Talk Science Primer

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TERC

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Part 1: What is Academically Productive Talk?

The Vision

Imagine a classroom where students have just completed a science investigation and a whole class discussion is underway. Students put forth competing ideas in their clearest and strongest form, even though some ideas may turn out to be more correct than others. Students explain their ideas in detail with evidence. They listen carefully to each other with respect. Students take seriously and evaluate their own and others' competing ideas. In other words, they are intellectually engaged.

What are the hallmarks of a productive discussion such as this one?

- Everyone can hear and understand what is being said, so that every single student is part of the conversation.
- The conversation is focused, coherent, rigorous, and leads to deep conceptual understanding.
- Students are motivated to participate and want to go public with their thinking, feeling like they have a stake in the conversation.
- Conversation is not just for good talkers; everyone has a right and responsibility to contribute.
- The teacher guides students in practicing new ways of talking, reasoning, and collaborating with one another.

In the context of the classroom, talk is not an add-on. It addresses important academic content and is a critical component of the lesson, including whole class, small group, or pair or partner discussions. Through talk, teachers and students explore ideas and use evidence to build and critic academic arguments.

There is solid research evidence and widespread agreement that academically productive talk is critical for learning in science (NRC Consensus Report Taking Science to School (2007).

Isn't all classroom talk productive?

This is the vision, and yet we know that much of the talk typically occurring in classrooms is not academically productive. Teachers at all grade levels often fall back on the kinds of discussions we experienced in our own learning. These discussions were something more like recitation, where the teacher asks a question with a single right answer, calls on a student to respond, indicates whether the answer is correct, and moves on to another question. While this is often helpful for review or for checking what students remember, it fails to create a culture where students take each other seriously, take risks, and build complex arguments together.

How do we break away from this conventional pattern and facilitate discussions that support reasoning and deepen student understanding of complex material? Making the break may require a shift in classroom culture, new norms and practices, as well as a belief that students learn more when they do the "heavy lifting."

Orchestrating talk that is focused on key content, where every student is motivated and willing to participate, can indeed be challenging. However, there is a set of key elements of academically productive talk that makes this doable.

What are the elements of academically productive talk?

1. A belief that students can do it
2. Well-established ground rules

3. Clear academic purposes
4. Deep understanding of the academic content
5. A framing question and follow-up questions
6. An appropriate talk format
7. A set of strategic "talk moves"

1) A belief in the possibility and efficacy of this kind of talk.

The first key element is a belief from the outset that all students can learn from participating in well-structured discussions, and that all students are smart and capable of doing this.

> *Students have to feel a sense of trust that their ideas will be taken seriously and that disagreements will be handled respectfully, so that ideas—not individuals—are challenged.*

In addition, a teacher must be committed to two major learning objectives: deep understanding of concepts (as contrasted to familiarity with concepts), and students' ability to learn with increasing independence. Teachers who orchestrate productive talk believe that even very young children can tackle challenging, rich, and ambiguous problems, and reason about them with evidence. They believe that if their students work hard at explaining their own ideas and think through the ideas of their classmates, they will become strong reasoners. They believe that all their students—even struggling ones—are smart and have something to contribute to discussions.

2) Well-established ground rules for talk.

Before you can use talk reliably to promote learning, you must lay the foundations for it by establishing a set of clear norms or ground rules for class discussions. Most important are the norms that students will listen to one another attentively and respond respectfully. Students have to feel a sense of trust that their ideas will be taken seriously and that disagreements will be handled respectfully, so that ideas—not individuals—are challenged. Students have to speak loudly enough so that everyone can hear (which is not easy for many students to do at first), and all students have to be on notice that if they cannot hear or understand what someone has said, they have to speak up and ask for clarification. Students need to understand that this kind of talk is expected of everyone, and everyone will have a chance to participate and express their ideas, perhaps not in every discussion, but certainly over the course of several days. There are a number of ways that teachers establish these norms and many helpful strategies for holding students accountable for them, which are discussed more fully in Part 3: Establishing a Culture of Productive Talk.

3) Clear academic purposes for the discussion

Teachers who orchestrate academically productive talk take the time to plan and prepare for discussions. They make sure that they truly understand the key science concepts in play, and how they relate to other concepts that students have learned or will learn later. But most important, they take the time to get clear on the specific academic purposes of each discussion.

The Inquiry Project investigations incorporate four discussion types, each with a unique purpose:

- **Elicitation discussions** uncover students' prior experience or knowledge about a phenomenon or topic, provide insight into their thinking, and pique students' interest in new learning.
- **Consolidation discussions** help students solidify their understanding of the steps they took during an investigation, as well as the underlying science concepts.
- **Data discussions** help students focus on the dimensions of the data set that are most relevant to the investigation; for example, interpreting data or evaluating different data representations.
- **Explanation discussions** help students learn how to make claims, provide evidence to support their claims, and explain why they think the evidence and claims are tied together.

Part of the planning process for a productive discussion includes teachers anticipating how the discussion might unfold. It is helpful to articulate to yourself the key ideas you hope to bring forward, to be aware of what children typically think about a concept, and to have strategies for dealing with challenging content. And it helps for teachers to think about their particular students. Who has been quiet lately and might be brought into this discussion? Might there be an opportunity for partner talk, and what partner talk question will help me achieve the goals of my discussion?

4) Deep understanding of the academic content

The better you understand the science, the better you will facilitate discussions. The Scientist Video Cases and Roger Tobin's essays on Key Science Concepts in the Inquiry Curriculum address the essential science ideas highlighted in each section of the curriculum for each grade. Additionally, Carol Smith's essays on Children's Understanding of these concepts will help you to anticipate how your students are likely to think about these very same science topics. Understanding the core science concepts, scientific processes and habits of mind, and students' common ideas will help you recognize which ideas to bring forward for further discussion and debate.

