



beetles

Science and Teaching for Field Instructors

Professional Learning Materials

Promoting Discussion

Deep learning can take place when we have the opportunity to struggle with ideas. Discussion is a powerful vehicle to promote this productive struggle. Putting ideas into words, listening to others' ideas, and becoming aware of varied perspectives help learners to make sense of the world. Discussions between peers are at least as important as those between learners and instructors. Promoting discussions among learners also helps an instructor to understand what learners are thinking and to create a brave and open environment in which ideas are exchanged. Lively, free-flowing discussion is almost always an indication that deep learning is taking place.

Discussion-based instruction can be challenging. Leading a productive large-group meaning-making discussion requires curiosity, skills, knowledge, and practice on the part of both instructor and learners. The tone set by the instructor is crucial: *Does the environment feel like a brave space in which learners share ideas, ask questions of one another, take risks, expose what they don't know, and sit with discomfort during productive struggle?* Outdoor science programs offer an ideal environment for instructors to develop and refine these skills as they work with a variety of groups—often for an extended time and often by repeating and refining activities throughout a season.

This session offers knowledge, strategies, and discussion practice to help instructors treat their outdoor science program as a laboratory for developing the practice of discussion. The session develops awareness of how discussions can be a tool to promote equity, inclusion, and cultural relevance or can unwittingly reinforce problematic power dynamics.

Goals for the session:

- Learn how discussion promotes learning, especially scientific meaning-making.
- Discuss questions about the role of discussion in education.
- Experience several discussion routines and strategies.
- Practice leading discussions, using discussion tools and instructor moves.
- Explore how discussions can be a powerful tool to support equitable, inclusive, and culturally relevant learning.

Note: Although all BEETLES Professional Learning Sessions are interconnected and complementary, this session has a Companion Session, *Questioning Strategies*, that explores the difference between broad and narrow questions, the role of instructors, and how to lead student discourse in the context of exploration. Although both sessions can be flexibly used, we recommend presenting *Questioning Strategies* before *Promoting Discussion* so instructors are introduced to the role of different types of questions before focusing on more complex student discourse.



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ABOUT BEETLES™

BEETLES™ (Better Environmental Education Teaching, Learning, and Expertise Sharing) provides environmental education programs nationally with research-based approaches and tools to continually improve their programs.

www.beetlesproject.org

The Lawrence Hall of Science is the public science center of the University of California, Berkeley. www.lawrencehallofscience.org

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Other locations: Balarat Outdoor Education, CO; Barrier Island Environmental Education Center, SC; Chincoteague Bay Field Station, VA; Eagle Bluff Environmental Learning Center, MN; Great Smoky Mountains Institute at Tremont, TN; Wellfleet Bay Wildlife Sanctuary Mass Audubon, MA; Mountain Trail Outdoor School, NC; NatureBridge (CA, WA, VA); Nature's Classroom (CT, MA, ME, NH, NY, RI); North Cascades Institute Mountain School, WA; NorthBay, MD; Outdoor Education Center at Camp Olympia, TX; The Ecology School, ME; UWSP Treehaven, WI; Wolf Ridge Environmental Learning Center, MN; YMCA Camp Mason Outdoor Center, NJ; and YMCA Erdman, HI.

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Promoting Discussion

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TEACHING ABOUT TEACHING



Use effective discussion strategies while presenting this session on discussion. An important aspect of this session is that participants actually experience and feel what it's like to be engaged in interesting discussions, so they recognize their value. Many people have had far more experience with being taught in a didactic manner than with learner-centered instruction and can benefit from this kind of modeling. When leading a session about how to lead discussions, it helps (a lot) if the presenter models effective discussion strategies. Otherwise, the session could seem like a *Do as I say, not as I do* situation. Ideally, choose a staff member who has the most experience leading discussions on science ideas with children to lead the discussions in the session. Presenters should also review the *Tips For Promoting Discussion* handout to implement as many of these strategies as possible in their presentation.

PRESENTATION OPTION



Want to spend more time outdoors than in? Other than the video-watching bit, this whole session can be done outdoors. You and your co-presenter can take turns writing text from slides on whiteboards and/or printing some slides, using a black font on a white background on as large sheets as possible. You may want to put them in plastic page protectors.

