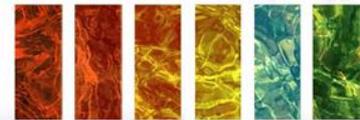


# PD that Makes a Difference for *Students*: Science Teachers Learning from Lesson Analysis (STeLLA)

Kathleen Roth  
STEM Smart

NSF Regional Workshop, Las Vegas  
September 19, 2012



# Overview of Session

- Learn about the STeLLA videocase-based, lesson analysis approach to science teacher professional development
- Experience a taste of STeLLA lesson analysis
- Take away ideas and resource

# The NRC Report: Successful K-12 STEM Education

Key Element: Teachers with high capacity to teach in their discipline(s).

*“To be effective, teachers need content knowledge and expertise in teaching that content, but the research suggests that science and mathematics teachers are particularly underprepared for these demands.”*

# The NRC Report: Successful K-12 STEM Education

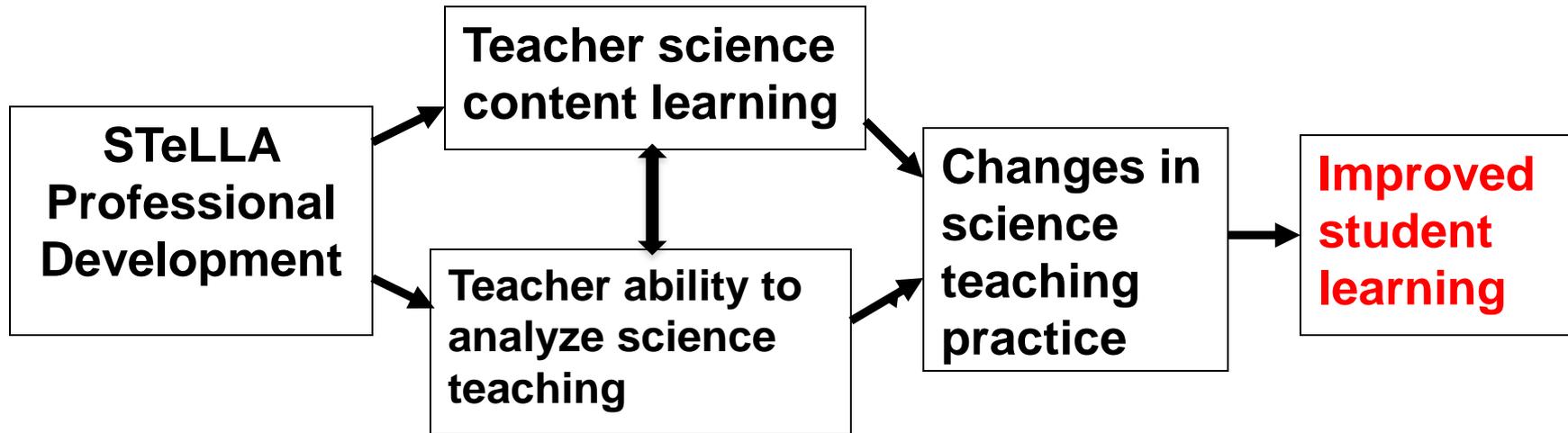
Effective professional development should:

- **CONTENT:** Focus on developing teachers' capabilities and knowledge to teach content and subject matter,
- **TEACHERS' PRACTICE:** Address teachers' classroom work and the problems they encounter in their school settings, and
- **TIME:** Provide multiple and sustained opportunities for teacher learning over a substantial time interval.

# The NRC Report: Successful K-12 STEM Education

*“The evidence suggests that these characteristics are levers for changing teachers’ practices. However, the evidence of **their effects on student achievement** is more tenuous because very little research traces the causal pathway from professional development to student achievement.”*

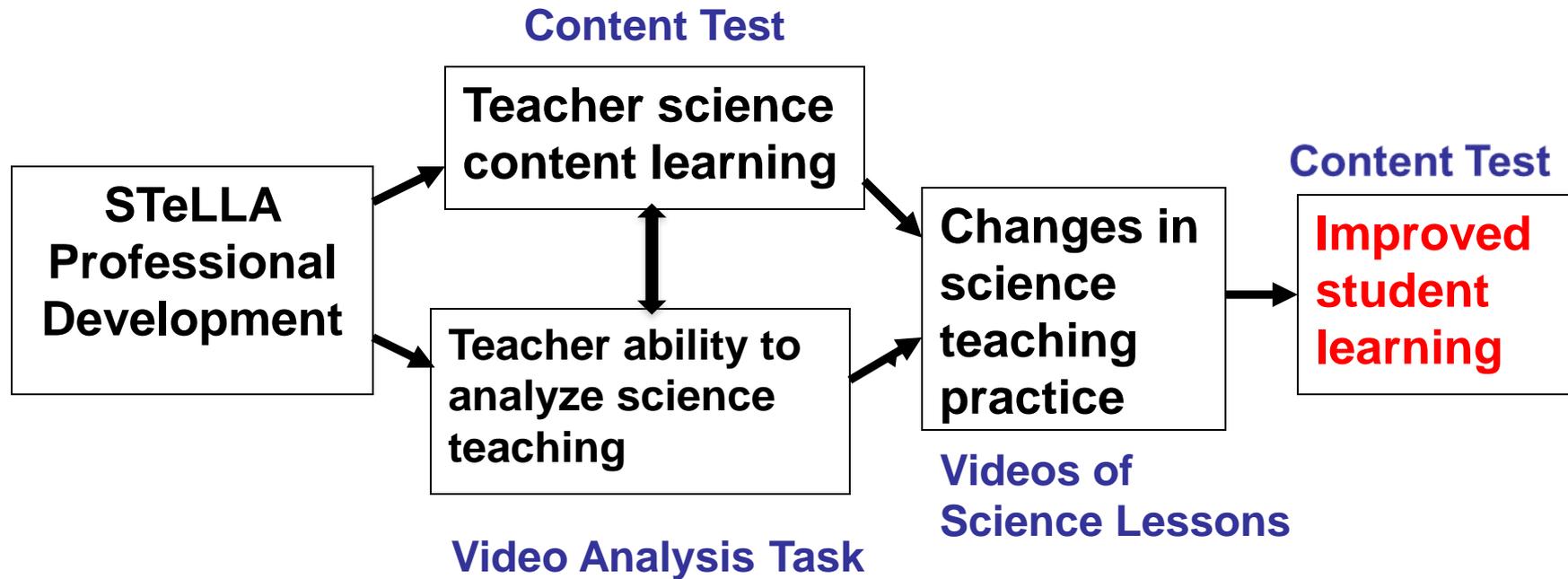
# Research on the STeLLA PD Program Traces the Causal Pathway to Student Achievement



