STEM Smart Nevada

Video-rich, web-based professional development to improve science discussions

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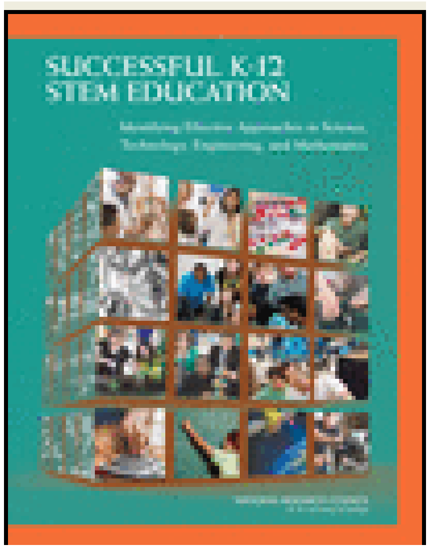
Session Focus

The Successful K-12 STEM Education Report

Our focus is the report's recommendations for effective STEM instruction, and in particular, engaging students in the practices of science talk.



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Session Goal

Use *The Inquiry Curriculum and Talk Science PD*—2 NSF-funded projects to think about the report's aims for instruction and for PD.

We'll see how coherence between curriculum and professional development can be established.

We'll explore the role of talk in science, identify instructional practices that lead to productive science discussions, and see how these instructional practices can be developed and used in the classroom.

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Session Structure

5-10 Minutes: Small groups—From your own experiences, what qualities of PD lead to more effective instruction? (5 min.)

30 Minutes: Become familiar with how the Inquiry Curriculum and Talk Science attempt to increase the productivity of science discussions.

30 Minutes: Plenary—Discuss challenges and strategies for improving the effectiveness of instruction. (30 min.)

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STEM Report—

Three PD Aims for Improving Instruction

Small Group Discussion: From your own experience, what contributes to meeting each aims?

1. Develop content knowledge and the expertise to teach it
2. Develop instructional practice
3. Provide multiple and sustained PD opportunities over time

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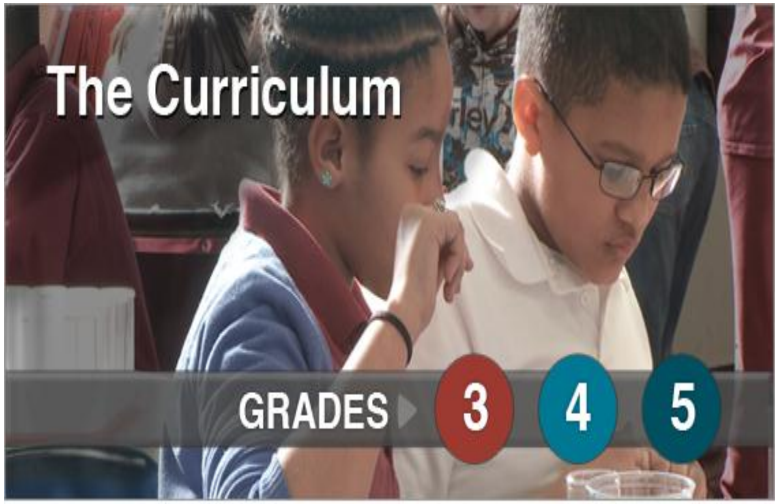
The Inquiry Curriculum

The Inquiry Curriculum: A curriculum for grades 3-5 to deepen student understanding about the nature of matter.

- Organized around an important science idea and challenge
- Focuses on a few core and component ideas—material, weight, volume, and matter
- Based on a learning progression
- Emphasizes scientific practices and science talk
- Replacement sequence



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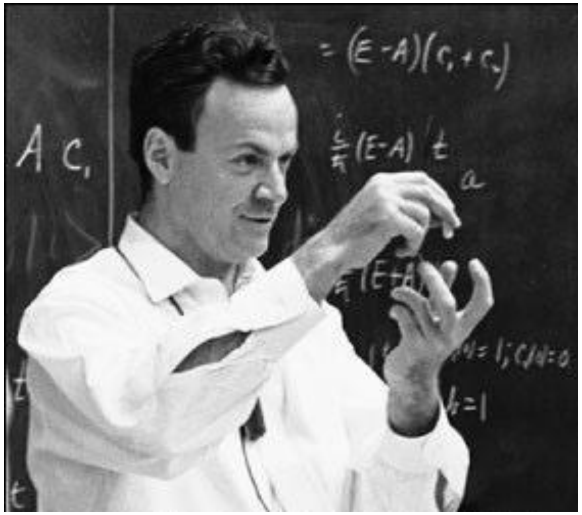
The Challenge



"If, in some cataclysm, all the scientific knowledge were to be destroyed, and only one sentence passed on to the next generation of creatures, what statement would contain the most information in the fewest words? I believe it is the atomic hypothesis.... (Feynman, Leighton et al. 1963)"

Matter is the core idea.
The atomic hypothesis is our target understanding.