TIMING TIP



Keep things moving. The prompts provided in the session are purposefully designed to generate productive and interesting conversations, but interesting discussions can make it challenging to stay within the estimated time frame. You may need to gently limit some of the discussion and then pick up on the topic at another time, perhaps after staff has had some experience applying the teaching strategies.

SESSION OVERVIEW

	Promoting Discussion	Activity Locations	Estimated Time
Invitation	Introducing the Session Participants are engaged in the topic and the guiding question: <i>How can we nurture discussion about science ideas in outdoor science?</i>		5 minutes
Exploration	Thought Swap (formerly known as Walk & Talk) Participants take part in a discussion routine to whet their appetites for discussing discussion.	 or 	20 minutes
Concept Invention	Discussing Discussions Participants discuss the benefits of discussion through watching and debriefing two videos of learners engaged in discussion. This section includes a variety of discussion routines to offer participants varied experiences with discussion.		70 minutes
	Strategies and Tools for Leading Discussions The whole group discusses how to achieve academically productive discussions, including how to nurture a culture of discussion, offer opportunities to practice specific skills, and promote equity and inclusion. The Discussion Map is introduced.		30 minutes
Application	Discussion Lab Instructors volunteer to practice leading a small group in discussion. Small-group and whole-group debriefs follow to discuss which instructor moves were more productive and which were less productive.		40 minutes
Reflection	Making Sense of the Session Outdoor science programs are discussed as laboratories for instructors to improve their ability to promote discussion. Participants review and reflect on the session and plan their own deliberate practice.		10 minutes
	TOTAL		2 hours, 55 minutes (175 minutes)

PREPARATION

Before the day of the session:

1. **Prepare to present.** Choose who will present each part of the session (see Step 3 below for information on model student activities). Consider inviting any staff who have already experienced the session to present a small section or co-present the entire session. Read through the session write-up, slides, handouts, sidebars, and Background Information for Presenters (beginning on page 56). The more comfortable each presenter is with the session, the better. Record notes on a printed version of the session, or however you prefer. For the sections you choose to present outdoors (the videos need to be presented indoors), make large copies of slides and/or print out half-page copies for yourself to refer to; alternatively, you can write them on whiteboards.
2. **Set up a projection system/review multimedia.**
 - **Set up and test the projection system.** Be sure participants will be able to see what is projected during the session.
 - **Preview and watch the videos.** If you won't have Internet access during your session, download the videos to your computer. You'll need quality speakers to make sure the entire group can hear the videos.
 - You can find both videos (*Kids Discuss Discussion* and *Kids Discuss Decomposition*) in *Promoting Discussion* online (<http://beetlesproject.org/resources/for-program-leaders/promoting-discussion/>) under View and Download Materials.
3. **Read and familiarize yourself with the *Thought Swap* (formerly known as *Walk & Talk*) student activity guide and other embedded discussion routines; decide who will lead the activities.** Choose members of your staff who are most successful at leading discussions with learners to lead these parts of the session. Instructions for the routines are embedded in this *Promoting Discussion* activity write-up. If you will be leading the routines using the embedded write-up, we suggest that you also read through the more complete *Thought Swap* BEETLES activity write-up, particularly the Instructor Support section, and record notes on the embedded write-up included in *Promoting Discussion*.
4. **Make copies of handouts.** See Materials list on page 6.
5. **Make copies of video transcripts and gather sticky notes.** Participants will record notes on the transcripts, so if you plan to reuse the transcripts, distribute sticky notes for participants to write on.