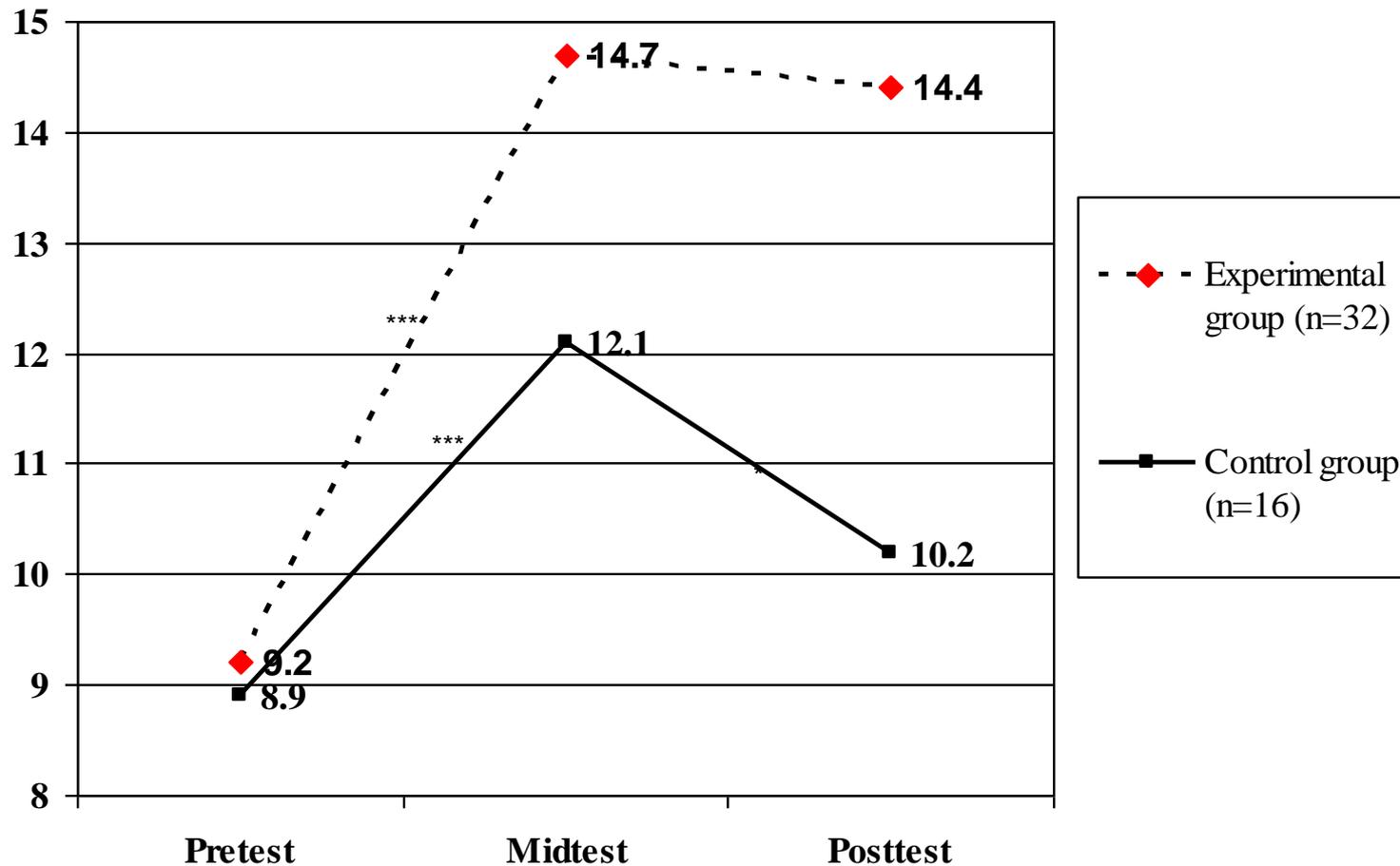
# Testing the Impact of STeLLA PD

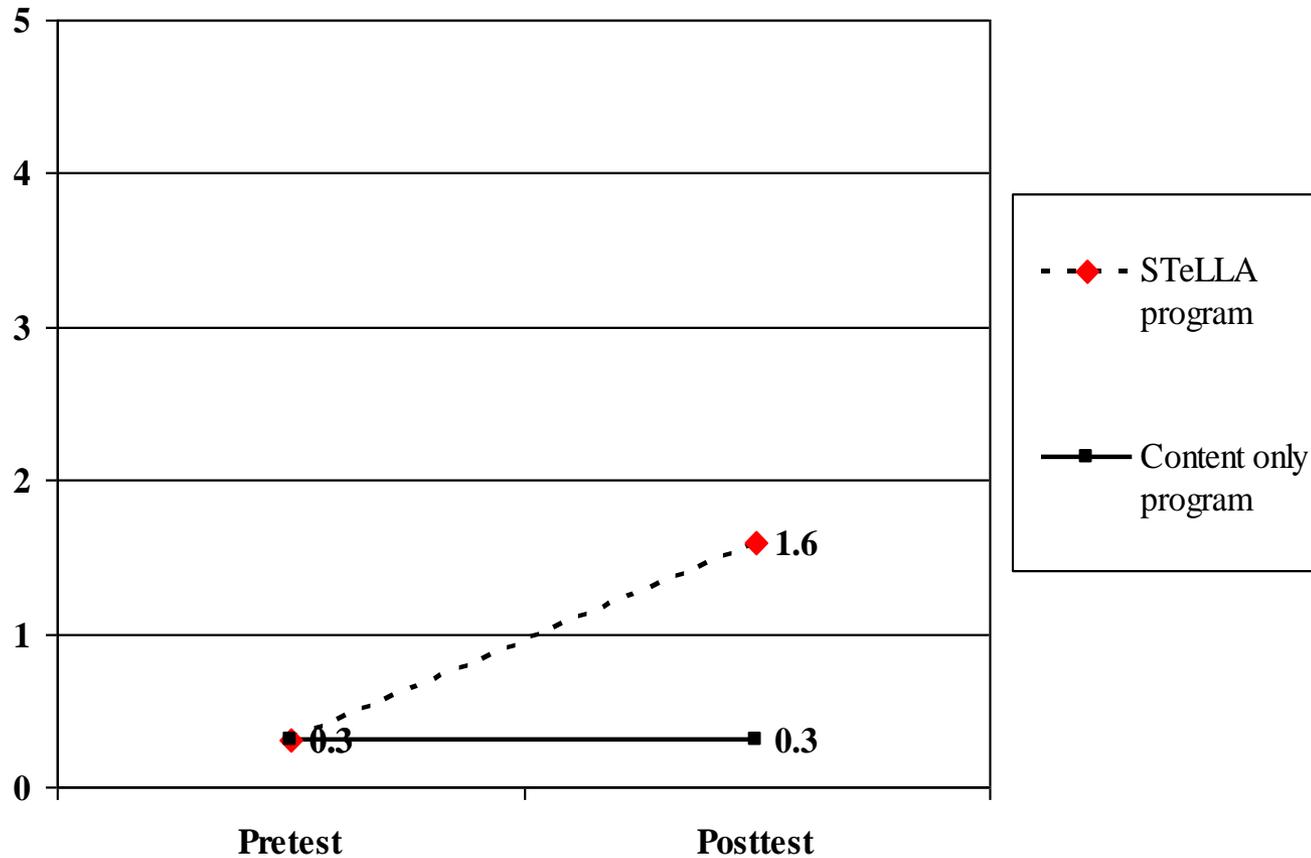
Research Design	Comparison Group	# Teachers	Status
STeLLA I: Quasi-experimental	Content deepening, Summer Institute only	48	Complete
STeLLA II: Randomized, controlled study	Content deepening, same # contact hours as Lesson Analysis group	140	Currently underway