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Core Ideas

The Inquiry Project BRIDGING RESEARCH & PRACTICE

Core Science Concepts

	Weight	Volume	Material	Matter
Grade 3	The weight of objects can be compared using a pan balance and standard (gram) units.	Two solid objects cannot occupy the same space. The amount of 3D space that objects occupy can be compared.	Objects can be described in terms of their weight and volume and the materials they are made of (clay, cloth, paper, etc.). Materials have observable physical properties such as color, size, texture, flexibility, etc. Same size objects can have different weights when they are made of different materials.	Materials can be subdivided into small pieces and the pieces still have weight.
Grade 4	The weight of solids and/or liquids can be compared using a digital scale and can be represented on a weight line or a table. Weight is conserved during crushing and reshaping.	Liquid and solid volumes can be measured in cubic centimeters. When immersed, a solid displaces a liquid volume equal to the solid volume.	The relationship between weight and volume (i.e. density) is a property of solid and liquid materials.	Matter can be divided into tiny pieces, and even the tiniest pieces have weight and take up space.
Grade 5	Weight is conserved during dissolving, freezing, melting, evaporation and condensation.	Volume may not be conserved in phase change.	Air is a mixture of gaseous materials composed of particles too small and spread apart to see. Melting, freezing, evaporation and condensation change the form of matter but do not change the material.	Matter is composed of particles that have weight, occupy space, and are too small to see. Gases, liquids and solids are all forms of matter and have weight and take up space.

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Based on a Learning Progression

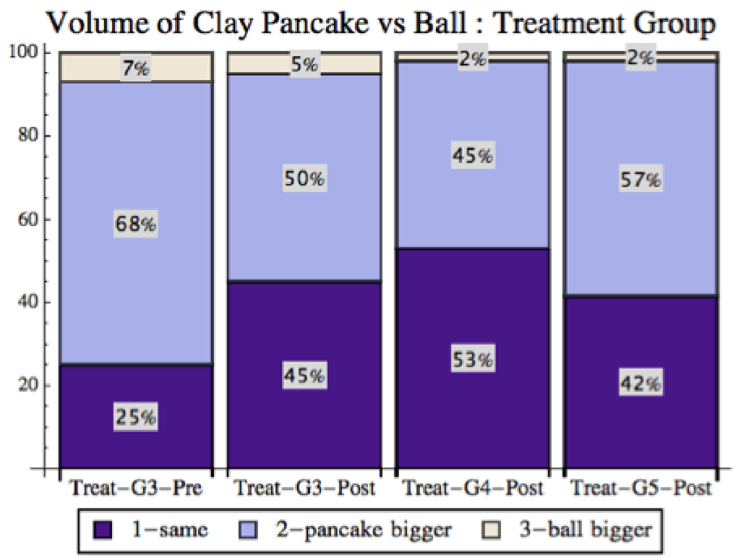
Scientific Ideas & Children's Cognition

Three-year Longitudinal Study

- Control and Treatment Group
- 345 pre/post interviews
- How Does Learning Progress?
- Take Volume

Volume across 3 Years

How Does Learning Progress?



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Volume across 3 Years

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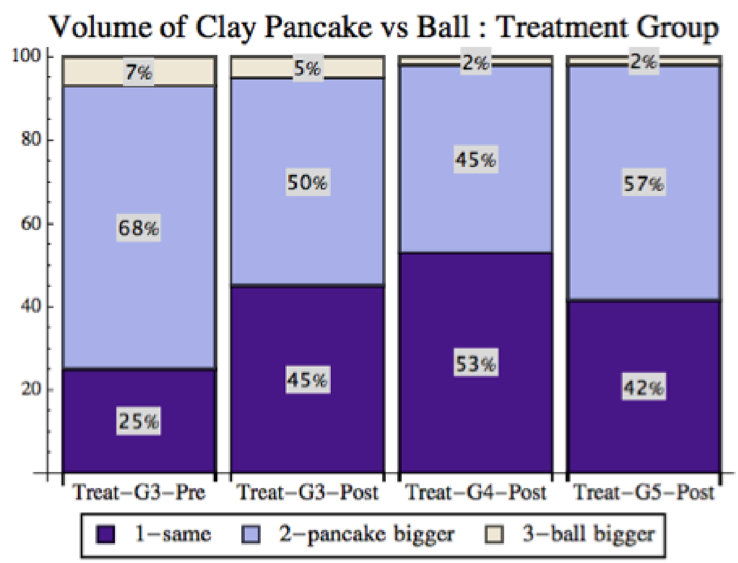