(continued on next page)

MATERIALS

For the group:

- projection system and computer
- presentation slides
- access to in-session videos: *Kids Discuss Discussion* and *Kids Discuss Decomposition* (at <http://beetlesproject.org/resources/for-program-leaders/promoting-discussion/>)
- Discussion Norms poster
- optional: a small portable whiteboard and marker
- optional: chart paper and marker
- optional: sticky notes
- optional: Session Overview to post on wall

For each participant:

- journal or paper (and something to write on: e.g., a clipboard, binder, or piece of cardboard)
- pencil

MATERIALS (continued)

Handouts:

- ❑ *Transcript: Kids Discuss Discussion* (page 34)
- ❑ *Transcript: Kids Discuss Decomposition* (pages 35–38)
- ❑ *Discussion Lab Planning Sheet* (pages 39–40)
- ❑ *Discussion Map* (pages 41–42)
- ❑ *Goals and Instructor Moves for Productive Discussion* (page 43)
- ❑ *Tips for Promoting Discussion* (pages 44–47)
- ❑ *Research Related to Discussion* (pages 48–51)
- ❑ *Steps Toward Discussion* (page 52)
- ❑ *Discussion Routines* (pages 53–55)

PREPARATION (continued)

6. **Recommended: Read *Talk Science Primer* by Sarah Michael and Cathy O'Connor.** Throughout this session, it is important to model good discussion habits. We recommend that you read this great primer to help you plan your productive discussion moves.
7. **Create (or reuse) Discussion Agreements poster.** If you have established group agreements and created a poster, make it visible during this session. If you haven't, consider taking about 30 minutes prior to the session to create group agreements with your staff. (See the Teaching Note on page 7 for more information.) Alternatively, you can create a poster including the following discussion agreements:
 - Listen actively and share ideas.
 - Use evidence.
 - Keep an open mind.
 - Share responsibilities.
 - Disagree productively.
 - Work toward a deeper understanding.
 - Pay attention to participation.
8. **Take time for short breaks or divide the session into two shorter sessions.** Take breaks when needed. A good time for a break is after the "Discussing Discussions" section. If the session is too long for the time you have available, you can divide it into two shorter sessions. The first session could begin with "Introducing the Session" and go through "Discussing Discussions." The second session could begin with "Strategies and Tools for Leading Discussions" and go through to the end.
9. **Make sure participants are prepared.** Even though this session has less outdoor time than other BEETLES Professional Learning Sessions, make sure participants bring the gear they need to be comfortable outdoors, including their journals and something to write with.
10. **Optional: Create a chart for the Discussion Lab discussion.** On a sheet of chart paper or on a whiteboard, make three columns. From left to right, label the columns: "More productive," "Instructor move," and "Less productive."
11. **Optional: Make Session Overview to post on the wall.** You may choose to make a Session Overview on a sheet of chart paper to post on the wall during this session. Some presenters and participants prefer having it so they can see the flow of the session.

Introducing the Session

1. Show Slide 1: *Promoting Discussion. Welcome.*

- Welcome participants.
- If you're planning on doing the *Thought Swap* activity outside, make sure everyone is ready to begin and has the gear they need to be comfortable.



slide 1

2. Introduce the session's guiding question. Share:

- The session is titled *Promoting Discussion*, and the guiding question for this session is *How can we nurture discussion about science ideas in the outdoors?*
- While there are many different types of discussions, this session is focused on meaning-making discussions that build on learners' science ideas.

3. Show Slide 2: *Talk is not an add-on... Share that there is consensus among educators and researchers that promoting discussion is important for learning in all subjects at all grade levels:*

- Engaging learners in discussion of ideas can create powerful learning experiences.
- The National Academy of Sciences National Research Council consensus reports and major teacher organizations emphasize the need for learner discussion. We learn by discussing our ideas.
- Research also points out that engaging learners in discourse is largely underused by educators.



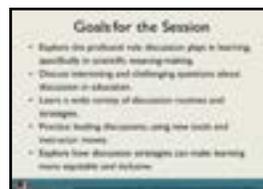
slide 2

4. Share that leading discussions can be challenging. This session will address some of these challenges:

- Guiding a group of learners in a meaning-making discussion around science concepts can be challenging for instructors.
- Some learners may not feel comfortable participating in a public discussion of their science ideas.
- In this session, we'll focus on the benefits of discussion and introduce strategies to help overcome some of the challenges and make discussions more successful for both learners and instructors.

5. Show Slide 3: *Goals for the Session. Share the goals of the session.*

- Give participants a minute to read the session goals.
- Ask if anyone has questions.



slide 3

YOU ARE HERE:



5 minutes



TEACHING NOTES

Learners and students. During this session, we mostly use the word *learners* (and occasionally the word *students*) to refer to the group of people who instructors teach in your program. We use the word *participants* to refer to the group of instructors and any other people who are participating in this professional learning session that you are facilitating.