# Testing the Impact of STeLLA PD



# STeLLA I: Teachers' Science Content Learning

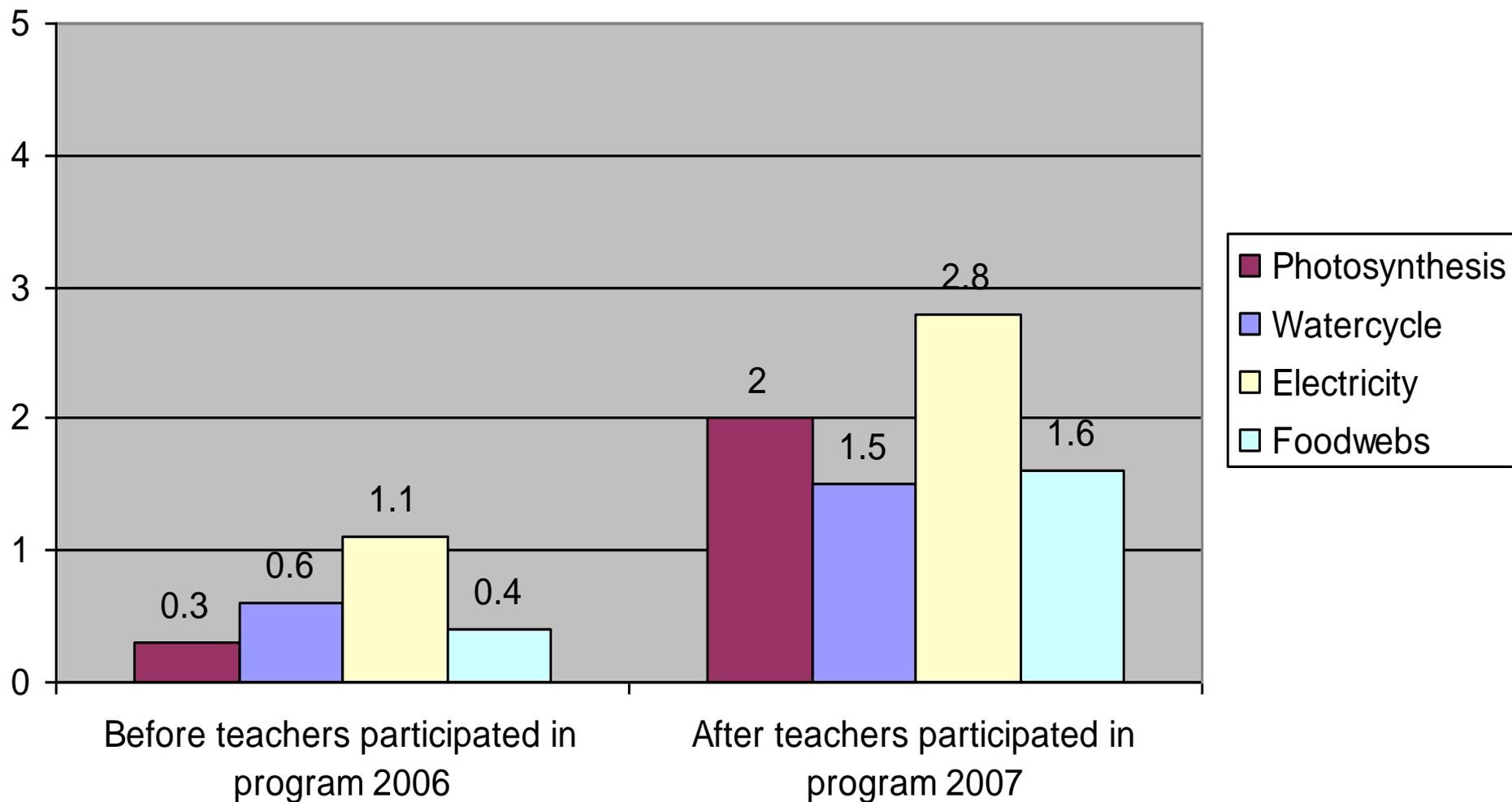




# STeLLA I: Teachers' Science Teaching Practices

- Increased use of questions that probe and challenge student thinking
- More frequently engaged students in activities designed to reveal, support, and challenge student thinking
- More frequently used strategies to create a coherent science content storyline

## Students' Science Content Learning



# How does the STeLLA PD Program achieve these results?

Features of effective professional development defined in the **NRC Report**:

- **CONTENT**: Focuses on developing teachers' capabilities and knowledge to teach content and subject matter,
- **TEACHERS' PRACTICE**: Addresses teachers' classroom work and the problems they encounter in their school settings, and
- **TIME**: Provides multiple and sustained opportunities for teacher learning over a substantial time interval.

# Features of the **STeLLA** Program

- **CONTENT:** Focused on specific science content in teachers' curriculum; deepens content knowledge in the context of analyzing practice.
- **TEACHERS' PRACTICE:** Analysis-of-practice PD using videocases in facilitated study groups
- **TIME:** One-year intensive PD program for 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grade inservice teachers [90 face-to-face PD hours]
- **RESEARCH-BASED CONCEPTUAL FRAMEWORK:** Focuses on two lenses for analysis of science teaching practice

# Analysis of practice is guided by The STeLLA Conceptual Framework

Student  
Thinking

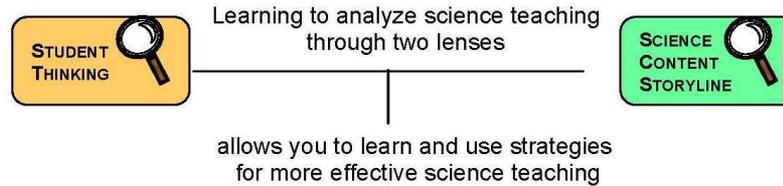


Science  
Content  
Storyline



## Strategies for Effective Science Teaching: Using the Student Thinking and Science Content Storyline Lenses

### STeLLA Conceptual Framework



#### SCIENCE TEACHING

##### STRATEGIES TO REVEAL, SUPPORT, AND CHALLENGE STUDENT THINKING

1. Ask questions to elicit student ideas and predictions
2. Ask questions to probe student ideas and predictions
3. Ask questions to challenge student thinking
4. Engage students in interpreting and reasoning about data and observations
5. Engage students in using and applying new science ideas in a variety of ways and contexts
6. Engage students in making connections by synthesizing and summarizing key science ideas
7. Engage students in communicating in scientific ways