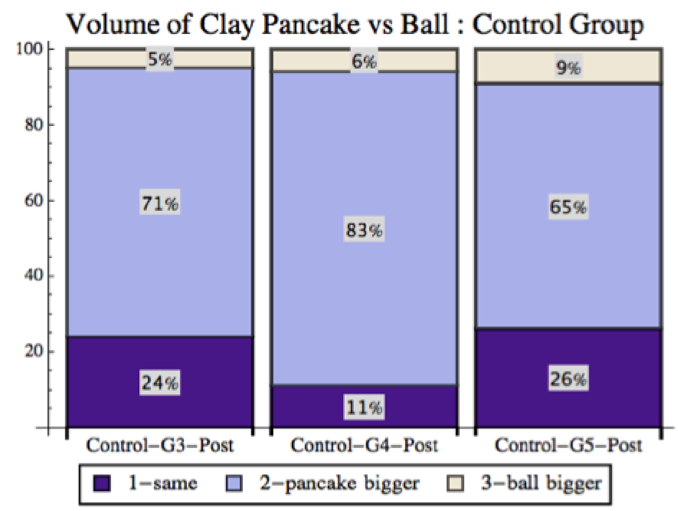

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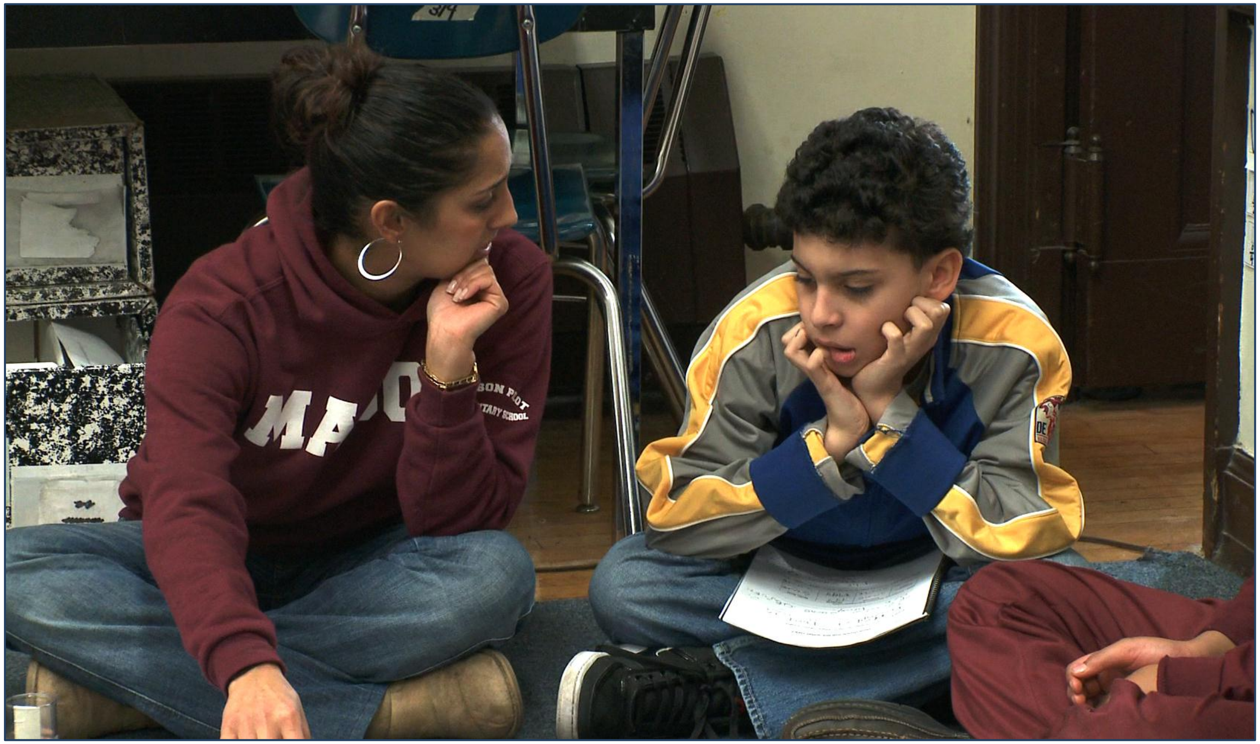
Scientific Practices

Encountered a Problem



So, We Built Talk Science

Professional development to increase the productivity of science discussions

Hybrid model that blends:

1. Independent web-based study
2. Grade level study group meetings
3. Implementation of teaching strategies into classroom practice
4. Criterion-based self-assessment

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Expected Outcome

Teachers orchestrate more productive science discussions in which students reason with evidence.

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Four Features

1. **Aligned** with the curriculum
2. **Vivid video** cases of the same discussions teachers will lead and of scientists thinking aloud about the science investigations students do
3. **Sharp focus** on nine doable teaching strategies
4. School-based learning **community**

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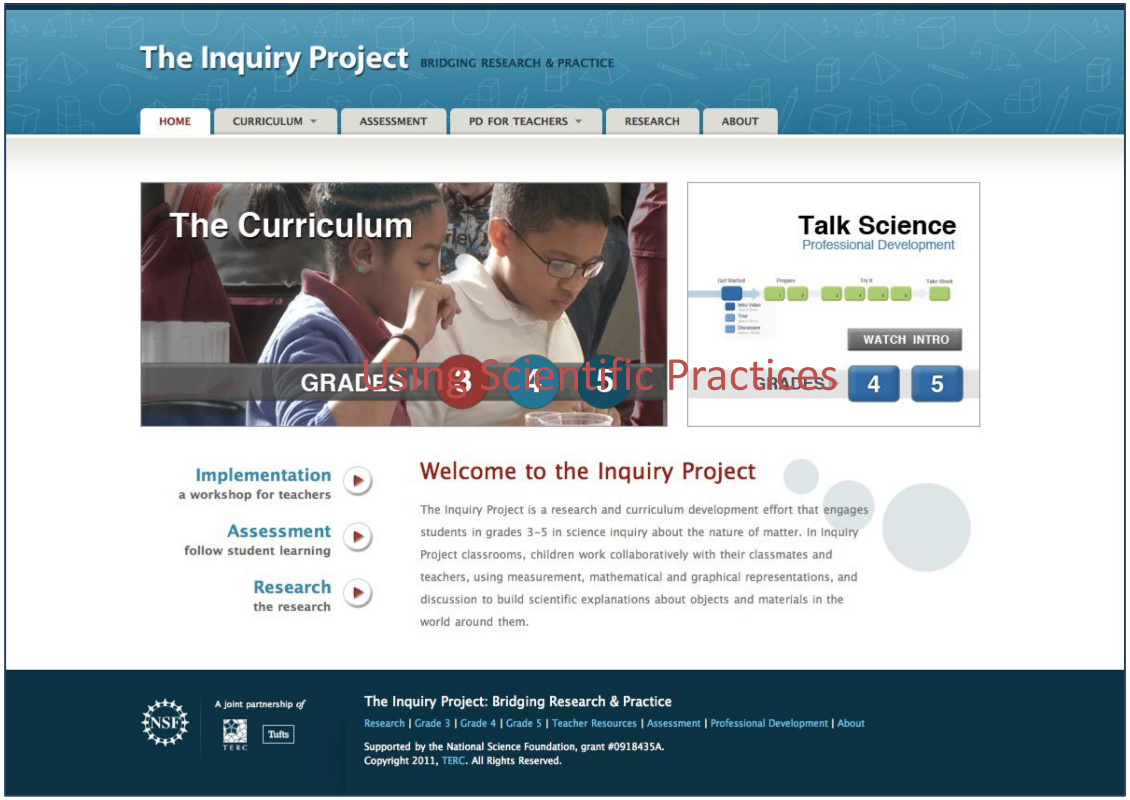
Curriculum Plus PD



