HIGH SCHOOL SCIENCE CLASSROOM DISCOURSE & ARGUMENTATION SUPPORTS

Food and Agriculture Center for Science Education

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Building a Class Culture of Talk

Norms for Discussions

Purpose: A set of norms that reinforces the general principles of open and safe dialogue where ideas are respected are a prerequisite for effective classroom discussions. Effective and rigorous conversations can occur only when a classroom culture is built in which students are comfortable sharing their thinking without fear of being wrong or being personally attacked or shamed.

When To Use This Tool: Classrooms should have norms for civil discussions that are developed—with help from your students—on the first day of school, are explicitly modeled and revisited by the teacher (i.e. the teacher "names" the norm as she/he uses it or when a student uses it or breaks it), and are reinforced on a regular basis. A starter set of norms you can have on the first day might include:

- Anyone can ask questions if they don't understand an idea that is being talked about.
- We (students and the teacher) can critique ideas of others, but personal attacks are out of bounds.
- Don't talk over your classmates.
- The teacher will give "think time" before asking for students' ideas.
- In small group work, everyone will contribute to the conversations.

For other examples of classroom discussion norms, see the OpenSciEd Classroom Norms.

Adapted From: Ambitious Science Teaching - Scaffolds for Talk

Teacher Talk Supports & Tips

Teacher Responsive Talk

Purpose: Teacher Responsive Talk is one of the foundational strategies for how a teacher can engage in questioning with students to shift students' discourse towards that of higher-order thinking and away from the repetitive turns of teacher-student talk that can be largely a fact-based, "guess what's in my head" form of talk.

When to Use This Tool: This support can be used as a framework for facilitating small group and whole-class discussions.

Reposition Yourself Physically and Intellectually

Purpose: These strategies help reinforce a class culture and discussion dynamics that emphasize students making sense with each other rather than with the teacher. That is, these strategies may help build a culture of talk where students respond to one another rather than having the teacher intervene in between most student responses.

When to Use These Tools: These strategies are particularly helpful tools to consider using in any discussion, be it small group or whole class.

1. **Resist the urge to respond to every idea—you might be getting in the way of students discussing with one another.** Instead of evaluating a student's idea or asking a follow-up question, ask, "What do others think?" and return the floor to students. Or even better, stay silent and wait for students to respond. Remind students that it is their responsibility to figure the task out together. If they did not hear or understand what a student said, you can ask that student to repeat it. If they are unsure of how to respond to a student's idea, point out the talk moves or discussion starters again.
2. **Have students call on each other**. Set a norm that if one student shares an idea, then that student gets to call on another student to respond to the idea. This way, several turns of talk can happen without you doing or saying a thing. You, too, should raise your hand and wait to be called on if you would like to respond to a student idea. Otherwise, your main role in the discussion is managing the discussion norms.
3. **Physically reposition yourself strategically so students have to talk loudly enough for the whole class to hear**. Instead of moving toward the student who is talking, move away, across the room and out of the natural line of sight for the student speaking. Because the student is likely talking "to" you, this forces the student to speak loudly and face the rest of the class. Subtly, this reminds students that you are not their audience; the entire classroom community is their audience.
4. **Intellectually reposition yourself as a learner**. Purposefully situate yourself as an individual with equal knowledge to the students so that you take the appearance of trying to figure out what is going on alongside the students. This gives a subtle cue that emphasizes figuring out something together rather than looking to the teacher for approval or evaluation.
5. **Use your forgetfulness to your advantage**. Keeping track of ideas is hard work. Undoubtedly, you will forget where an idea came from, whose turn it is to be talking, or why students are talking about a certain topic. If you have forgotten, someone else in the class probably has as well. Frequently ask questions such as, "Whose question are you responding to again?" or "How is this helping us figure something out again?" or "Who had the floor?" This metatalk, making your own thinking explicit while trying to follow the conversation, also helps students learn how to listen actively to the discussion as well.

Adapted From: Christina Krist, Michael Novak, Lisa Brody, and Keetra Tipton. Teacher's Toolkit: Cultivating a Next-Generation Classroom Culture. January 2016. Science Scope 039(05). DOI:10.2505/4/ss16_039_05_8

Dealing with the "Know It All"

Purpose: To avoid one or a small number of students who dominate the classroom discussion because they are known as the "know it all" or "smart kid." These strategies can help you elevate the ideas of all students without entirely ignoring or discounting the ideas of your more vocal or high performing students.