##### STRATEGIES TO CREATE A COHERENT SCIENCE CONTENT STORYLINE

- A. Identify one main learning goal
- B. Set the purpose with a focus question or goal statement
- C. Select activities that are matched to the learning goal
- D. Select content representations matched to the learning goal and engage students in their use
- E. Sequence key science ideas and activities appropriately
- F. Make explicit links between science ideas and activities
- G. Link science ideas to other science ideas
- H. Highlight key science ideas and focus question throughout
- I. Summarize key science ideas

# STeLLA Conceptual Framework is **RESEARCH BASED**

Research support for the  
STUDENT THINKING LENS:

Large body of research on the importance of paying attention to students' naïve ideas and explanations and of engaging students in thinking and reasoning to develop meaningful understandings.

## The Student Thinking Lens: NRC Report *How People Learn Science*

- Draw out and work with the preexisting understandings that students bring with them
- Teach for understanding: Help students organize science knowledge around big ideas that enable them to use and apply that knowledge
- Track students' evolving understanding and conceptual change over time, rather than expecting “understanding” to develop in one lesson.

# STeLLA Conceptual Framework is **RESEARCH BASED**

Research support for the  
**SCIENCE CONTENT STORYLINE LENS:**

TIMSS International Video Study of Eighth-  
Grade Science Teaching

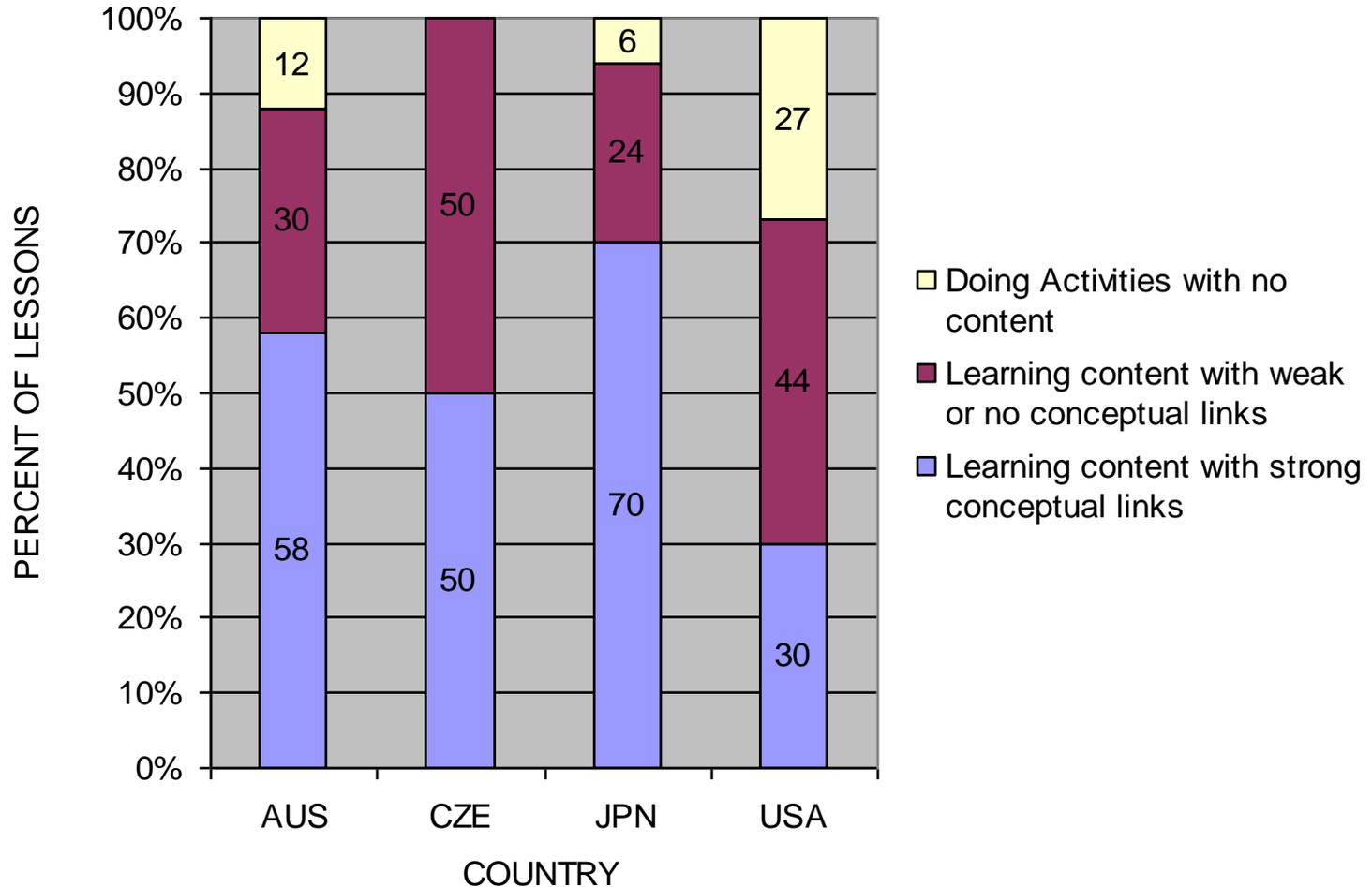
# TIMSS Video Study

- What does science teaching look like in different countries?
- What can we learn from looking at science teaching practice in higher-achieving countries?

# TIMSS Results

- Although each higher-achieving country had its own approach, they all had strategies for engaging students with core science concepts and ideas.
- In U.S. lessons, content played a less central role, and sometimes no role at all. Instead, lessons engaged students in carrying out a variety of activities.

# Connecting Ideas and Activities: Coherence in Science Lessons



## The TIMSS findings show...

- Each higher-achieving country engaged students with core science concepts and ideas.
- All the higher-achieving countries linked ideas and activities.
- In U.S. lessons, the focus was on doing activities with less attention to content and even less attention to linking activities and science ideas.