Creating your own group agreements.

Many teams create their own group agreements. If you decide to do that now, make sure to include an extra ~30 minutes to complete this session. If you have group agreements your staff uses regularly, you can substitute them here or, perhaps, add any from the list offered to those you've been using. A cautionary note: Sometimes when groups develop their own agreements, they can unintentionally cause harm or reinforce existing status and power dynamics. Following are some resources to help you lead this discussion:

Anti-Oppressive Facilitation for Democratic Process: Making Meetings Awesome for Everyone. Accessed online: <http://infoshop.io/media/Aorta%20Anti-Oppressive%20Meeting%20Facilitation.pdf>

The Adaptive School: A Sourcebook for Developing Collaborative Groups, 3rd edition, by Garmston & Wellman.

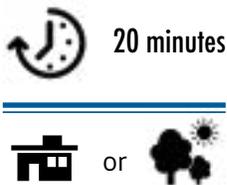
Group Agreements for Workshops and Meetings. Seeds for Change: <https://www.seedsforchange.org.uk/groupagree>

From Safe Spaces to Brave Spaces: A New Way to Frame Dialogue Around Diversity and Social Justice. Accessed online: <https://www.anselm.edu/sites/default/files/Documents/Center%20for%20Teaching%20Excellence/From%20Safe%20Spaces%20to%20Brave%20Spaces.pdf>

TEACHING NOTES

Agreements vs norms. We chose not to use the term *norms* because it can imply one normal/accepted way to participate in discussions. This can lead to marginalization of learners who don't identify with the assumed "normal" culture, which is typically white (Solomon, et al., 2005). Group (or community) agreements can shift the culture to be more inclusive, deliberately highlighting different acceptable ways of being and acting, and placing value on hearing and integrating different perspectives.

YOU ARE HERE:



Stationary or mobile *Thought Swap*? *Thought Swap* can be done in one place (stationary version) or while a group is moving from one location to the next (moving version). In both versions, learners discuss prompts and questions in rotating pairs. Moving alongside someone you're discussing with tends to make discussion more comfortable. During lulls in conversation, you're not staring awkwardly at each other. The moving version of *Thought Swap* is a great way to move a group of learners along a trail while engaging them in discussing relevant topics. The stationary version also has many benefits, especially if it is too challenging to take the group outdoors (i.e., if the weather is uncomfortable).

Why not *Walk & Talk*? Wondering why we changed the name from *Walk & Talk* to *Thought Swap*? We received feedback from our community partners on how we can use more inclusive language that doesn't normalize walking as the only way of moving and talking as the only way of communicating.

6. **Show Slide 4: *Discussion and Group Agreements*. Introduce group agreements about discussion. Share:**



slide 4

- a. Before we dive into discussion, it's important to review some group agreements for science discussions.
- b. Read aloud the group agreements and then ask the following questions:

- ▶ *Is anything missing from this list? Does anyone want to discuss any of these group agreements?*
- ▶ *Can we agree to these to help keep our discussions inclusive and productive?*

Thought Swap (formerly known as *Walk & Talk*)

1. **Show Slide 5: *Thought Swap*. Introduce the next activity. Share:**



slide 5

- a. This first routine is called *Thought Swap*.
- b. You'll be discussing a series of questions about discussion.

2. **Share that participants will discuss an important topic in education—not to come up with a single answer but to have an interesting discussion:**

- a. This activity is a chance to engage in meaning-making discussion, so you can remember what it feels like from the perspective of a learner.
- b. It also brings up interesting topics that may be discussed long after this session.
- c. The goal is not to come up with definitive answers. These topics are interesting to discuss because they are complex and juicy and don't have definitive answers.

3. **Lead participants outside. Start the *Thought Swap* by forming two equal lines with everyone in the group, including yourself and other leaders in one of the lines. Share:**

- Form two parallel lines and have each participant stand shoulder-to-shoulder with a little space between. Each person should be facing a partner in the line across from them, *including leaders*.