When to Use These Strategies: Any time you think you have one or a small number of students who are perceived as smart and their responses are flat-lining the discussion because other students default to agreeing with them. Alternatively, these strategies can be used when students look something up online and think they already have the right answer or to open conversation to more students at any point in a discussion.

1. **Demonstrate genuine interest in all students' ideas and "revoice" them to give them credibility, even if they don't sound like science knowledge**. Be attentive to elevating all ideas, especially those from non-Know It All students. For example, revoicing an idea by saying, "So you think that..." demonstrates to others that he has ideas worth making sense of, and it also demonstrates to the student that anything he or she says will be taken seriously and he or she will be held accountable to it. Asking other students to "link in" can also reinforce that a student is not alone in what they think and that the ideas voiced are useful ones for the whole class to engage with.
2. **Strategically use impromptu think-pair-shares**. If a particularly interesting idea is mentioned by a non-Know It All student, have students spend two minutes with a partner discussing if they agree or disagree with that idea. This models the kind of serious engagement you expect with all ideas, even ones that on their face seem correct, or inversely ideas that might sound silly or wrong at first.
3. **Press on Know It All's use of vocabulary.** Often the "know it all" type student thinks that by sharing science vocabulary that fits in the context of the lesson, they are getting the "right answer." Purposefully press and probe these students to say more about their use of a vocabulary word. You can use use pressing and probing questions or a more playful approach. For example, if students are investigating how plates move about the Earth's surface, ask a student what he means by "plates." As in, a dinner plate? Can I see them if I look on the ground? These types of pressing moves may get even the most talented of students to push towards the boundaries of what they think they know.
4. **Press on their use of evidence.** If a Know-It-All student seems confident in their explanation, ask them what evidence they have to support any of the claims within their explanation. Often, this is an additional intellectual step to take that they may not have done, and you can invite other students to find evidence or agree or disagree with evidence the Know-It-All may present.

5. **Turn the Know It All student's idea over to the classroom community—and if it's not taken up, let it die, even if it's right.** When you ask the class what they think about the Know It All's idea, there may be no uptake. Often "correct science" answers are very counterintuitive—they won't make sense to most students when they actually think about them. If other students in the class do not respond to or accept the idea—even though it is right and is the key conceptual idea you want students to develop—don't try to change students' minds. Redirect them towards interpreting the evidence collected in the lesson, and start the discussion focusing on a new facet of this evidence that hasn't been discussed.
6. **Press the Rest of the Class for Why They Agree With the Know It All.** If one student changes her mind to accept the Know It All's idea simply because he said it, or if other students in the class then default to agreeing with the Know It All, ask all of the other students to explain why they changed their mind or to rephrase what the Know It All said then to say more about what that means to them. As this is unfolding, reiterate that the class can't just accept an idea; students also need to understand why they would accept it. For the Know It All, reinforce that if everyone doesn't agree, then he hasn't done his job of communicating to everyone in a way that they understand.

Adapted From: Christina Krist, Michael Novak, Lisa Brody, and Keetra Tipton. Teacher's Toolkit: Cultivating a Next-Generation Classroom Culture. January 2016. Science Scope 039(05). DOI:10.2505/4/ss16_039_05_8

Student-Student Talk Supports

Student-Student Talk Science Cards

Purpose: These Talk Science Cards are intended to provide students a variety of sentence stems to help build their repertoire of ways to productively talk in the science classroom.

When To Use This Tool: These cards can be used to support students in any type of classroom discussion, including partner talk, small group talk, and whole-class discussions. For each student in your class, print, cut, laminate, and bind (via a hole-punch and ring or other means) a set of talk science cards. If you are using these cards for the first time, you may wish to introduce the various cards over the course of several lessons so that students can focus on one new type of talk at a time as they build their overall familiarity with each different talk card.

Adapted From: STEM Teaching Tools Constructive Conservation Resource Cards. STEM Teaching Tools, 2014-2019.

