model:</li> <li>2. Identify 3-5 important vocabulary terms related to the model:           <ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul> </li> <li>3. Predict what concept the model is associated with:</li> </ol>	<p style="text-align: center;">model #4</p> <ol style="list-style-type: none"> <li>1. Analyze and describe the model:</li> <li>2. Identify 3-5 important vocabulary terms related to the model:           <ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul> </li> <li>3. Predict what concept the model is associated with:</li> </ol>