5) A well-thought out question to frame the discussion, and a few follow-up questions.

The teacher starts the discussion with an open, clear, framing question. It should be designed to spark multiple positions, perspectives, or solution paths that can be taken, explicated, and argued for with evidence. Often, this launching question is suggested in the curriculum materials. Sometimes the teacher has to invent or adapt it from the curriculum guide. Crafting a good framing question is key to a yeasty and rich discussion.

In addition to having a good framing question, it is helpful to prepare a few follow-up questions that will help keep the discussion focused. Developing a set of questions helps the teacher to anticipate or prepare for discussion and be better able to listen hard to the students' ideas, hear connections among them, and support their development.

6) An appropriate talk format or set of formats to guide and scaffold academically productive talk.

There are different ways to organize groups for talk—whole group discussion, small group work, and partner talk. Each talk format creates different opportunities for talk and allows students to participate in a number of ways with different levels of support.

We can think of these formats as tools teachers can use strategically to support productive talk. The talk formats are discussed in more detail later in this document.

7) A set of strategic "talk moves" to help maintain a rigorous, coherent, engaging, and equitable discussion.

The final element is a set of general all-purpose moves that can be used at any point in any kind of discussion (elicitation, data, explanation, or consolidation) and can be used at any grade level. These moves support the essential goals of academically productive discussions. The goals are discussed in more detail below in Part 4: How can teachers support productive talk? Facilitating a group discussion takes work, but there is good news here. These talk moves are remarkably helpful tools for making discussions effective. You can keep them in your back pocket, so to speak, or better yet, on a clipboard in front of you, and they are especially well-designed tools for talk in busy and heterogeneous classroom settings. You will learn more about talk moves in Part 4. In addition, the Talk Science program includes videos that describe each of nine talk moves and show teachers using the moves to facilitate productive discussions in real classrooms.

Part 2: Why is talk important?

In the U.S., we have achieved a national consensus that it is critical to promote talk in all instructional subject areas and at all grade levels. All major teacher organizations and all recent National Research Council consensus reports emphasize the need to involve students actively in "communication" about their thinking and investigations, and to encourage them to use evidence to support their claims, conjectures, predictions, and explanations (NCTM, NSTA, NRC reports). Why this emphasis on talk? How does talk promote learning? And why is it particularly critical in science?

1. Talk provides a window into student thinking, revealing understanding and misunderstanding. If students talk about the content they are studying, teachers can see more clearly what they do not understand and what they do understand. Students themselves may realize what they do not and do understand. In this way, talk about academic content helps teachers and students take stock of where they are and assess ongoing learning, so that instruction can build on students' current understandings and advance their thinking in productive ways. This is formative assessment at its best.

2. Talk supports robust learning by boosting memory, providing richer associations, and supporting language development. Talk is a fertile source of information. By hearing and talking about concepts, procedures, representations, and data, our minds have more to work with. Talk provides food for thought. By talking about academic content with others, students begin to see ideas from more angles, and make links to other concepts and meanings they already have. This helps them remember new ideas and develop a richer set of associations with them, so that they can use them in new contexts. Students gain a deeper sense of what words and expressions mean and how to use them. By using scientific vocabulary, they build their ability to use this vocabulary effectively. Talk supports language acquisition, vocabulary development, and the acquisition of the particular ways of speaking and writing that are valued in science. In science and other disciplines, it can be said that "talk builds the mind."

3. Talk supports deeper reasoning and encourages students to reason with evidence. All students are adept language users, able to think abstractly and argue for what they think is right. But not all have been exposed to the kind of reasoning and explaining that is valued in school and later in public life. Such talk requires that speakers explicate their thinking clearly so that others can understand their ideas, and that they use evidence to support their claims. Students practice doing this when they are encouraged to explain their ideas and support them with evidence and link their claims and evidence so that others see that their evidence is relevant and credible. With guided practice, students' evidence-based reasoning improves, which shows up in their writing and performance on standardized tests.

Research in a variety of fields relating to education, such as cognitive science, learning sciences, and discipline-specific investigations of curriculum and pedagogy, has begun to converge on the fact that when teachers "open up the conversation" and engage students actively in reasoning with evidence and building and critiquing academic arguments, students make dramatic learning gains. This is the case for students from a range of socioeconomic and linguistic backgrounds in mathematics, science, history, and English and English language arts.

4. Talk apprentices students into the social and intellectual practices of science. Experienced scientific thinkers (professionals working in science-related fields) typically work in groups or teams, and they populate larger networks or communities where communication of their ideas, findings, and data is essential for advancing knowledge in their fields. They communicate their thinking informally and formally, in face-to-face meetings, in e-mail communications, in formal conference presentations, in peer-reviewed journals, on the Internet, and in books and other media. For evidence to have weight in these professional communities, it has to be explicated, argued for, and made public, so that others can evaluate and think about it. This requires dedicated and disciplined approaches to the explication and sharing of evidence, and agreed-upon ways of challenging or critiquing evidence in the effort to advance knowledge and understanding. Through well-structured talk, students are guided—or apprenticed—into the fundamental practices of science.

> *"Through well-structured talk, students are guided—or apprenticed—into fundamental practices of science."*

5. Talk supports the development of social skills and encourages risk-taking with huge payoffs for learning. When students believe that others are interested in their ideas, and believe that reasoning with evidence is more important than simply having the correct answer, they become motivated to engage in exploratory reasoning talk. They are willing to try out ideas before they are fully formed, so that others can hear them and think with them. They become motivated to hear others' views so that they can, in turn, think with them. This promotes a classroom culture that values effort over ability.

