Talk Science Primer

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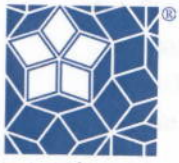

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Part 1: What is Academically Productive Talk?

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.

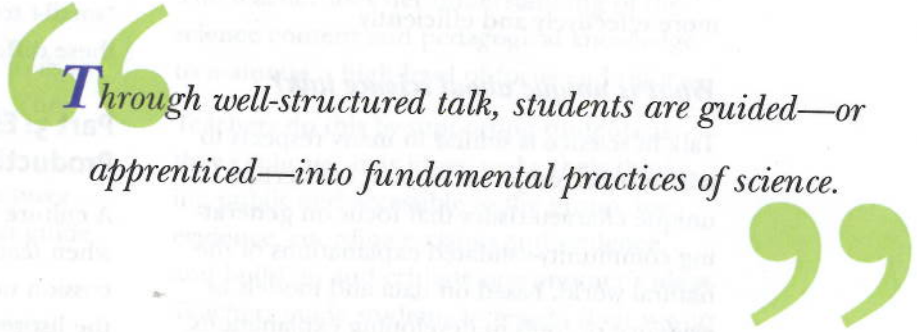
2. Talk supports robust learning by boosting memory, providing richer associations, and supporting language development. Talk is a fertile source of information. By hearing and talking about concepts, procedures, representations, and data, our minds have more to work with. Talk provides food for thought. 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.



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.

"Not only can whole-group discussions be exciting intellectually (for students and teachers alike), they can be highly productive academically."

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?"