# What can we learn from the findings?

- Make science ideas more prominent in science lessons
- Develop coherent science content storylines that connect activities to science ideas and that connect ideas to ideas

# The Science Content Storyline Lens

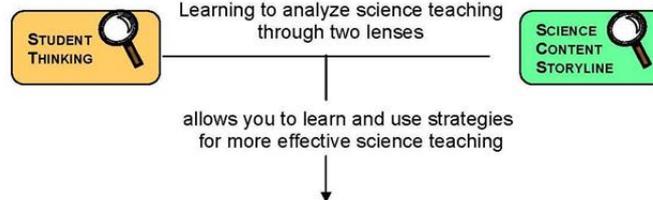
- Strengthen connections among science content ideas
- Strengthen connections between content ideas and activities
- Improve lesson coherence – science lessons as “stories” that make sense to students

# STeLLA Conceptual Framework is

# FOCUSED

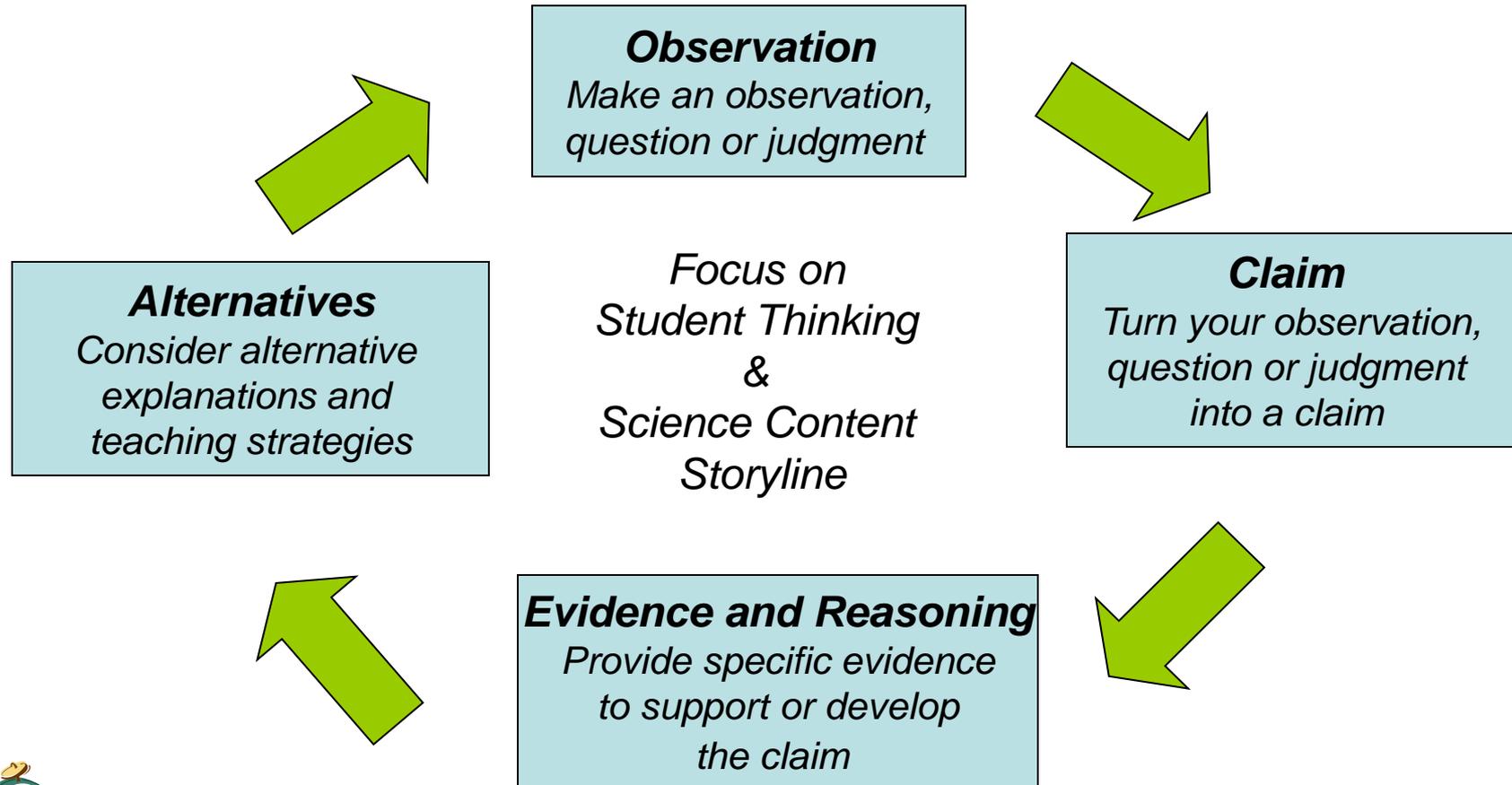
Strategies for Effective Science Teaching:  
Using the Student Thinking and Science Content Storyline Lenses

## STeLLA Conceptual Framework



<b>SCIENCE TEACHING</b>	
<b>STRATEGIES TO REVEAL, SUPPORT, AND CHALLENGE STUDENT THINKING</b>	<b>STRATEGIES TO CREATE A COHERENT SCIENCE CONTENT STORYLINE</b>
1. Ask questions to elicit student ideas and predictions	A. Identify one main learning goal
2. Ask questions to probe student ideas and predictions	B. Set the purpose with a focus question or goal statement
3. Ask questions to challenge student thinking	C. Select activities that are matched to the learning goal
4. Engage students in interpreting and reasoning about data and observations	D. Select content representations matched to the learning goal and engage students in their use
5. Engage students in using and applying new science ideas in a variety of ways and contexts	E. Sequence key science ideas and activities appropriately
6. Engage students in making connections by synthesizing and summarizing key science ideas	F. Make explicit links between science ideas and activities
7. Engage students in communicating in scientific ways	G. Link science ideas to other science ideas
	H. Highlight key science ideas and focus question throughout
	I. Summarize key science ideas

# STeLLA PD Program Lesson Analysis Process



# Whose videos are analyzed? And why?

<b>When?</b>	<b>Whose video?</b>	<b>Science Content</b>	<b>Purpose</b>
2-week Summer Institute	Videocases from other teachers' classrooms	Content Area 1	Learn about STeLLA Lenses and Strategies
Academic Year, Sept-Dec	Teachers in the STeLLA program	Content Area 1	Practice using STeLLA strategies to teach STeLLA lesson plans
Academic Year, Jan-May	Videocases from other teachers' classrooms	Content Area 2	Practice using STeLLA strategies to plan and teach new content

# Let's try STeLLA Lesson Analysis!

When?	Whose video?	Science Content	Purpose
<b>2-week Summer Institute</b>	<b>Videocases from other teachers' classrooms</b>	<b>Content Area 1</b>	<b>Learn about STeLLA Lenses and Strategies</b>
Academic Year, Sept-Dec	Teachers in the STeLLA program	Content Area 1	Practice using STeLLA strategies to teach STeLLA lesson plans
Academic Year, Jan-May	Videocases from other teachers' classrooms	Content Area 2	Practice using STeLLA strategies to plan and teach new content

# STeLLA Video Analysis Pattern

- **Read:** What are the STeLLA teaching strategies?
- **Identify:** What STeLLA strategies was the teacher using?
- **Analyze:** What student thinking was revealed by use of the strategies? Were there missed opportunities?
- **Reflect:** What did you learn from identifying and analyzing?