Students begin to realize that everyone can learn more with effort, and they begin to speak up when they do not understand something. This, in turn, motivates others to explain their thinking more clearly, so there is a spiraling effect in which greater effort increases everyone's motivation to participate, think hard, and take risks. They take one another seriously as thinkers, and evaluate the content of others' contributions, challenging ideas, not people. They gain confidence in expressing their ideas. These social skills are, of course, also intricately related to learning. A group of skillful, engaged, and respectful communicators becomes better learners over time. It takes time, practice, and effort to induct students into this kind of "talk culture," but once developed, the entire group learns more effectively and efficiently.

What is unique about science talk?

Talk in science is similar in many respects to talk in other subject areas, but has certain unique characteristics that focus on generating community-validated explanations of the natural world, based on data and models as evidence or tools in developing explanations. Primacy is given to the use of logical reasoning; anyone proposing a credible theory must be concerned about and grapple with contradictory evidence. Science requires that we change our ideas when new evidence emerges. We can challenge the credibility or value of new evidence—that is, its status as evidence—but once it is accepted as valid and relevant, we must accede to it and be willing to change our views. While science is grounded in particulars of data, the goal is always to generalize and construct increasingly broad explanations or theories.

Although scientists can never prove that something is true for all time, they are concerned about converging toward accurate and generalizable claims, or truth. They stay alert to considering new ideas or evidence, and are intent on converging on common representations or understandings. This is not to say that well-established claims or "laws" are up for grabs, using the argument that "It's just a theory!" Well-accepted and widely validated Theories—those labeled with a capital T (Theory of Relativity, for example)—take on a special status among scientists, and are rarely undermined. Their status rests not on their having been proved true beyond doubt and for all time, but on the fact that they are, at present, the most useful and widely-validated tools for thinking about, exploring, and explaining the natural world. Each scientist has his or her own limited perspective, but the goal of science is to converge on the central "small-t truth" underlying and integrating all these different perceptions of reality.

Part 3: Establishing a Culture of Productive Talk

A culture of talk is more likely to take hold when teachers develop a common set of discussion norms across classrooms, and limit the list to just three to five important ground rules. While teachers may want to develop the set with their students, this may result in a list that is too long and omits important expectations Instead, teachers can gain that same sense of buy-in by setting aside time to introduce and talk about the importance of the norms with their students. Teachers implementing a culture of productive talk often have an all-class discussion in which students explain how the expectations will benefit their discussions. Teachers report that this norm setting is best done at the beginning of the school year, when possible.

Once the expectations are introduced, they need to be reinforced until they become an established part of the school culture. Keep in mind that you may be changing the way school works for your students, so this will take vigilant reinforcement for a while. It helps to revisit the norms at the beginning of each discussion and to take a minute or two to take stock after a discussion. Teachers sometimes identify one of the norms to work on prior to the start of the discussion. Posting the norms in the classroom will help you and the students' keep them in mind. And finally, expect these norms to become the established way that all your discussions work—everyone listening, everyone contributing, everyone speaking loud enough for all to hear, and everyone respecting and building on each others' ideas.

Part 4: How can teachers support productive talk?

Teachers have a number of different tools to support academically productive talk. The tools fall into two categories:

- **Talk formats** – participation structures (ways to group your students) that guide student talk
- **Talk moves** – strategic teacher moves designed to open up the conversation and support student participation, explication, and reasoning.

Talk Formats

Different talk formats create opportunities for students to talk and allow for different kinds of participation and practice. Three formats are particularly productive within the Inquiry Curriculum: whole group, small group, and partner talk.

Teacher-guided whole group discussion

In this format, the entire class focuses on making sense around a shared problem or task. Students gather in a circle so that everyone can see everyone else to maximize listening, and make use of body language to show that they are listening.

Not only can whole-group discussions be exciting intellectually (for students and teachers alike), they can be highly productive academically. Everyone is together and benefits from access to the thinking of the entire group. The teacher is both participant and guide, able to support the students to think productively with one another, ensure that talk is respectful and equitable, and make sure that everyone can hear and understand each other (something students rarely do on their own). The teacher uses her understanding of the science content and pedagogical knowledge to maintain a high level of focus and rigor.

Teachers do this by supporting students as they explicate their ideas, make their thinking public and accessible to the group, use evidence, coordinate claims and evidence, and build on and critique one another's ideas. Teachers guide students to reason their way to deep understanding of complex problems through collective exploration of explanations, data, or natural phenomena. They support and guide rather than tell or ask students to recite.

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The benefits of whole-class discussions are many. It is worth the effort to establish classroom norms for discussion, incorporate the key elements into discussion planning, and use the strategic tools to help students engage in productive discussion.

Small group work

In this format, students work in groups of three or four, or even partnerships of two, sharing materials and ideas, and coming up with shared solutions. The teacher circulates among the groups, listening in and occasionally interacting with students if they need support or guidance to advance their collaborative work. Much of the group discussion is out of the earshot of the teacher, however, and this can be problematic. For small group work to be productive, tasks need to be designed for group work (not tasks that an individual could do by him- or herself). The teacher establishes clear expectations for the intellectual work the groups will carry out, a time limit for small group activity, and some kind of accountability. Students often reassemble as a class to make public what went on in each group and build toward collective understanding.

When norms are in place for listening, participating equitably, and collaborating in small groups, this format allows more air time for students to voice their ideas. Students may be more comfortable making their ideas public to a small group of peers rather than the whole class. When students have time to pull their ideas together in a small group beforehand, the whole-class discussion that follows is typically richer and deeper and students are more eager to contribute.