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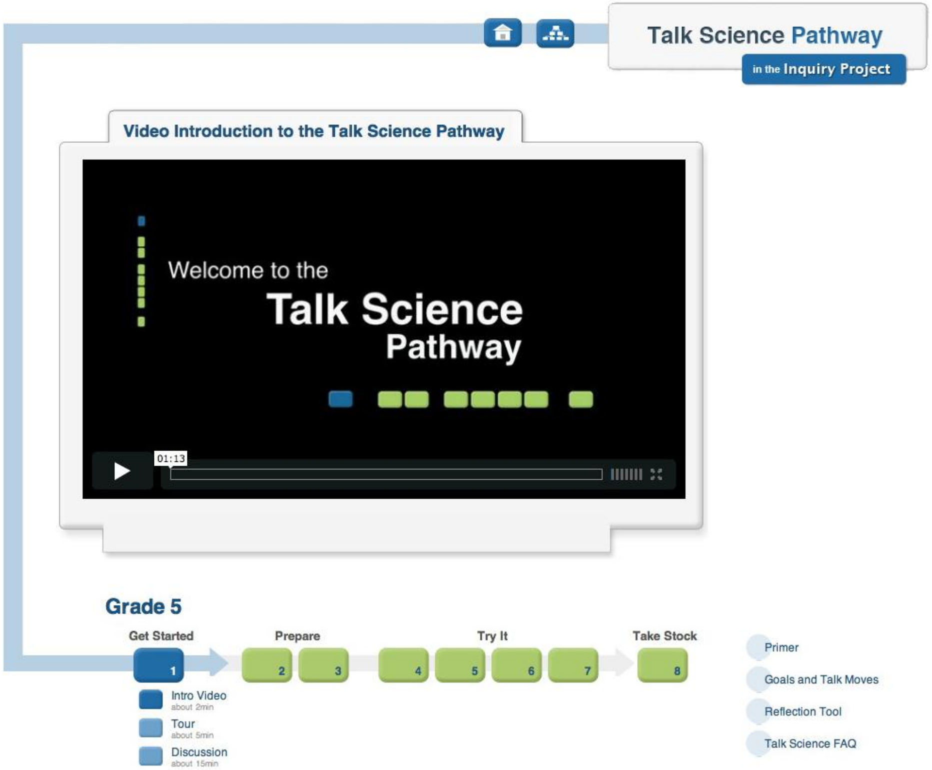
Professional Development Pathway

"Game Like"



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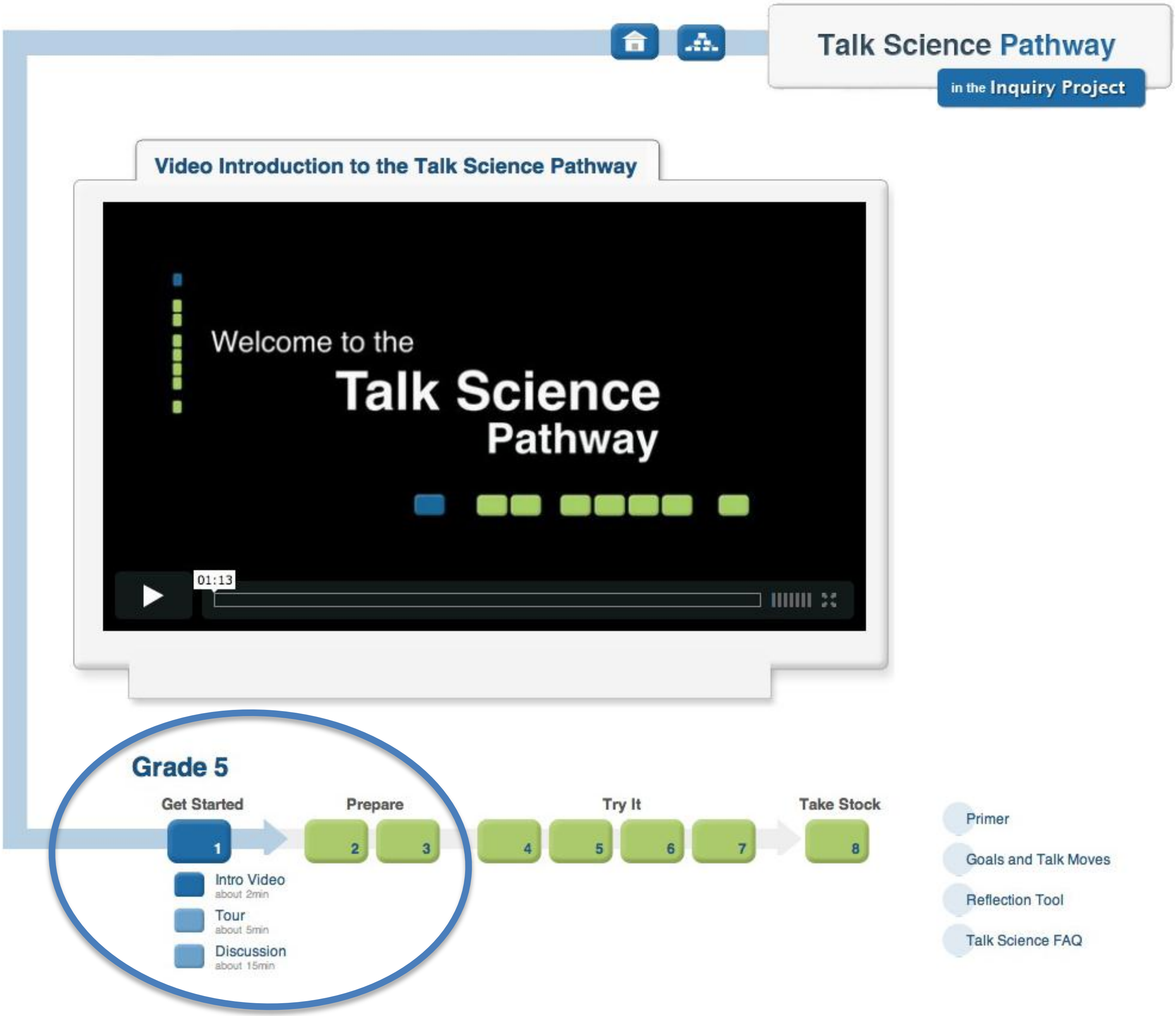

