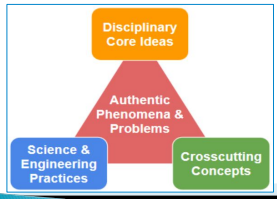
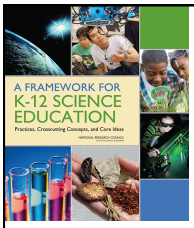
TSTA's Professional Learning Series:
Implementing 3-dimensional learning through the TN Science Framework





The *Framework* supports our understanding that students are **born investigators** who acquire knowledge by integrating scientific and engineering practices, cross-cutting concepts, with core scientific ideas.

This **integration** provides a foundation for applying literacy and mathematical reasoning to answer questions about natural phenomena that are experienced.

An Analogy between 3-Dimensional Learning and Cooking

Kitchen Tools & Techniques (Practices)

Basic Ingredients (Core Ideas)

Vegetables, Herbs, Spices, & Seasonings (Crosscutting Concepts)

Preparing a Meal (Three dimensional Learning)

TSTA's Professional Learning Components

1. Designs and offers professional development opportunities for science educators
2. Provides access to resources that support science learning and teaching
3. ***Inside the Science Teachers Studio***
   - Explores best practice by highlighting successful instructional approaches through the lens of an interview
   - Provides further elaboration during a Pop Up Conference
4. ***TN STEM Leadership Cadre***
   - Thoughtful and timely professional development anchored in effective instructional practices
   - Supports implementation of the *K-12 Science Framework* and new TN science standards

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Implementing 3-dimensional learning through the TN Science Framework

Inside the Science Teachers Studio and *TN STEM Leadership Cadre* are made possible through **Building Capacity for Tennessee Science Education" (BCTSE)** a partnership between Tennessee Science Teachers Association and the Oakley STEM Center at Tennessee Tech University.

TSTA's Professional Learning Series: *Implementing 3-dimensional learning through the TN Science Framework*

- This session of the TSTA **Implementing 3D Learning** series is "Developing Argumentation and Explanation Skills based on Evidence."
- We will explore a sample 5E lesson about the properties of air to support students in constructing scientific explanations and arguments. Additionally we use the Sense-Making Literacy Framework which focuses on phenomena, questions, and models within the context of purposeful reading, productive dialogue, and meaningful writing.

Importance of Scientific Explanations

- FOCUS: Science and Engineering Practices
- SEP – Constructing explanations (science)
  - Explanations focus on a specific question about a phenomenon and construct a how or why account for that phenomenon.
  - Explanations draw on a scientific model or generalized principles
  - Explanations lie at the core of what the science discipline is about
  - *Argumentation is a key part of developing explanations

FOCUS: Science and Engineering Practices

- SEP – Engaging in argument from evidence
- Key Features of this practice
  - Supported claims: students describe why the claim should be believed. The description includes some combination of available evidence, DCIs, and logical accounts.
  - Evaluation and critique: Students identify strengths and weaknesses of the supported claims
  - Reconciliation: When multiple possible claims are discussed, students will eventually reconcile these claims in order to make progress of the problems about which they are arguing.

Engage

- Demonstration
- How hard would is it to inflate a balloon in a plastic bottle?
- Materials (per team):
  - Empty water bottle
  - Latex balloon
- Experiment
  - Slip the balloon inside the neck of the bottle and stretch the mouth of the balloon over the bottle top.
  - Take a deep breath and try to blow up the balloon inside the bottle. Good Luck!

Engage

- Could you do it?
- Why do you think you could or could not?

- Introduce KLEWS chart.
- Complete the K column with what do we know about air? Discuss

Essential Question:

K What we think we know about this phenomena.	L What we are learning.	E Evidence Observations/Data	W Wonderings	S Scientific Concepts and Words

Explore – Stations

1. Does Air Take up Space?
2. Does Air Have Weight?
3. How does the compressibility of air and water compare?

- Use Plickers to poll the group about their predictions prior to completing stations.

- Complete each station with your team and record your observations, claims, and evidence that supports the claim.

Explain

- Discuss results of 3 Investigation Stations
- Write the Evidence and observations made in the E column of the KLEWS chart.
- Use the Evidence to write some statements about What we are Learning in the L Column.
- Ask Class to share some of their Wonderings at this time? Do they have ideas about the Balloon in the Bottle activity at this time?

Explain – Properties of Gas Partner A & B Read

- In A-B pairs, A Starts – read a paragraph aloud.
- Partner B listens and paraphrases the meaning.
- Partner A then shares a connection he/she can make with the text.
- Next paragraph – switch roles.
- Continue until the entire reading is complete.

Explain – Interactive

- Use the Particle Magnifier with Air and Water found at
- https://inquiryproject.terc.edu/curriculum/curriculum5/resources/particlemag/code/particle_motion_water_and_air.html
- Observe the differences in the particle nature of air and water at different temperatures.
- Use Annotated Drawings to explain the compressibility of water and air.

Explain

Essential Question:

K	L	E	W	S

- Use knowledge from your investigations and reading to add to the scientific concepts and words column (S).

KLEWS chart | Scientific Concepts

Elaborate

- How Strong is a Bag of Compressed Air?
- Complete the investigation for Station 4

Essential Question:

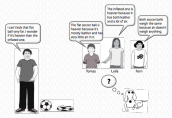
K	L	E	W	S

Bag of Air Experiment | Add to your KLEWS chart

CER Statements

- Claim – A statement or conclusion that answers the original question/problem
- Evidence – Scientific data that supports the claim
- Reasoning – A justification that connects the evidence to the claim using scientific principles

Evaluate



Soccer Ball

Floating Balloon

Strategies for Supporting Scientific Argumentation

- Use in multiple activity types (individual, small group, and whole class)
- Evaluate student ideas on whether they align with available evidence and shared DCIs.
- Ask student groups to construct a single product about which they all agree.
- Encourage students to question your ideas and demonstrate how to support those ideas with evidence and reasoning.
- Explore phenomena that are complex enough to create tentative claims that students can question and resolve.
- Frequently ask students to support their ideas with evidence and DCIs.