Partner Talk

While gaining in popularity, this is the most underused of the three effective talk formats but one that can be deployed to very good effect before or in the midst of a whole group discussion. In partner talk, the teacher simply pauses and asks students to consider a particular question with the person next to them or a pre-designated "talk partner." Partner talk is usually brief—no more than a minute or two. This format produces a very focused kind of exploratory talk in a low-stakes environment. It serves as a practice ground, priming the pump for more formal talk to follow. The teacher typically listens in on different talk partnerships, sometimes with a clipboard in hand to note interesting comments that she can refer to with the whole group. This kind of exploratory talk has many benefits. Students who may be shy or afraid to go public with an idea in front of the entire class get to practice it with a classmate. For English Language Learners (ELL) paired with a native speaker of English, this practice ground can be helpful for both hearing and rehearsing their ideas in English. Partner talk can be a time to use their native language to deepen their thinking before attempting to try their ideas in English.

Because the teacher is present, the task is clear, and the time is short, students tend to stay on task and treat each other respectfully. There is 100% participation. The classroom is noisy but everyone is thinking and preparing to explain their ideas in public.

Teachers use partner talk strategically in two ways. They may plan for partner talk in advance, coming up with a perfect question, posed at the perfect time, to get every student involved. Once everyone has had a chance to explain their thinking with a partner, the teacher then strategically recruits several of these ideas into the whole group discussion that follows to advance everyone's thinking. Alternatively, it sometimes happens that a question arises that puzzles the group and no one knows what to say (the teacher included). This can be a wonderful, spontaneous moment to launch a partner talk. Take the following scenario for example:

Teacher: (after something unexpected happened in a science lesson on water displacement)

So, why do you think that happened? What's your explanation?

[No hands, no responses, 25 blank faces.]

[The teacher waits 10 seconds, still nothing.]

Teacher: Okay, turn and talk to the person next to you for a minute. Then I'll ask the question again.

After 30-60 seconds, many students will have something to say. Now, the teacher can be strategic about selecting which students are to talk. Perhaps a shy student or an ELL student has something to say, and because everyone has been thinking about this question, all are interested and primed to hear it.

Goals for Productive Discussion

"Some of my students won't talk. It seems like the same few always dominate."

"My students love to talk, but don't listen to each other."

Productive discussions do not just happen. Teachers need to guide students in practicing new ways of talking, reasoning, and collaborating with one another. Many students are unaccustomed to explaining their ideas in detail and depth with evidence. Many are not accustomed to listening carefully, with interest and respect, to the thinking of their peers.

Four necessary and foundational goals underpin academically productive discussions:

Goal One: Help *Individual* Students Share, Expand, and Clarify Their Own Thoughts

If a student is going to participate in the discussion, he or she has to share thoughts and responses out loud in a way that is understandable to others. If only one or two students can do this, you do not have a discussion—you have a monologue or, at best, a dialogue between the teacher and a student.

Goal Two: Help Students Listen Carefully to One Another

Students need to listen to others and try to *understand them* in order to contribute to the discussion. Your ultimate goal involves helping students to share ideas and reasoning. It is not enough to hear a series of students giving their own unconnected thoughts one by one. Students need to hear and understand the ideas of others.

Goal Three: Help Students Deepen Their Reasoning

Even if students express their thoughts and listen to others' ideas, the discussion can fail to be academically productive if it lacks solid and sustained scientific reasoning. Most students are not skilled at pushing to understand and deepen their own reasoning. Therefore, a key role of the teacher is to continuously and skillfully press the students for reasoning and evidence.

Goal Four: Help Students Engage with Others' Reasoning

The final step involves students actually taking up the ideas and reasoning of other students and responding to them. This is when the discussion can take off and become exhilarating for students and teachers alike.

These four goals are critical in promoting discussions that lead to greater learning. Unless students are developing new and expanded ways of talking and arguing, and new ways of listening and attending to the thinking of their peers, using evidence and data to support their claims, the talk may remain superficial and fail to lead to robust learning.

Talk Moves

Orchestrating talk that focuses on key content, where each student is motivated and willing to participate, everyone can hear and understand what is said, and students are guided to talk and argue in new ways can be challenging. Research over the past 20 years and documentation of teachers who facilitate productive discussions has led to the identification of a small number of general talk moves that are remarkably helpful tools for making discussions work. These talk moves can be used at any point in a discussion, in any subject domain, and are especially helpful in classroom settings. They strategically set students up to think, reason, and collaborate in academically productive ways.

Different talk moves do different kinds of kinds of work in achieving the four goals. Some prompt students to share and expand upon their ideas, others help them listen carefully to one another. Still others help students dig deeper as they provide evidence to support their claims, and some help students think with the reasoning of others to build on, elaborate, and improve the thinking of the group. The goals and supporting talk moves are summarized in the following table.

Goals for Productive Discussions and Nine Talk Moves

Goal: 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: 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: 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?"
   "Is there anything in the text that made you think that?"

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: Students think with others

7. **Agree/Disagree and Why?:**

   "Do you agree/disagree? (And why?)" "Are you saying the same thing as Jelya or something different, and if it's different, how is it different?" "What do people think about what Vannia said?"
   "Does anyone want to respond to that idea?"

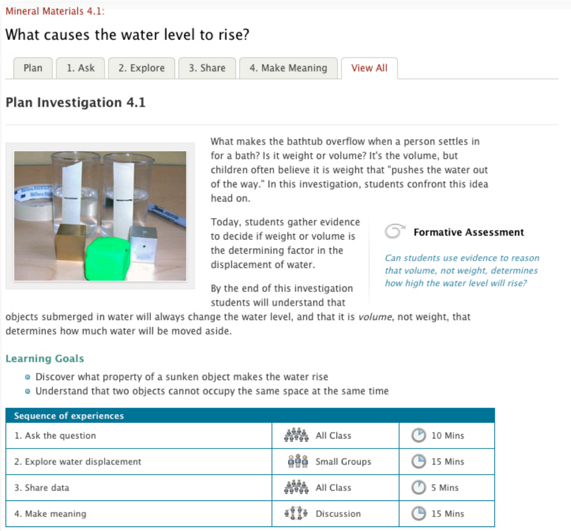
8. **Add On:**

   "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 in their words why Simon came up with that answer?" "Why do you think he said that?"