Talk Science Pathway
in the Inquiry Project
Video Introduction to the Talk Science Pathway
Welcome to the
Talk Science
Pathway
01:13
Grade 5
Get Started
Prepare
Try It
Take Stock
1
2
3
4
5
6
7
8
Intro Video
about 2min
Tour
about 5min
Discussion
about 15min
Primer
Goals and Talk Moves
Reflection Tool
Talk Science FAQ

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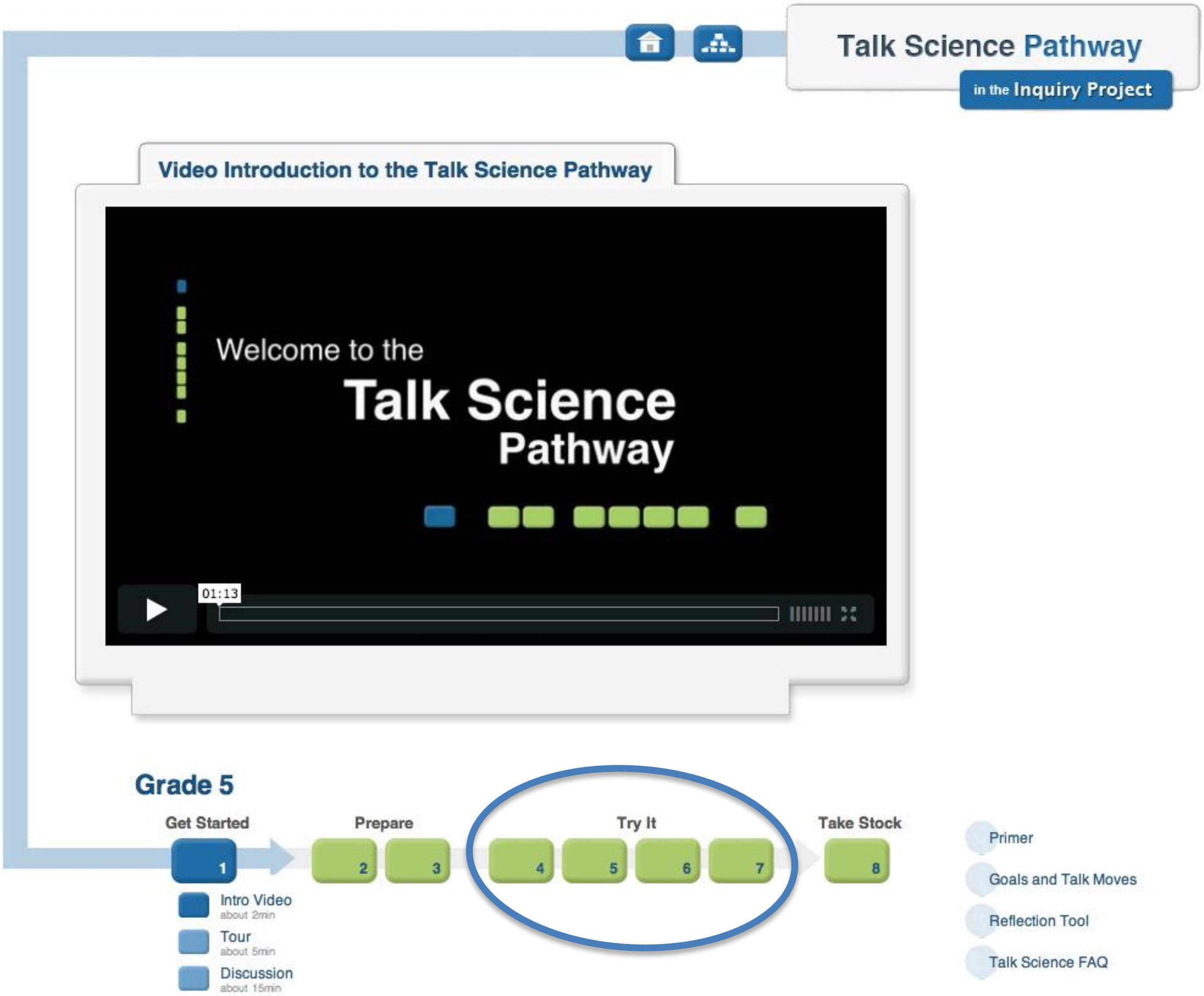