A. Individual Think Time	

● Use the prompts and/or sentence stems provided by your teacher to record your ideas for the specific task you are working on. ● Use this card to suggest that your group takes a moment to pause the discussion and have individual think time before resuming.	
B. Starter Prompts ● My idea is ____. What is your idea? ● I think ____ because...What do you think? ● I think _____ happened because _____. What do you think? ● I think _____ had something to do with _____. What do you think?	**B. Starter Responses** ● One idea could be… ● This makes me think… ● I noticed… ● My idea is… ● I think ____ happened because… ● I think that… ● I'm not quite sure, but I think…
C. Clarifying & Listening Prompts ● It sounds like you think ____. Is that accurate? ● I heard you say... ● What do you mean when you say…? ● Can you say more about…? ● I understand the part about ____ , but can you say more about ____?	**C. Clarifying & Listening Responses** ● What I meant was… ● Yes, that's what my idea was. ● No, that's not quite what I meant. I meant to say… ● That's kind of what my idea was. I'd like to add… ● Yes, I can tell you more about _____ . I'm thinking…
D. Pressing Prompts ● Can you say more about…? ● I heard you say _____. What makes you think that? ● Can you say more about (how / why) _____ works the way it does? ● I heard your idea, and I agree/disagree with it because…	**D. Pressing Responses** ● I can add _____ to my original idea by saying… ● I think _____ works the way it does because...
E. Evaluate and Compare Prompts ● What I heard you say was ____. One alternative idea is… ● I think you said _____ , but I disagree with	**E. Evaluate and Compare Responses** ● In response to your question, I can say... ● I agree/disagree with your interpretation because… ● It seems like you are saying ____, and I am

this. Instead I think… ● How can we take the best from both ideas? How can we decide which idea is better? Or which is more supported by the evidence?	saying ____. ● I think the evidence shows _____ is the better idea because… ● That is a valid point, but I disagree because…
F. Using Evidence Prompts ● Evidence to support my idea is… ● What evidence do you think supports or refutes your/my idea? ● I heard you say _____, and evidence that supports/refutes your idea is ____ because… ● Can you explain further about how evidence supports your idea?	**F. Using Evidence Responses** ● I agree/disagree with the evidence you shared for your idea because... ● One piece of evidence to support/refute your/my idea is… ● I think this evidence supports my idea because… ● I can explain how my evidence supports/refutes that idea more by saying...
G. Cultural Connections Prompts ● What does this make you think of in your life? ● This reminds me of _____. ● One example from my life is…	**G. Cultural Connections Responses** ● This reminds me of _____. One example from my life is…
H. Coming to Consensus Prompts ● We agree/disagree about _____ because... ● My partner thinks _____ and I think _____. ● We both thought... ● My idea about _____ changed when my partner said… ● (Partner's name) said _____, but I think _____. ● We used to think (evidence) supported / refuted (claim), and now we think…	
I. Big Picture Prompts ● Do we think we have evidence to answer our question yet? Is there more we can figure out? ● Our original question was _____. What more do we need to figure out to make progress?	**I. Synthesis Prompts** ● How does what _____ said compare with what _____ said? Are there similarities? Differences? ● One thing that I notice that is similar/different between _____'s idea and

• What are our major findings we have for the original question?	_____'s idea is… • I think that _____ relates to _____ because...
I. Skeptic Prompts • Does it always work that way? • What if…? • What evidence do we have to support that idea? To refute that idea? • That seems like a helpful idea, but I think we can go deeper. How / why do you think that…?	**I. Inviting Prompts** • _____, what do you think? • _____, I've noticed you haven't shared yet, can you tell us your ideas? • I like that idea you shared, _____ . Can you say more about that?

Small Group Talk Roles

Purpose: Students participating in intellectually demanding group work are engaged in productive dialogue with each other. However, students may not naturally know how to engage in intellectually productive and inclusive conversations. Small Group Talk Roles are intended to provide students guidance about how to intellectually participate in small group talk and to push group roles beyond logistical roles such as the recorder, timekeeper, or materials grabber.
When to Use This Tool: These roles can be used at any time in which students are working in small groups on a task that requires meaningful discussion. They are meant to be paired with the Student-Student Talk Science Cards. We recommend introducing these roles early in the year and gradually removing the scaffold as students become more comfortable working in groups.