## Student Thinking Lens:

What kinds of questions can make student thinking more visible in science lessons?

- Ask questions to **elicit** student ideas and predictions
- Ask questions to **probe** student ideas and predictions
- Ask questions to **challenge** student thinking

# Read about ONE STeLLA Student Thinking Lens Strategy

- What is the purpose of this strategy?
- What are key features of this strategy?
- What is an example of this kind of question?

# Compare these STeLLA Student Thinking Lens Strategies

- Ask questions to **elicit** student ideas and predictions
- Ask questions to **probe** student ideas and predictions
- Ask questions to **challenge** student thinking

# STeLLA Video Analysis Pattern

- Read: What are the STeLLA teaching strategies?
- Identify: What STeLLA strategies was the teacher using?
- Analyze: What student thinking was revealed by use of the strategies? Were there missed opportunities?
- Reflect: What did you learn from identifying and analyzing?

## Preparing to **Identify** Strategies

- Watch the video
- Refer to the transcript to help you “hear” the students better
- After watching, study and mark up the transcript to identify....

**Identify** clear examples of the teacher's use of questions that...

ELICIT

PROBE

CHALLENGE

## Context for the Video Clip

- Ms. Hershberger's 3<sup>rd</sup> grade class
- The Lesson:
  - 1<sup>st</sup> of 5 lessons about evaporation, condensation, and the water cycle
  - Unit Central question: How are clouds formed?
  - Focus question for this lesson: What happens to water when it evaporates?
  - Learning goal for this lesson: *When water evaporates, it changes from a liquid to a gas, which is water vapor. The water vapor goes into the air.*

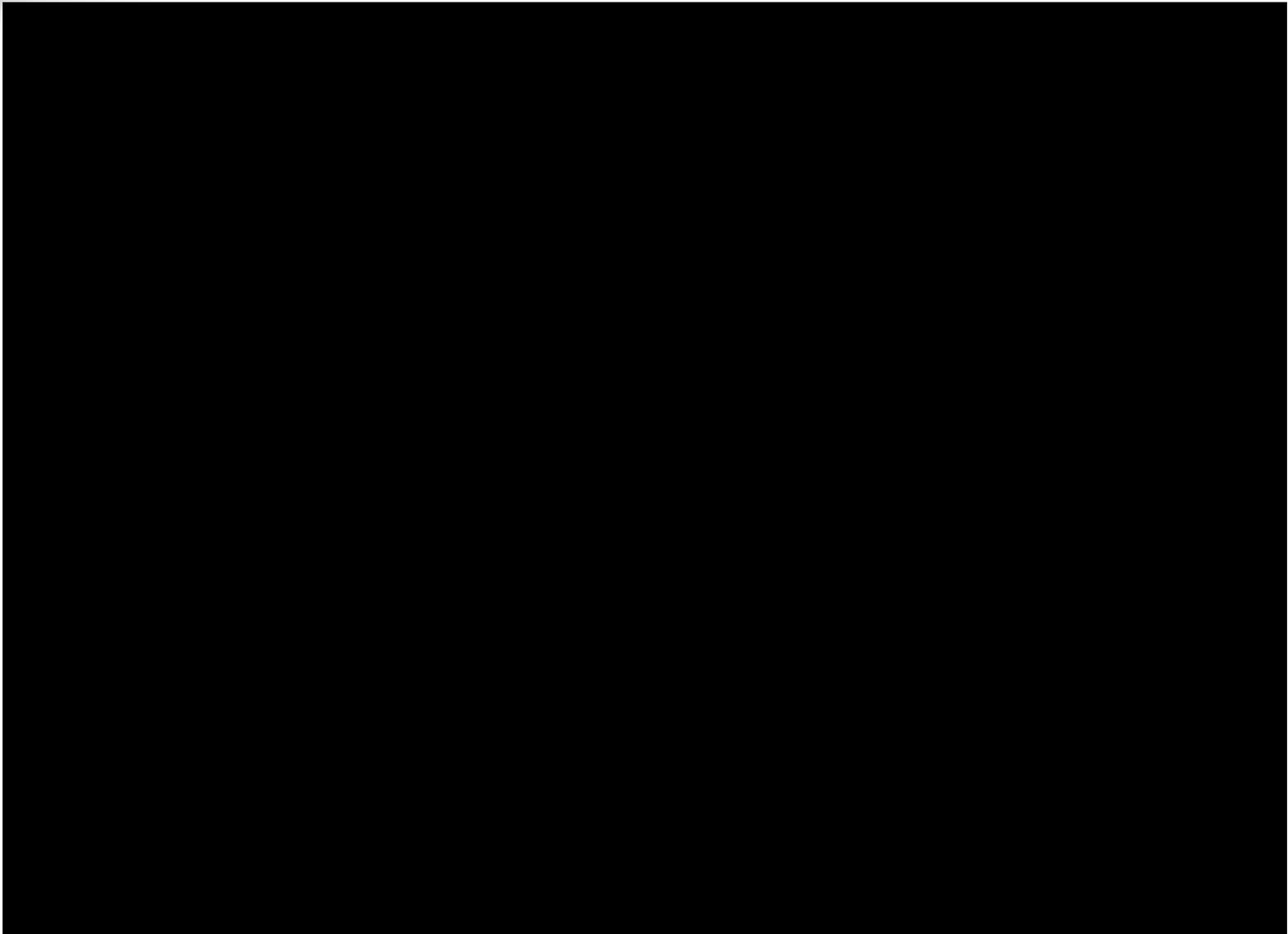
Your task....

**IDENTIFY** clear examples of the teacher's use of questions that...

ELICIT

PROBE

CHALLENGE



## Identify: Discussion

- Share examples of elicit, probe, and challenge questions you identified.
- What questions arose about the purpose of each of these types of questions?
- Were there missed opportunities to ask elicit, probe, or challenge questions?

# STeLLA Video Analysis Pattern

- Read: What are the STeLLA teaching strategies?
- Identify: What STeLLA strategies was the teacher using?
- Analyze: What student thinking was revealed by use of the strategies? Were there missed opportunities?
- Reflect: What did you learn from identifying and analyzing?