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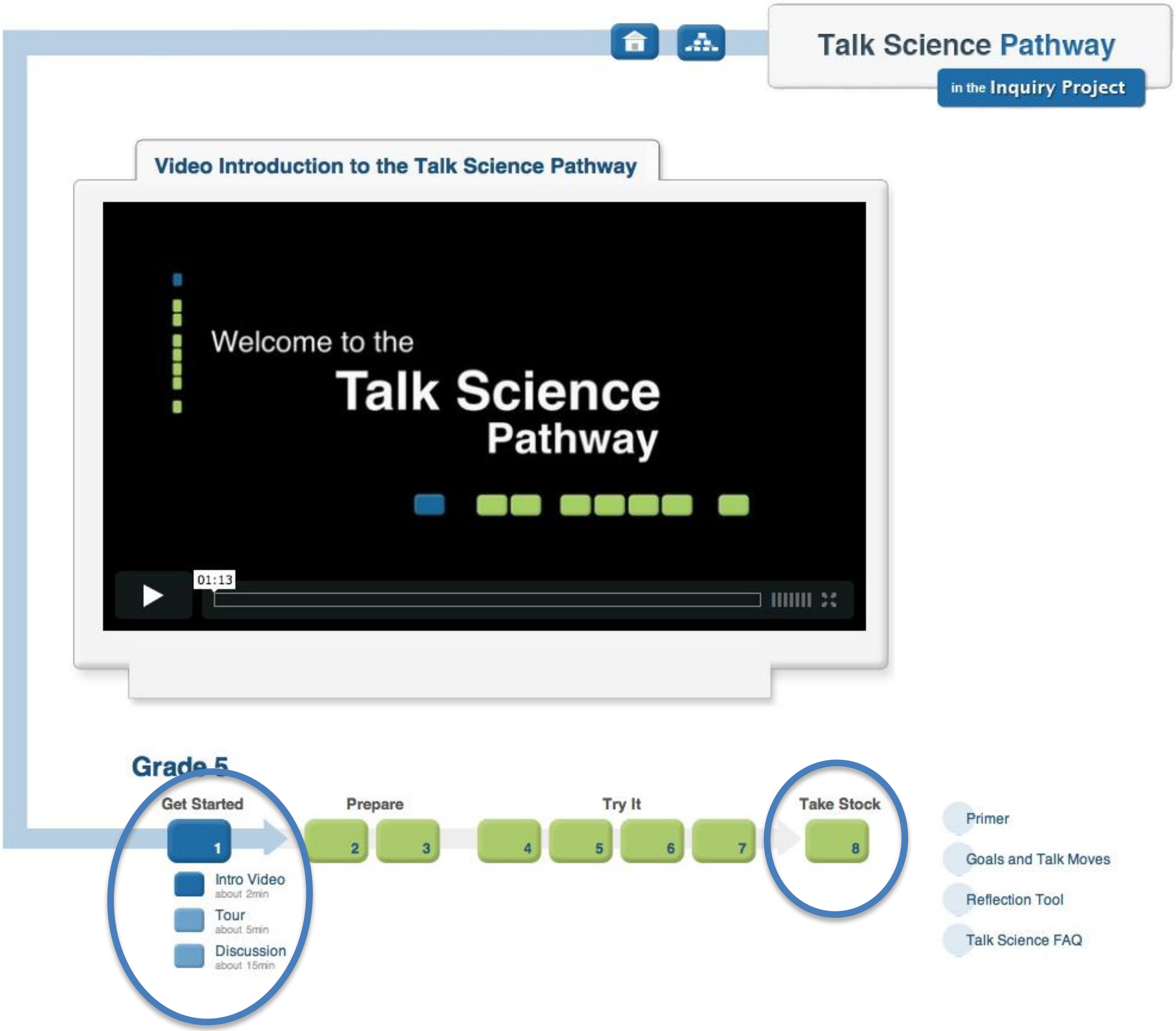
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Pathway Step

Video to Demystify

How Scientists Think

(Video available at inquiryproject.terc.edu)

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Video to Reveal

Productive Science Discussion

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Video to Reveal

Productive Science Discussion

Student Investigation: *What causes the water level to rise?*

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Video to Reveal

Productive Science Discussion

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(Video available at inquiryproject.terc.edu)