You will find each of these talk moves helpful in achieving the overarching aim of supporting scientific reasoning, argument, and learning through talk.



An Example of a Productive Science Discussion

Below we explore these four goals and the small set of talk moves that support each one in the context of an actual example. This is a constructed, composite example but it is based on videotapes of Inquiry Project lessons, using the actual words of students. (You can see a video of an extended segment of this discussion on the website.)

Through the example, you will see how talk moves are used and the work they do for both teacher and students. First some background about the investigation students were engaged in so you have a sense of the role of the discussion within the investigation.

Background

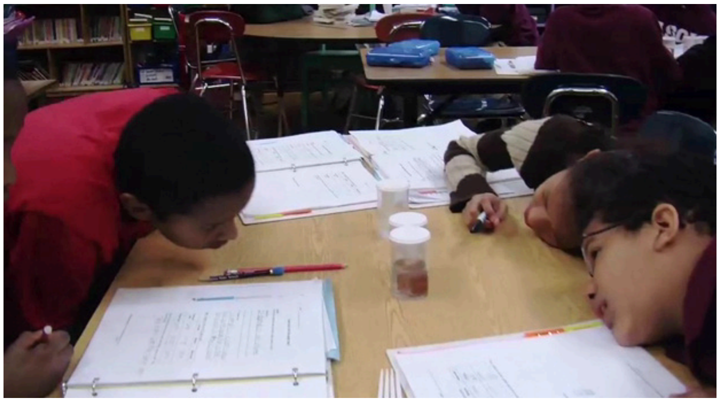
Fourth graders are investigating water displacement (Investigation 4.1 in the Inquiry Curriculum). They are attempting to figure out whether it is weight or volume that makes the water level rise when an object is dropped into the water and sinks. In the beginning of the session, the teacher, Ms. B., has her students sit around her in a circle so everyone could see one another, and poses the guiding question for the investigation:

> *Ms. B.: All right, over the past several days, we've been investigating a lot about volume and weight. Who can remind us of some things we've learned together?*

[Several exchanges follow where students summarize some of the group's understandings. Luis says, "Volume and weight aren't the same." Jayla adds, "If two materials have the same volume, they can have like, um, a different weight?" Frank says, "Yeah, we learned that volume doesn't depend on weight and weight doesn't depend on volume."]

> *Ms. B.: Well, today we are going to take those ideas of what we've learned about volume and weight and think about them a different way. So our big question for today is, what causes the water level to rise? When you put an object in water, like this rock, what causes the water level to rise? Is it weight or volume? Take a minute and think about that question.*

After a long pause, Ms. B. has students rephrase the question in their own words and asks for their ideas. Nearly all think that it is weight, rather than volume that makes the water rise (a misconception widely shared by both children and adults). They reasoned



that heavier things would make the water rise more because they have more force to push the water out of the way. Ms. B. was careful in this discussion not to tell the students the correct answer, but to elicit a number of different viewpoints.

Ms. B. then explained the investigation for the day—the students will return to their tables in groups of four and explore what happens when they immerse in water two metal cubes that have the same volume: 1) a copper cube (weighing 147 gm.) and 2) an aluminum cube (weighing 44 gm.). They also have a cube of plasticine that was slightly larger in volume than the two metal cubes, but also weighed 44 gm. They were to write their predictions (about what would happen to the water level in each case) and then record their results.

For the next 20 minutes, the students in groups of four carried out their investigations (see photos) and then regrouped in a circle, their science notebooks in hand, to discuss their findings.

Talk Moves in Action

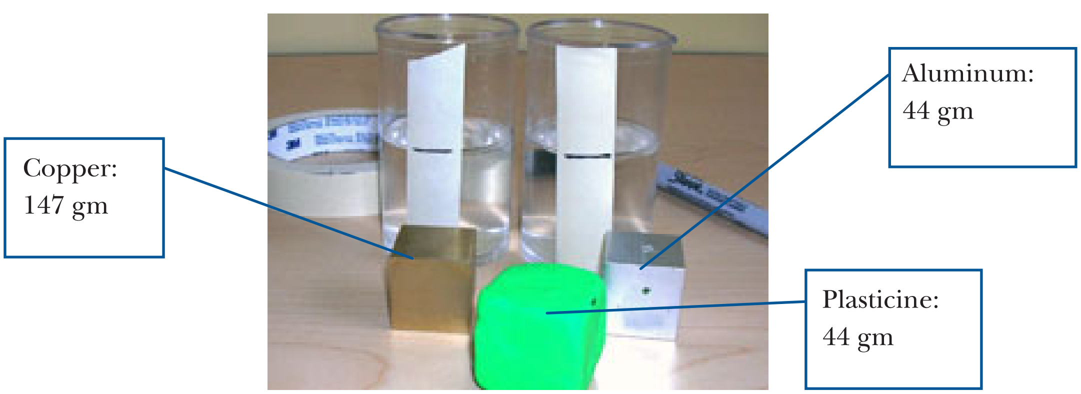
Talk moves that help individual students share, expand, and clarify their own thinking (Goal One)

- **"Say More"** (asking a student to expand on what he or she said)

Students often assume that their perspective is shared by everyone. So a student's response to a question is often very condensed and does not fully spell out his or her thinking. When a student does not say much, it is hard to understand their thinking. When this happens you can ask the student to expand: "Can you say more about that?" or "Tell us more about your thinking." or "Can you expand on that? or "Can you give us an example?"

- **Wait Time** (silence or "Take your time. We'll Wait.")