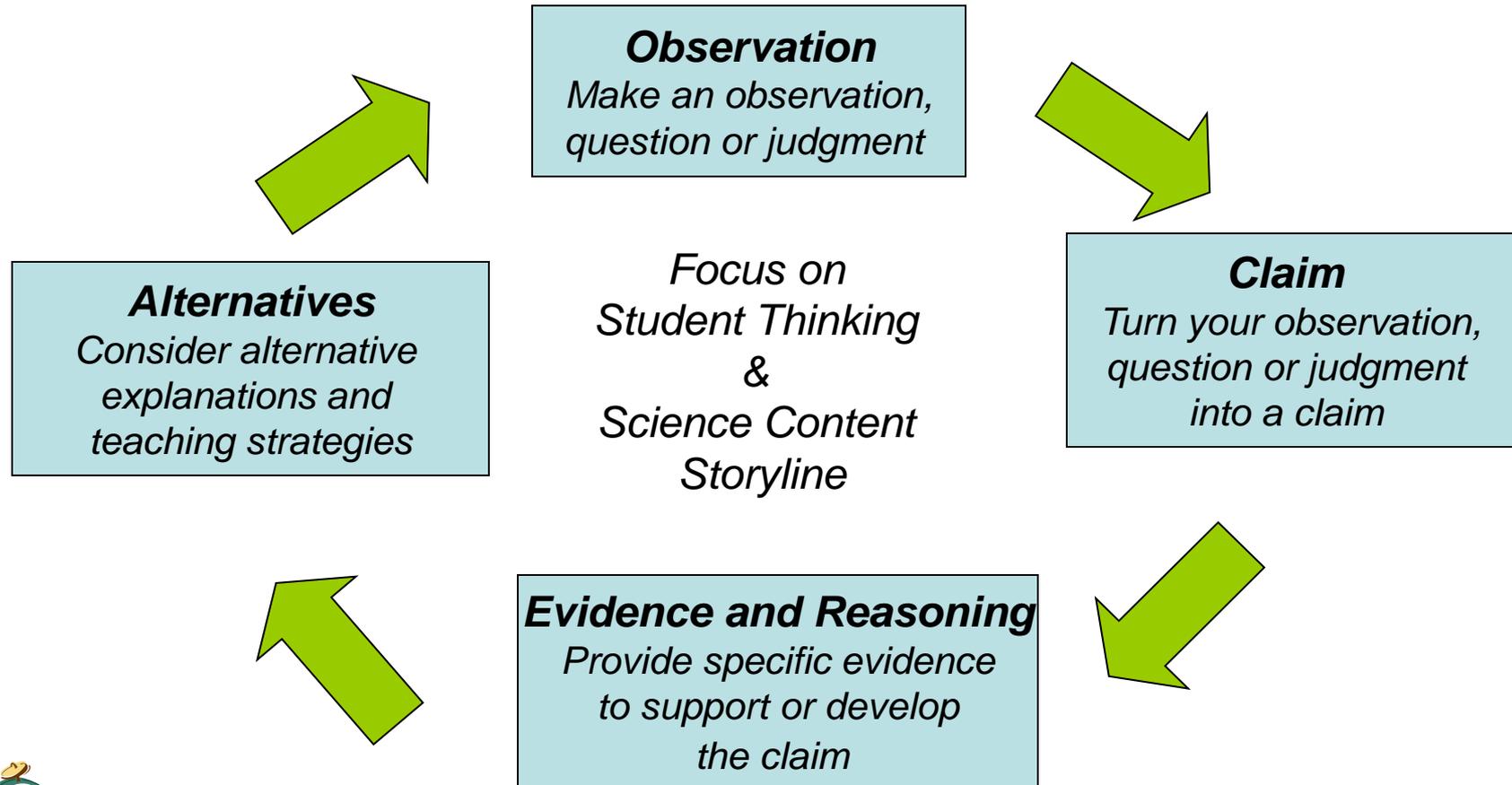
## Preparing to Analyze

- Viewing Basic #1: Look past the trivial, the little things that “bug” you.
- Viewing Basic #2: Avoid the “this doesn’t look like my classroom” trap.
- Viewing Basic #3: Avoid making snap judgments about the teaching or learning in the classroom you are viewing.

## Preparing to **Analyze**

- Analysis Basic #1: Focus on student thinking and the science content storyline.
- Analysis Basic #2: Look for evidence to support any claims.
- Analysis Basic #3: Look more than once.
- Analysis Basic #4: Consider alternative explanations and teaching strategies.

# STeLLA Lesson Analysis Process



# STeLLA Lesson Analysis Protocol: Example

## 1. Identify the Lens & Strategy:

*What Student Thinking or Science Content Storyline strategy(s) is highlighted in this lesson?*

## 2. Analyze the Focus Question(s):

*What do we learn about student thinking when the highlighted strategy(s) is used?*

*How does the identified strategy contribute to making student thinking visible or to developing the Science Content Storyline?*

*How does the “visible student thinking” relate to the intended storyline?*

Lesson Analysis Step	To Do	Example
<b>Claim</b>	Turn an observation, question or judgment into a specific claim that responds to the focus question.	I think Maria is confused about water vapor. She links the term “water vapor” to the droplets of liquid water she sees on the mirror.
<b>Evidence and Reasoning</b>	Point to a specific place in the video transcript, lesson plan, or student work that supports your claim. Also look for evidence that challenges your claim.	When Maria is breathing onto the cool mirror and seeing the water droplets form she says (14:34) “I can see my breath on the mirror!” Another student in her group says, “We have to use science words to describe what we see.” Maria says, “Oh yeah, the science word is ‘water vapor’”. Water vapor cannot be seen; what Maria sees is liquid water that has condensed on the mirror.
<b>Alternatives</b>	Consider an alternative interpretation or explanation.	Maria may know that water vapor is in her breath, which might explain why she calls the water droplets on the mirror water vapor.
	Consider new questions this might raise.	How does Maria think about other instances of condensation, like “a fogged up mirror after a shower”, or “moisture on the outside of a cold glass”?
	Consider alternative question(s), activity(s), or strategies	Probe and challenge questions would clarify what Maria was thinking. For example, “Can you point to where you think water vapor is?” “Is there water vapor anywhere else?” “What if you breathed on a mirror that was hot? Would that make a difference?”

## 3. Reflect:

*Videotaped teacher shares reflections on the analysis discussion.*

# STeLLA Lesson Analysis Protocol: Blank

## 1. Identify the Lens & Strategy:

*Identify any elicit, probe, or challenge questions in this lesson video clip.*

## 2. Analyze the Focus Question(s):

*What do we learn about student thinking when elicit, probe, and challenge questions are used? What student thinking is made visible? Are there missed opportunities to ask elicit, probe, and challenge questions?*

Lesson Analysis Step	To Do	Example
<b>Claim</b>	Turn an observation, question or judgment into a specific claim that responds to the focus question.	
<b>Evidence and Reasoning</b>	Point to a specific place in the video transcript, lesson plan, or student work that supports your claim. Also look for evidence that challenges your claim.	
<b>Alternatives</b>	<ul style="list-style-type: none"> <li>-Consider an alternative interpretation or explanation.</li> <li>-Consider new questions this might raise.</li> <li>-Consider alternative question(s), activity(s), or strategies</li> </ul>	

## 3. Reflect: *What did we learn from analysis of this video clip?*

## Questions that Elicit, Probe, Challenge Student Thinking

- As you watch, think about our analysis focus questions:

***What do we learn about student thinking when elicit, probe, and challenge questions are used? What student thinking is made visible? Be specific!***

***Are there missed opportunities to ask elicit, probe, and challenge questions? Be specific!***

- Make notes or highlight places in the transcript where you see/hear interesting student ideas.
- Develop a **claim** supported by **evidence** from the transcript and reasoning from the Strategy Documents.
- Think of an **alternative** claim or a suggested teaching alternative.