Adapted From: Ambitious Science Teaching - Designing Group Work

Starter & Inviter • *Starting the Discussion*: After the starter opens the conversation, share your ideas using **Starter Responses** • *During the Discussion*: Monitor the airtime of people in the group to ensure that everyone gets a chance to talk. Invite others into the conversation using **Inviting Prompts** • *During the Discussion*: Use any of the **Green Prompts & Responses** as needed.	**Synthesizer** • *Starting the Discussion*: After the starter opens the conversation, share your ideas using **Starter Responses** • *During the Discussion*: Compare and contrast the different ideas in the group using **Synthesis Prompts** • *During the Discussion*: Use any of the **Green Prompts & Responses** as needed.
Skeptic • *Starting the Discussion*: After the starter opens the conversation, share your ideas using **Starter Responses**	**Big Picture Person** • *Starting the Discussion*: After the starter opens the conversation, share your ideas using **Starter Responses**

• *During the Discussion*: Challenge the ideas the group is sharing using **Skeptic Prompts** • *During the Discussion*: Use any of the **Green Prompts & Responses** as needed.	• *During the Discussion*: Reorient the group to the focus question using **Big Picture Prompts** • *During the Discussion*: Use any of the **Green Prompts & Responses** as needed. • *Ending the Discussion*: Find a group consensus on where you ended up with the **Coming to Consensus Prompts**

Talk Protocols

A/B Partner Talk Protocol

Purpose: The A/B Partner Talk Protocol can be used as a means for students to share their thinking, actively listen to their partner, and deepen their reasoning about the topic being discussed. The A/B Talk Protocol aims to build a culture of student talk in which students are less concerned about finding "the right answer" and more concerned about probing, expanding, critiquing, and revising the ideas they share with each other.

When to Use This Tool: This protocol can be used when you want students to "go deeper" in a classroom discussion in a paired setting. Use this most often when students are engaged in trying to figure out the answer to a lesson question after an investigation, for example, and less often when a quick response will do. We recommend using this protocol often early in the year and gradually removing the scaffold as students become more comfortable with productive partner discourse.

Adapted From: A/B Partners Protocol for Critical Thinking. Ambitious Science Teaching, 2016.

0. Individual Think Time (A)	
Partner A: Use a Starter Prompt (B)	**Partner B: Use a Starter Response (B)**
1. Partner A: Choose a Prompt Category • (C) Clarify & Listening • (D) Pressing • (E) Evaluate & Compare • (F) Using Evidence • (G) Cultural Connections	**4. Partner B: Respond to the Prompt** • Use the responses in the category that your partner chose. • For example, if your partner used a "Clarifying" prompt, you would choose a "Clarifying" response.
5. Partner B: Choose a Prompt Category • (C) Clarify & Listening • (D) Pressing • (E) Evaluate & Compare • (F) Using Evidence • (G) Cultural Connections	**6. Partner A: Respond to the Prompt** • Use the responses in the category that your partner chose. • For example, if your partner used a "Clarifying & Listening" prompt, you would choose a "Clarifying & Listening" response.

7. Coming to Consensus (H)

Discuss and reach a consensus statement from your discussion. You do not necessarily have to agree on all ideas but do record on your handout the outcome of your discussion.

No-Hands Sharing Strategies

Purpose: A variety of sharing strategies, such as Random Reporter or Popsicle Sticks and their digital equivalents such as the random selector feature on the apps SmartSeat or Popsicle Sticks can make class share outs more inclusive of different students who may not volunteer to raise their hand.
When to Use This Tool: Always allow students individual think/write time and partner share time prior to randomly calling on a student. This gives students time to not only think through and practice their own response in a low-stakes way, it also allows them to listen to an idea from their peers. This way, when they are asked to share with the whole room, a student can share their own, rehearsed idea or the idea of their peer.

Argumentation Strategies

General Tips for Scaffolding Argumentation

This video from Ambitious Science Teaching summarizes a few general approaches to take when creating an argumentation session. In summary, they recommend:

- The teacher summarizes and captures the disagreement students have into 2 or 3 competing positions.
- As students work, the teacher continuously uses Responsive Talk to press students and ask for evidence, while still letting students lead the conversation.
- As students work, the teacher records a public summary of the ideas students share.
- To hear from all students, provide "Pause and Reflect" time during whole class conversations.