This is perhaps an odd talk move because it is actually silence, a pause in the talking. But providing time (3-5 seconds or more) after asking a question, as well as after a student has



spoken, has been shown to help all students, particularly English Language Learners, expand, explain, and clarify their ideas. This talk move sends the message that the teacher wants to understand the student's thinking and seeks more than just a nominally correct answer. It also gives the student time to regroup and clarify, as in the following example:

> *1. Ms. B.:So now that you've had a chance to investigate with your cubes and plasticine in your groups, what do you think? Is it weight or volume that makes the water level rise? [8 seconds of* ***Wait Time****. Gradually several hands go up.] Jashida?*
>
> *2. Jashida: It's the weight, I mean, they all have weight, so yeah it's the weight, um, of the volume.*
>
> *3. Ms. B.:* ***Can you say a bit more about that?*** *Tell us what you mean and how you figured that out.*
>
> *4. Jashida: I came up with–I thought that–I thought that it was, um, the weight for the copper cube, and the aluminum cube because, because in my group, I found out that the alumin-, the, yeah, the aluminum cube, had less, less–the water went up less. It didn't go up more than the copper cube. So it's weight.*

• **"So, are you saying?"** (asking a student to verify your interpretation and clarify their thought)

When students talk about complex phenomena in science, it is often difficult to understand what they say. And if you as the teacher have trouble understanding a student's reasoning, the student's classmates will likely not do any better. Yet given your goals to improve the thinking and reasoning of all students, you cannot give up on an especially unclear student. Deep thinking and powerful reasoning do not always correlate with clear verbal expression. Therefore, teachers need talk moves that can help them interact with the student (without putting the student on the spot) in a way that will encourage a student to clarify his or her own reasoning.

One such tool is "So, are you saying?" Here the teacher essentially tries to repeat some or all of what the student has said, and then asks the student to verify whether or not the teacher's representation is correct, as in the next stage of our example. In doing this, she leaves room for the student to clarify her original intention.

After hearing Jashida's contribution in (2), Ms. B. could grasp that Jashida was claiming that it is weight, not volume (an incorrect claim). But she is unsure of the basis for Jashida's claim. By asking her to "say more," the situation improves, but is not cleared up entirely. Ms. B. knows that Jashida seems to be thinking that she has evidence in her notebook that the water level rose less with the lighter aluminum cube than the copper cube. Ms. B. also knows that this is NOT what Jashida and her teammates found because she visited their table and saw Jashida's science notebook. And, of course, Ms. B. is fully aware that thinking it is weight rather than volume is a common misconception, and that this might be leading Jashida to misread her own data. By phrasing this guess as a question, she is asking Jashida if her understanding is correct. By waiting for her answer, she gives her a chance to clarify.

> *5. Ms.B.:* ***Okay, let me see if I understand. So you're saying you found that the water level rose more with the copper cube than with the aluminum cube, and so that's what's making you think it's weight and not volume? Do I have that right?***
>
> *6. Jashida: Yeah. Because, right here [pointing to her notebook], it says that…oh wait [6 second*

pause], I'm confused. The water rose the same with both cubes. Wait. I think I made a mistake. I think it's weight because the heavier cube makes the water go up more, just a tiny bit more, even if it's hard to see. The heavier object has more force and it pushes the water up more.

By opening this conversational space for Jashida to respond, Ms. B. has learned that Jashida WAS misreading her data and still holds the basic misconception that weight rather than volume causes the water level to rise. That is, she is treating her data as if it contains an error. Ms. B. gained a foothold in the discussion that she lacked after simply hearing her contributions in turns (2) and (4). Now Ms. B. has to somehow include other students in this conversation. She has to ensure that everyone is following and can think about their own findings and what they mean, in light of Jashida's contribution.

Talk moves that help students *listen carefully* to one another (Goal Two)

• **"Who can repeat/rephrase?"** (asking students to restate what has been said)

When a student says something potentially important, whether it is correct or not, you may want to ensure that everyone can engage with that idea. But if other students did not hear it or were not paying attention, they will be unable to take the next step and think about it. There are many ways to do this, using what we call a "Who can repeat?" move. "Who thinks they understood what Jashida was saying and can put it into their own words?" or "Who can just restate what Jashida said?" or "What do think Jashida was saying?" Even in cases where the student is not correct, all students can benefit from understanding the reasoning behind it, particularly when a common misconception is at stake.

7. Ms. B.: ***Who thinks they could repeat or put into their own words what Jashida has said?***

8. Luis: I think I can. I think what she's saying is, um, that she thinks it's the weight that matters, because heavy things have, um, more force than light things. And I think she said that the heavy cube made the water rise a tiny bit more than the aluminum cube.

9. Ms. B.: Is that right Jashida? ***Is that what you were saying?***

10. Jashida: Uh huh. Yep.

11. Luis: But I'm confused. Because we found that the copper and aluminum cube went up the same amount. I mean, um [looking at his notebook], it made the water go up the same amount. And it was the–the plasticine that went up a little bit more, not the copper cube.

Notice that in line 9, Ms. B. checks back with Jashida to see if Luis got her idea right.

It is important to note that Ms. B.'s "Who can repeat or put into their own words?" move (in line 7) is **not** being used as a management move. Some teachers use this move to "catch" students who are not listening, but we recommend against using this move as a management tool. Students will be more enthusiastic if you use it in a positive way, asking for volunteers who think they **have** understood to repeat the idea or put it into their own words. Notice that Ms. B. asked someone to repeat what Jashida said, even though she **knew** that Jashida's idea was incorrect and contained the misconception with which many students began the investigation. Some might think that having this idea repeated will only confuse students and reinforce the wrong idea. However, if everyone has not heard and understood Jashida's idea, albeit an incorrect idea, they will be unable to think with it and interrogate it. If alternative conceptions or misconceptions are not explained and explored, students never fully understand what is problematic about them. It is here that Ms. B. has "set the table" for digging deeper into the data and letting different views come into play.