4. **Make sure everyone knows who their partners are.**

- a. Look across at the other line, figure out who your partner is, and agree on a greeting/icebreaker such as a fist bump, high-five, wave, elbow bump, do-si-do, etc. (See sidebar on negotiating consensual greetings.)
- b. Ask anyone without a partner to raise their hand; make adjustments as necessary.
- c. If you have an odd number of participants, find another person or make one group of three at the front or back of the lines.

5. Share the procedure: Participants will move or walk in lines, discussing a question with their partners until they see the gentle “wave of silence.” Share:

- a. I’ll give you a question to discuss with your partner as we move along. I will say, “Thought Swap!” and you’ll have 1–3 minutes for discussion while we are moving along the trail.
- b. When we stop, I’ll ask for volunteers to share something you heard from your partner to encourage good listening, so let your partner know if you prefer they don’t share something you say with the whole group. I’ll stop walking and will signal for quiet with the “wave of silence” by gently waving my fingers at the first two participants behind me. These two will then gently pass the wave down the line until the entire group is quiet. When you see the wave, stop discussing and pass the wave (gently) down the line until the whole group is quiet.

6. Ask the first *Thought Swap* question for participants to discuss:

- a. Once the group understands the directions, ask the first question twice. Invite participants to begin discussing by saying, “Thought Swap!”
 - ▶ *Think about discussions you’ve been in when you have felt comfortable participating and when you haven’t felt comfortable participating. What was it about those discussions that brought up those feelings?*
- b. Make sure those at the far end of the line can hear the question.
- c. For large groups, ask someone close to the end to repeat the question, or just get a thumbs-up that everyone heard.

7. Use the wave of silence to get participants’ attention and to signal that it’s time to stop discussing.

- After 1–3 minutes, pass the wave of silence to the first two participants at your end of the lines and wait for the whole group to become silent. If you’re moving, stop the lines before starting the wave of silence.

8. Ask students to move slightly apart from their partners and then facilitate a whole-group share about interesting things their partners said.

- a. Once participants have stopped moving and discussing, ask them to move a little apart from their partners (depending on how wide your trail is) to make it easier to see each other.
- b. Repeat the question:
 - ▶ *Think about discussions you’ve been in when you have felt comfortable participating and when you haven’t felt comfortable participating. What was it about those discussions that brought up those feelings?*
- c. Ask a few participants to share with the whole group what their partner told them (with their partner’s consent).

TEACHING NOTES

Be sure that you and other adults participate by partnering with learners. Participating in the activity yourself is an important opportunity to discuss one-on-one with learners (including staff), listen to their ideas, learn about their experiences and perspectives, and understand their ideas in a low-pressure way. When you form the lines, your first partner is the person at the front of the opposite line. Participating in *Thought Swap* also helps chaperones engage with the topics and with the group.

Negotiating consensual greetings. Partner greetings in *Thought Swap* offer an opportunity to model and practice awareness around touch consent. When learners get new partners, instead of assigning a way of greeting the new partner (e.g., giving your new partner a fist bump), invite learners to come up with their own greetings that both partners agree to such as a wave, a high-five, a hug, a bow, or whatever they choose.

About touch consent. “Every 92 seconds, an American is sexually assaulted. And every 9 minutes, that victim is a child” (RAINN: the Rape, Abuse, Incest National Network, 2019, <https://www.rainn.org/statistics>). Awareness about and prevention of sexual harassment and assault are also on the rise, and the rate of sexual assaults is on the decline (RAINN, 2017, <https://www.rainn.org/statistics/scope-problem>). “Camps have a responsibility to empower their campers and staff to have educated and empathetic conversations about consent to continue the downward trend in sexual assault. Many of these crimes are preventable if people are increasingly empathetic and respectful toward one another...Discussions about consent are not only based around sexuality. There are plenty of opportunities at camp to teach children about consent. Consider teaching consent in the context of permission to touch another person’s body. Every person has the right to accept or deny another person’s touch or personal-space intrusion” (Compton, S. 2018).

TEACHING NOTES

Sharing partners' ideas with the whole group. Asking learners to share something their partner said (with consent) helps them become better listeners and helps them to voice someone else's perspective. These are essential skills for engaging in discussions.