## Analyze: Discussion

- Share claims, evidence and reasoning, alternatives.
- What student ideas would you like to probe or challenge further, and what questions might you ask to better understand student thinking?

# STeLLA Video Analysis Pattern

- Read and clarify meaning of STeLLA strategy(ies)
- Identify: What STeLLA strategies was the teacher using?
- Analyze the use of the strategies in terms of student thinking or the science content storyline.
- **Reflect: What did you learn from identifying and analyzing?**

# Reflect on Your Learning

What did you learn from identifying strategies and analyzing the focus questions for this video?

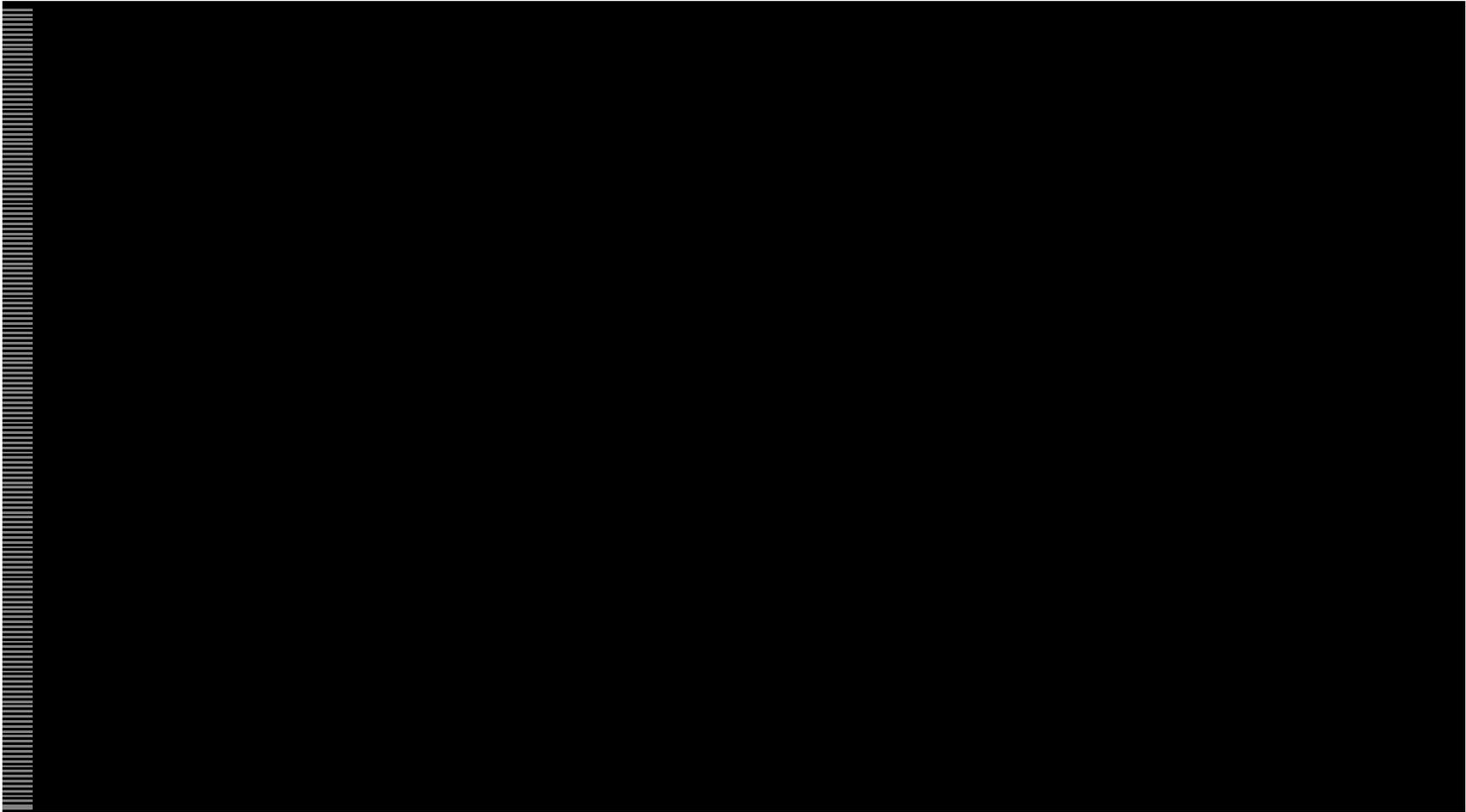
How did you learn from identifying strategies and analyzing the focus questions for this video?

# What does STeLLA Lesson Analysis look like during the school year?

When?	Whose video?	Science Content	Purpose
2-week Summer Institute	Videocases from other teachers' classrooms	Content Area 1	Learn about STeLLA Lenses and Strategies
<b>Academic Year, Sept-Dec</b>	<b>Teachers in the STeLLA program</b>	<b>Content Area 1</b>	<b>Practice using STeLLA strategies to teach STeLLA lesson plans</b>
Academic Year, Jan-May	Videocases from other teachers' classrooms	Content Area 2	Practice using STeLLA strategies to plan and teach new content

# School Year Lesson Analysis: Paul's Study Group

- This is a 4<sup>th</sup> grade study group focused on content about Earth's Changing Surface
- Teachers studied STeLLA lesson plans about Earth Changing Surface during Summer Institute
- Three teachers taught the lessons and were videotaped
- PD Leader selected clips from these lessons to allow teachers to identify use of STeLLA strategies and analyze student thinking made visible
- This is the second session where teachers examine each other's videos
- We join them as they are **analyzing** student thinking made visible in the clip



# What are the teachers learning?

- To develop their ability to analyze student thinking and learning
- To better understand the STeLLA strategies
- To deepen their understanding of the science content
- To improve their science teaching practice

## Take Away Ideas

- The STeLLA videocase-based, lesson analysis PD Program meets the criteria identified in the NRC Report, *Successful K-12 STEM Education*.
- STeLLA research shows impact on **student learning** after one year of teacher professional development.
- STeLLA research shows that teachers deepen their science content knowledge while engaged in lesson analysis work.

## Take Away Resource

Explore *Videocases for Science Teaching Analysis*. Go to *bscs.org* and search “ViSTA.”  
*Click for 14-day free trial.*

<http://vista.bscs.org>

The ViSTA modules use the same framework and lesson analysis approach as STeLLA but are packaged in an online course structure that was designed for use in methods of teaching science courses.

Thank you for your participation!

Kathy Roth  
[kroth@bscs.org](mailto:kroth@bscs.org).