Talk moves that help students *dig deeper*, and provide evidence to support their claims (Goal Three)

- **Press for reasoning** (asking students to explain their reasoning)

Even if students speak so that everyone can hear, and even if they listen carefully to one another, it is possible that the discussion will remain at a superficial level. To deepen the shared reasoning, students must get used to explaining why they say what they say, and what the evidence is behind their claims. There are many ways to press for reasoning. Here are some examples.

Why do you think that?

What convinced you?

Why did you think that strategy would work?

Where in the text is there support for that claim?

What is your evidence?

What makes you think that? How did you get that answer?

Can you prove that to us?

Some students are not used to explaining their thinking in this way, and may at first be puzzled. *How did you know?* "I looked at our data." Or "I can't explain. I just know."

So you may need to be persistent.

At this point, Ms. B. has elicited Jashida's idea (weight not volume), and has heard, along with the group, her reason for it. And Luis has admitted some confusion over Jashida's results and the results he got in his group.

12. Ms. B.: Okay, let's slow down a little bit. It sounds like we need to discuss our data, our evidence. Can someone from Jashida's group explain their results? What did you find when you put your two metal cubes in the water? Alicia, you were in Jashida's group.

13. Alicia: Yeah, well I think I have to disagree with what Jashida said. What we found in our group is that, um, the metal cubes (pause), both made the water rise, like, the exact same amount. The copper cube was heavy and the aluminum cube was, um, lighter, but they both went up, the water went up the same. And we found that our plasticine cube made the water go up a little more than the metal cubes, even though it weighed, like, exactly the same as the aluminum cube. Kind of like what Luis said.

As you help the students dig deeper and explain or clarify their reasoning, everyone else has to be listening and following along. Even if the speaker is correct and clear, that does not mean that everyone else will hear and understand. Many students will tune out as they hear a classmate produce a long and complex piece of reasoning with pauses. This is an ideal time to use the **Who Can Repeat?** move introduced above, and ask for volunteers to put the student's ideas into their own words. Some might object that it takes extra time and it does, but everyone benefits. The student being repeated is honored by being taken seriously, and the student repeating has a chance to practice explicating a complex idea. And everyone in the group gets a second chance to hear and consider the idea. That is, it serves as a kind of Wait Time for everyone. The entire group moves forward together deepening their understanding of core concepts and explanations.

After Alicia's contribution in line 13, Ms. B. decides to ensure that everyone is following:

14. Ms. B.: Alicia, you said a lot. ***Can anyone put that into their own words?***

15. Johnny: Yeah, she said that in her group, they found that the cubes, um, aluminum and copper cubes, made the water go up the same, and they were, um, different weights. And that's what we found too. And the plasticine did make the water go up more. But it was lighter, a whole lot lighter than the copper. And so doesn't that mean that the weight didn't make the water go up?

Talk moves that help students think with others, or apply their reasoning to the ideas of others (Goal Four)

After everyone hears and understands the claim and the reasoning behind it, they are ready to think with that idea, to apply their own reasoning to the thinking of someone else.

• **Do you agree, or disagree…and why?** (asking students to take a position)

This talk move helps you guide the students to consider seriously the reasoning of their peers. There are a number of variants of this "Agree-Disagree/Why?" move. Other versions include "Who has a similar idea or a different idea about how this works, and how is it similar or different?" "Does someone want to respond to that idea and tell us why you agree or disagree?" Some teachers say, "Thumbs up if you agree, thumbs down if you disagree." Note, however, that it is crucial that you follow up with the question "Why do you agree?" or "Why do you disagree?" Otherwise, there is a chance that students will just "phone it in" and assert that they agree without much thought. Moreover, asking, "Does everyone agree?" or "So do we all agree?" and getting a chorus of yeses is not the same move. It telegraphs to everyone that there is one right answer, and students will stop pursuing their own ideas if they are different.

Ms. B. decides that the students are ready to build on each other's thinking, and think together about their results and what they mean.

16. Ms. B.: So, I'm, hearing some different ideas here, about what happened and what made the water level rise. Could someone from another group explain what they found and tell us where you stand? ***Do you agree or disagree and why?***

17. Mathais: Well, my group, we found out that that the–we thought it was because of the volume, because we found that the volume and the water level were the same, but the weight was different. And I thought that if–if the weight, was, um, there's more weight in the copper cube than the aluminum cube, then I think it just should depend on the volume because the weight, if it was more, the copper cube is more, then it would have more volume. If it really depended on the weight.

18. Ms. B.: ***Okay, does anyone want to respond to that?*** *Who wants to respond and can prove that they listened to Mathais' explanation and can kind of respond with their own ideas or can add another idea to it? Flaver, go ahead.*

19. Flaver: Um…I–I…

20. Ms. B.: Talk to Mathais about how you feel about what he said.

21. Flaver: I, I agree with what you said because this, for example, like if you put–if you had big, um, like if you got a big cup of water and you put an eraser in there, like, like the eraser over there [points to an eraser by the whiteboard], if you put something like that in a big cup of water, the water level would rise a lot, and, if you put in a copper cube, and it's not even gonna–it's not going to rise that much even though that copper cube will weigh more than an eraser.

(A few turns excerpted where Ms. B. asks "Who can repeat what Flaver said?")

22. Aisha: I have a question for you Flaver. Um, what if the object had like buoyancy, like it's able to float?

23. Ms. B.: Ohh…I think that's a good question for the whole group. But go ahead, Flaver.

24. Flaver: Then it would be a different story, because, if–if it had buoyancy then it wouldn't really be taking up much space, so but, I wouldn't know, um, so some things that have buoyancy it would–it wouldn't do the same thing like I was talking about.