Strategies for Supporting Scientific Argumentation

- **Discuss the CER Framework &** complete an introduction lesson
- Transition from detailed to intermediate to minimal support as needed.
- Connect to Everyday Examples
  - Sports
  - Choice of food at the cafeteria,
  - Favorite movie genres, books…
  - etc.

Curricular Supports – Detailed

- Use of a template with prompts
- Claim– write a statement that responds to the original problem.
- Evidence – provide scientific data to support your claim. You should only use appropriate data that is relevant to the problem and allows you to figure out your claim. Not all data is appropriate. Include enough data to provide the information necessary to convince someone of your claim.
- **Reasoning** – Connect your claim and evidence to show how your data links to your claim. Tell why your data count as evidence to support your claim by using scientific principles. Reasoning is the process where you apply your science knowledge to solve a problem.

Curricular Supports – Intermediate

- Claim – respond to the problem
- Evidence – provide scientific data to support your claim. You should only use appropriate data and include enough data.
- Reasoning – Connect your claim to evidence. Tell why your data counts as evidence using scientific principles.

Curricular Supports – Minimal

- Remember to include your claim, evidence, and reasoning.

Strategies for Supporting Students

- **Provide a rationale**
- Describe why a student or a scientist would construct a scientific explanation:
  - Science is fundamentally about explaining phenomena
  - Scientists justify as well as convince others of their claims by using evidence and reasoning
  - Scientists use evidence and reasoning in rebuttals to refute claims by other scientists and other lay people in the community

Strategies for Supporting Students

- **Connect to Other Content Areas**
- Help students link the CER framework to similar practices they engage in during other classes such as social studies, mathematics, and English Language arts.
  - Persuasive essays – ELA
  - Debate historical events – social studies
  - Justify an invented algorithm– math
- Important 21st century skill that cuts across different disciplines

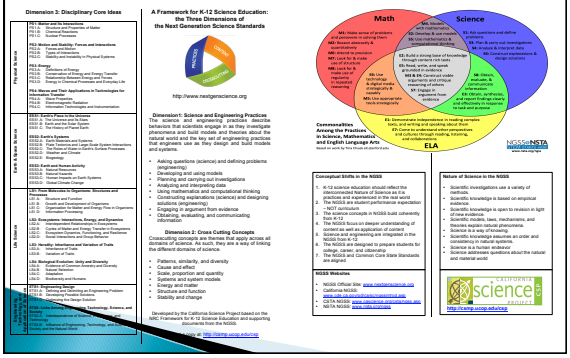
Strategies for Supporting Students

- **Model & Critique Examples**
- Provide examples of both strong and weak scientific explanations using a PPT slide, overhead, or handout. Critique the examples in terms of the strengths and weaknesses.
- **Provide Students with Feedback**
- Offer explicit feedback on student writing in either discussion or written feedback, including specific suggestions in terms of the strengths and weaknesses.

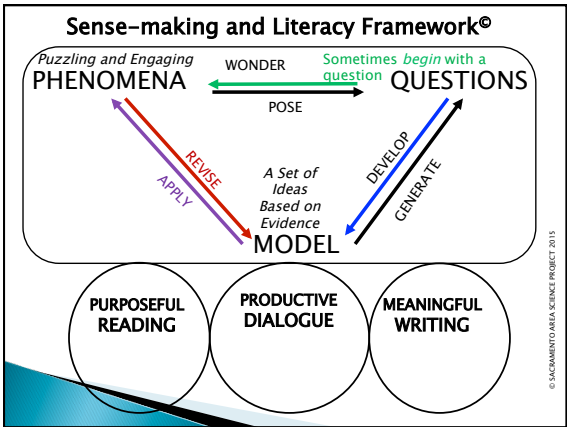
Strategies for Supporting Students

- **Have Students Engage in Peer Critique**
- Have students trade scientific explanations with partners in class and provide each other with feedback on the strengths and weaknesses. Example:
  - Circle the claim
  - Number the pieces of evidence
  - Underline the reasoning
  - Suggestions to improve the explanation
- Why? Expose students to other examples of scientific explanations and provide opportunity to think critically about what it means to construct a strong explanation.

NGSS Cheat Sheet Handout



Sense-making and Literacy Framework©



Reflect

- What Science and Engineering Practices did we specifically use during our exploration of air?
- Crosscutting Concepts?
- Disciplinary Core Ideas?
- How did we use
  - Purposeful Reading
  - Productive Dialogue, and
  - Meaningful Writing?

Resources

- *What's Your Evidence? Engaging K-5 Students in Constructing Explanations in Science.* Zembal-Saul, McNeill, & Hershberger (2013)
- *Supporting Grade 5-8 Students in Constructing Explanations in Science: The Claim, Evidence, and Reasoning Framework for Talk and Writing.* McNeill & Krajcik (2011)
- *Helping Students Make Sense of the World Using Next Generation Science and Engineering Practices*. Schwarz, Passmore, & Reiser (2017)

Resources

- *Argument-Driven Inquiry* Series
  - Physics Volume 1 (9-12); Physical Science (6-8)
  - Biology (9-12); Life Science (6-8)
  - Chemistry (9-12)
- *Teaching High School Science Through Inquiry and Argumentation. 2nd Edition*. Douglas Llewellyn (2012)
- *Inquiry Within: Implementing Inquiry and Argument-Based Science Standards in Grades 3-8. Third Edition*. Douglas Llewellyn (2014)