As argumentation is a type of classroom discourse, the tools and strategies in Teacher and Student Talk Supports can also be leveraged in argumentation sessions.

Elevating Discrepancies that Don't Make Sense

How and When To Use This Strategy: When students share ideas or student artifacts with contradictions, point out discrepancies or things that don't fit together or that contradict and let students work it out. Even when listening carefully, it's more socially acceptable to agree and build than it is to challenge, critique, or disagree. Instead of relying only on students' statements of agreement or disagreement, point out logical inconsistencies. For example, "But wait, if Josh is saying

Iceland is on a transform boundary and Danny is saying it's a hotspot, now I'm confused. Which is it?" "Wait, Maria and Sam are both saying that the air is expanding when we remove some pressure, but they each said something really different about what happens to the particles. Maria and Sam, can you each tell us what you said about…" Importantly, give the responsibility to students to work out these inconsistencies. They might just need to work through the justification for their explanations logically, they might decide that both ideas could work but in different circumstances, or they might need to gather more evidence to figure out which idea best explains the phenomenon.

Adapted From: Christina Krist, Michael Novak, Lisa Brody, and Keetra Tipton. Teacher's Toolkit: Cultivating a Next-Generation Classroom Culture. January 2016. Science Scope 039(05). DOI:10.2505/4/ss16_039_05_8

Setting Up Camps

Purpose: When students as a class have 2-3 different ideas that seem to make sense to them, this strategy can provide a time and space for students to 1) deepen their reasoning for their argument, 2) generate a counterargument, and 3) use evidence to support their argument and argue against the position of their peers.

How and When To Use This Strategy: When students are working with, debating, or discussing two or three different possible ideas that seem to make sense to everyone, you can set up "camps''. Ask students which idea they support and to physically rearrange themselves in the room to meet with others who are in their "camp." Students now have to work together in their "teams'' to deeply expand on their own argument and provide evidence for it. Students also have to generate a counterargument to the argument of the other team and evidence that refutes the other team's idea. As students work, the goal is still about sensemaking and taking seriously their own and the other group's ideas and interpretations of evidence.

Adapted From: Christina Krist, Michael Novak, Lisa Brody, and Keetra Tipton. Teacher's Toolkit: Cultivating a Next-Generation Classroom Culture. January 2016. Science Scope 039(05). DOI:10.2505/4/ss16_039_05_8

Sticky Bar Graphs & Agree/Disagree T Charts

Purpose: Sticky Bar Graphs (3 or more ideas) or an Agree/Disagree T Chart (2 ideas) can be a quick way to make a visual representation of student thinking when students need to choose from a few pre-selected options or agree/disagree with a claim and share their reasoning.

How and When To Use This Tool:
When students are working with a few different ideas and you'd like them to commit to supporting one idea over the others, or when you want students to evaluate if they agree or disagree with a claim. Two examples are shown below.

- When analyzing data, if students are analyzing a set of data and the class has come up with two or more different interpretations of the data, this strategy can be used to have students share their thinking on which interpretation they most support.

    - For example, if analyzing data on the DNA similarities between related organisms, the teacher might notice that students have a few different ideas about which organism a bat is most closely related to. The teacher can place the debated animals on the x-axis (cat, walrus, bird, horse) and ask students to vote on which they think is most closely related.
    - The same can be done with the T-chart. The teacher can choose a single student claim (on one poster) or multiple student claims (on multiple posters) to elevate. The teacher divides the poster(s) into two columns: agree and disagree. Students then choose if they agree or disagree, record their reasoning on a sticky note, and place their sticky note appropriately.
- When creating or revising explanations for a phenomenon, the teacher can capture the different main ideas the class has represented in their models or explanations and place these on the x-axis of the sticky bar graph.
    - For example, if students are trying to figure out how cancer forms in the body, and students are invoking many different ideas such as catching it from another person, mutations, or from toxic chemicals, you can have students vote for each of these options and share their reasoning.

Note that the purpose of using these graphs and T-charts is not to get all students to vote for the "correct" answer but is instead intended to make student thinking visible for the class community to then engage in further argumentation. The teacher can then continue to facilitate a conversation where the class presses on each other's ideas and asks for evidence to support or refute the different claims put forward.