• **Who can add on?** (asking students to add their own ideas)

Sometimes a student may explain her own reasoning or make a claim in a way that is clear enough and significant enough for others to respond to, such as Flaver's claim and example in line 21 above. This is a time when you can really help students engage with their classmate's reasoning and work to sustain and amplify the depth of the discussion. Asking "Who can add on?" or "Who wants to respond to that?" invites anyone to join in and respond. You can also personalize this move by calling on a particular student.

25. Ms. B.: So let's stick with the idea that all of these objects sink for right now. So Flaver is saying, if I have your idea right, that you think the size of the object matters, that objects with more volume would make the water go up more. And Jashida thinks it's weight that matters. Is that right? [Jashida nods.] ***So who wants to add on here? Tell us why you agree or disagree with Jashida or Mathais or Flaver.***

Some students raise their hands immediately but Ms. B. gives 17 seconds of ***Wait Time*** for more hands to go up. Her students are accustomed to Ms. B. waiting and know that they will have time to ponder and really think through her question. After a while, a few more hands go up. Finally, Felicia raises her hand. She is an English learner and rarely talks. Ms. B. calls on her. Felicia pauses, then speaks slowly, and pauses again.

26. Felicia: ***[6 second pause]*** *I think when you put the plasticine inside the water, the water will rise because the volume of the plastic is big and this is small. And…****[4 second pause]*** *and the water rises with volume because when–that's heavier but that one take more volume and it went up more than the copper cube did. And…****[8 second pause]*** *I used to think it was weight that made water rise because I compared when you're in the bathtub, when you sit and I thought your weight makes the water rise but now I know that it's really volume.*

• **Wait time** (giving students time to think, and time to answer)

Though we listed Wait Time in the first category of helping students expand and clarify their ideas, it is a talk move that actually supports all four steps and can be used productively throughout a discussion. As mentioned above, Wait Time might seem like an unusual "talk move" because it is a pause in the talking. But it is the most researched of all the talk moves and has been shown to remarkably impact the quality of both students' and teachers' thinking. Wait time, as described in the work of Mary Budd Rowe (1986), involves waiting at least 3 to 5 seconds after you ask a question, and then waiting again for the same interval after the student responds to the question.

The research on Wait Time is extensive. The research literature talks about two different kinds of wait time, both important, and powerful. The first is after you ask a question but before you call on a particular student or before a student begins to speak.

The second kind of Wait Time is pausing before you respond to what a student has just said. And of course, sometimes in the middle of a turn, a student pauses and this second kind of wait time is important as well, waiting after a student pauses or stops talking.

The research—at all grade levels and across all subject domains—shows that if you increase your wait time—to 3 seconds or even more—dramatic changes take place.

1. Students say more. The length of student responses increases between 300% and 700%.
2. They expand and clarify and explain their thinking with evidence.
3. The number of questions asked by students increases dramatically.
4. Student-to-student talk increases.

Increasing Wait Time **after** a student has talked is particularly powerful for expanding the complexity of student explanations, the depth of reasoning, and in growing the amount of student-to-student talk where students spontaneously address or ask questions of peers.

By waiting patiently, Ms. B. and the entire group enabled Felicia, a second-language learner, to make an important contribution that she and other students can build on in the ensuing discussion.

Although the research is clear on the value of wait time, anyone who has tried to do it knows that it is difficult to change one's ingrained conversational style with respect to pausing. We tend to feel uncomfortable with silence, as though we are putting a student "on the spot." Yet few students can put together an answer to a complicated question after only a second or two. And English Language Learners may need even more time to formulate their ideas. So if we do not use wait time consistently and patiently, students may give up and opt out of the conversation, assuming that someone else will carry the ball. If students opt out because they think they are not quick enough at formulating their ideas, they often stop listening with the same degree of focus as their peers. When this happens, everyone suffers. The discussion will not be enriched by the thinking of everyone in the group, and the talk will not lead to deeper learning for the entire group.

Notice that each of these talk moves—from "Say more about that" to "Who can repeat that in their own words?" to "Why do you think that?" to "Do you agree or disagree, and why?"—are all moves that **open up** the conversation to student thinking, explaining, and reasoning with evidence. Each move, in its own way, positions students as thinkers rather than "getters of the correct answer in the teacher's head." Each move helps to encourage the students to do the "heavy lifting" of explaining and clarifying, citing evidence, and critiquing or evaluating the thinking of their peers.

Talk Moves are Tools

These talk moves are **tools**, tools that you can get very good at using and that can help you take up the challenge of promoting productive talk. Like all tools, these take practice, ongoing experimentation, and the patience to make mistakes and try again. There is no such thing as perfection. These moves are relatively easy to pick up, try out, and the process can be exhilarating for both students and teachers alike. Many teachers have said things like the following, "These talk moves are not quite as simple as I first thought, but they totally changed my life…and the lives of my students."

Together, in the context of a rich task, talk moves help to build a classroom culture of equity, risk-taking, intellectual effort, and respect. Teachers who use these moves strategically and successfully find that students, from all cultural and linguistic backgrounds—even those who have struggled in the past—make significant gains in learning and conceptual understanding, gains that manifest in student writing and on standardized tests.

In Talk Science, a series of video clips illustrate this small set of productive **talk moves** in detail. These videos introduce you to these talk tools, give you tips for using them effectively and strategically, and show you a variety of different teachers using them in real time to guide student talk in science.

As you watch these video clips, ask yourself about your own discussions. Do you use some of these moves? Are there some that you would like to explore and practice in your own classroom?

The table, Goals for Productive Discussion and Nine Talk Moves, can be printed out and kept on hand for quick reference. It can also be used as a tool for self-reflection, or by colleagues who observe you during a discussion and check off each time you deploy a talk move to provide some non-judgmental feedback about the moves you use.