a Sharp Focus on 9 Strategies

Goals for Productive Discussions and Nine Talk Moves

Goal One: Help Individual students share, expand and clarify their own thinking		
1.	**Time to Think:** – Partner Talk – Writing as Think Time – Wait Time	
2.	**Say More:** "Can you say more about that?" "What do you mean by that?" "Can you give an example?"	
3.	**So, Are You Saying...?:** "So, let me see if I've got what you're saying. Are you saying...?" (always leaving space for the original student to agree or disagree and say more)	
Goal Two: Help Students listen carefully to one another		
4.	**Who Can Rephrase or Repeat?** "Who can repeat what Javon just said or put it into their own words?" (After a partner talk) "What did your partner say?"	
Goal Three: Help Students deepen their reasoning		
5.	**Asking for Evidence or Reasoning:** "Why do you think that?" "What's your evidence?" "How did you arrive at that conclusion?"	
6.	**Challenge or Counterexample:** "Does it always work that way?" "How does that idea square with Sonia's example?" "What if it had been a copper cube instead?"	
Goal Four: Help Students think with others		
7.	**Agree/Disagree and Why?:** "Do you agree/disagree? (And why?)" "What do people think about what Ian said?" "Does anyone want to respond to that idea?"	
8.	**Add On:** "Who can add onto the idea that Jamal is building?" "Can anyone take that suggestion and push it a little further?"	
9.	**Explaining What Someone Else Means:** "Who can explain what Aisha means when she says that?" "Who thinks they could explain why Simon came up with that answer?" "Why do you think he said that?"	

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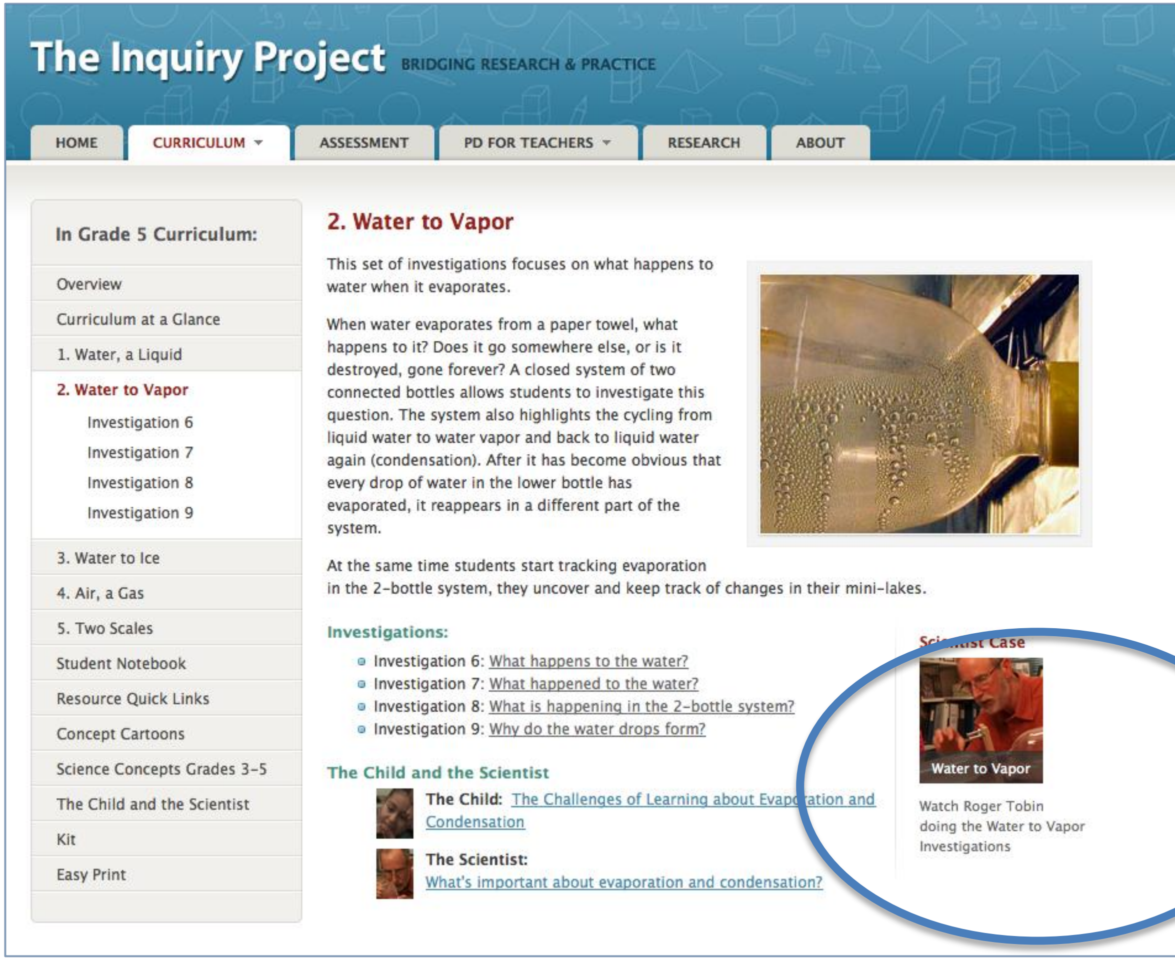
Video to Unpack

9 Strategies

Develop instructional practices

(Video available at inquiryproject.terc.edu)

Sustained Opportunity to Learn



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Pathway Step

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In Your Classroom

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Study Group

Meet with Colleagues to Reflect and Plan

"Book Club Like"

Study Group: Try It 5
Preparing To Teach Section 2: Water to Vapor
Suggested Guide (1 hour)

ORGANIZATION

To make the most of your time with colleagues: arrive on time and stay till the close of the meeting, come prepared to share ideas from the video cases and your own "In your Classroom" experiences, remain focused on the agenda, and support each other in sharing ideas and resolving challenges.

Date and time: **Location:** **Group facilitator:** Host the meeting, send out time/place/agenda reminder, prepare resources, introduce and facilitate discussion, encourage all to contribute, Role may rotate among members. **Time keeper and recorder:** Keep track of time, audiotape the discussion, and send a post-meeting summary. Role may rotate among members.	**Web study prior to meeting:** Scientist Case: The Water to Vapor Investigations Classroom Case: The Role of Explanation Discussions Strategy: Goal 2— Listening Carefully **What to bring:** Transcripts with annotations for Scientist and Classroom Cases **Study group resources:**

AGENDA & DISCUSSION QUESTIONS

Classroom Video Case

In science, explanations depend on observation, measurement, and well-established scientific principles. What is it that Colleen does to support her students in generating explanations that are based on data and evidence?

Colleen asks the question: "How do we know the salt is still there?" What makes this a particularly good organizing question for the discussion? (You may want to revisit Clip 2.)

In the video case (clip 3) students struggle to explain why they can't see the salt. Does someone put forward an idea Colleen might build on? What might she do next?

In Try It 5 we focus on the skill of listening. This skill is important as students need to know what their peers' ideas are in order to build understanding together. But scientists do even more than listen to each other, they listen with careful attention to the data. They ask, What data supports this explanation? How robust is the data? How else might the data be interpreted? What moves does Colleen use to encourage students to listen with a scientific ear? What moves could you use?

Is there something from this case that you might want to incorporate into your discussions?

Plan for "In Your Classroom"

The second section of the curriculum focuses on ideas about: *systems*, *water vapor*, *condensation* and *evaporation*. Look at the learning goals for Investigations 6-9 to see what ideas are highlighted. Based on your review of the goals and the Scientist Case, what ideas will you emphasize during class discussions?

Summary—Insights from this meeting:

PLANS FOR OUR NEXT STUDY GROUP MEETING (Try It 5)

Date and time (1 hour): **Location:** **Group Facilitator:**	Before the next meeting, study the following cases • Scientist Case: The Water to Ice Investigations • Classroom Case: The Role of Data Discussions • Strategy: Deepen their Reasoning What to bring: • Your annotated transcripts from the video cases

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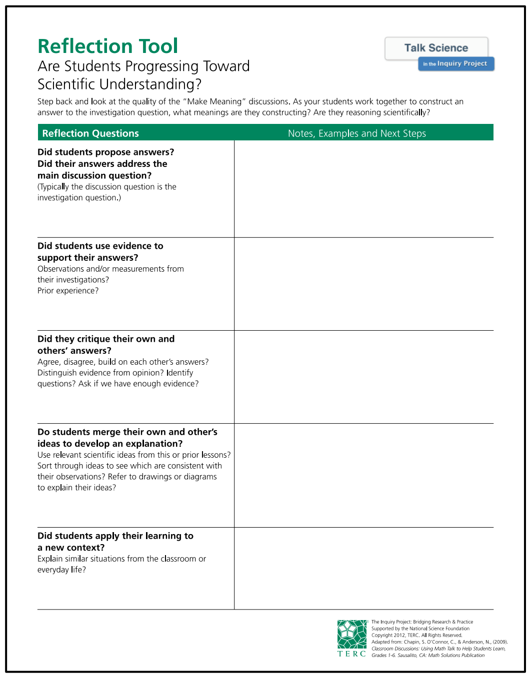
Tools for Taking Stock



Reflection Tool

Talk Science in the Inquiry Project

Are Students Progressing Toward Scientific Understanding?

Step back and look at the quality of the "Make Meaning" discussions. As your students work together to construct an answer to the investigation question, what meanings are they constructing? Are they reasoning scientifically?

Reflection Questions	Notes, Examples and Next Steps
Did students propose answers? Did their answers address the main discussion question? (Typically the discussion question is the investigation question.)	
Did students use evidence to support their answers? Observations and/or measurements from their investigations? Prior experience?	
Did they critique their own and others' answers? Agree, disagree, build on each other's answers? Distinguish evidence from opinion? Identify questions? Ask if we have enough evidence?	
Do students merge their own and other's ideas to develop an explanation? Use relevant scientific ideas from this or prior lessons? Sort through ideas to see which are consistent with their observations? Refer to drawings or diagrams to explain their ideas?	
Did students apply their learning to a new context? Explain similar situations from the classroom or everyday life?	

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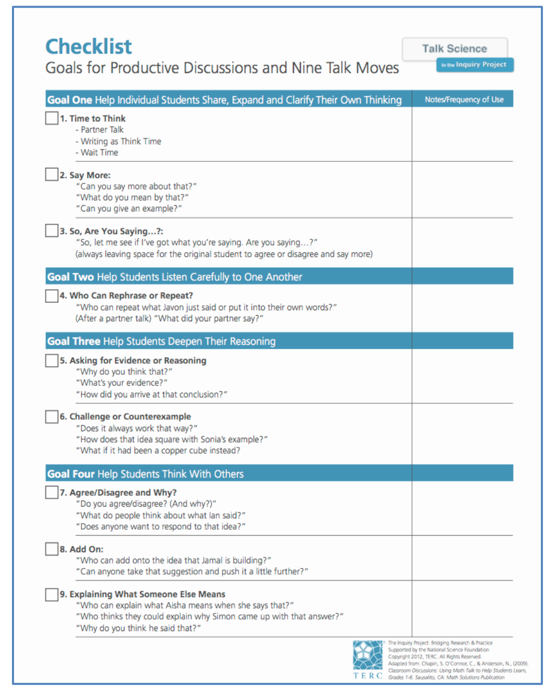

Checklist

Talk Science in the Inquiry Project

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A Closer Look

Productive Science Discussion

What is happening?

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