From sharing to discussing. *Thought Swap* helps learners and instructors ease into whole-group discussions. Although taking turns sharing is worthwhile, it isn't a discussion. Encourage discussion by asking follow-up questions to the learner speaking (e.g., *What do you mean by ___?* or *Can you say more about that?*) and to others (e.g., *What do others think of that idea?*). To have a lively and interesting discussion, learners need to be able to voice their own ideas. You might begin each pause by asking learners to share something their partner said and then encouraging others to respond with their own ideas about it. You might also mix it up throughout a hike, sometimes asking learners to share what their partner said and sometimes asking them to share their own ideas. Throughout *Thought Swap*, be on the lookout for juicy questions and topics of interest to pursue with the group later on. When a learner brings up an interesting question/topic, you can make that the next question for pairs to discuss.

YOU ARE HERE:

 70 minutes



- d. Use neutral responses (e.g., *Thanks for sharing!*) so everyone's ideas seem equally valued.
- e. Ask follow-up questions as you see fit such as: *Did anyone else discuss that idea? Or: Does anyone have a different idea? Or: Did anyone discuss evidence that supports that idea? What evidence did you discuss?*

9. Orchestrate the partner switch:

- a. Your partner goes to the other end of the line, and everyone in that line shifts up one person.
- b. Make sure participants are clear about which line will shift with each question—not the line you (the leader) are in!
- c. Invite the participant at the beginning of that line to move/walk/dance/run/skip between the lines to the end of the same line they were in.
- d. The group can cheer them as they walk between the lines.
- e. Ask participants in this line to shift one position toward the front of the line so everyone is facing a new partner.

10. Repeat the process for the next three questions.

- a. Ask the questions below, shifting partners in the same way after each question:
 - ▶ *Think about your own discussion experiences. What are some reasons why you think people may be reluctant to speak in large-group discussions?*
 - ▶ *Some classroom teachers and outdoor science field instructors don't give many opportunities for learner discussion of science ideas. Why do you think that is?*
 - ▶ *Optional (if you have time): Why is discussion important for learning?*
- b. Pause briefly after each question for participants to share some things they discussed in pairs and to discuss the question with the whole group.

11. Share that there will be more opportunities to discuss the topic:

- If you have more to say, that's great! We're just getting started, and you'll have more chances to discuss discussion throughout the session.

12. Return inside and have participants return to their seats.

Discussing Discussion

1. Debrief Thought Swap:

- a. Ask:
 - ▶ *What are the benefits of an activity routine such as Thought Swap?*
- b. Ask participants to share with the whole group. Listen to their responses and ask follow-up questions as appropriate. Remind



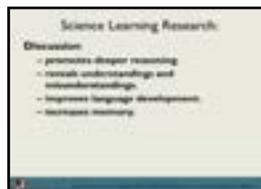
instructors that in whole-group discussions, everyone who shares needs to face the group and speak loudly enough for everyone to hear. Instructors can remind learners of this—you can't have a discussion if you don't know what is being said. If a learner is unable or unwilling to do this, the instructor may need to repeat what they say more loudly.

Afraid that learners will teach each other inaccurate ideas during discussions? Some instructors say that letting learners discuss an inaccurate idea will only further ingrain it, and they'll teach one another the wrong ideas. But learners have those inaccurate ideas whether or not you let learners discuss them. Research shows that giving learners opportunities to discuss misconceptions and figure out why they are wrong is a crucial component of deep learning—it's not only important to know what an accurate answer might be, it's also important to know *why* the wrong answers are wrong (Henderson, J.B., MacPherson, A., Osborne, J., & Wild, A. 2015;), (Osborne, J. 2010), (Rogoff, 1998; Vygotsky, 1978). The more learners discuss, the more they eliminate inaccurate ideas, and the more accurate their ideas become.

Discussion and Social and Emotional Learning. Learning how to lead rich discussions helps instructors support multiple learning goals in the outdoors. Many outdoor programs focus on social and emotional learning, character development, and healing trauma, in addition to science and nature study. Point out to your instructors how the approaches in this session lead to a "culture of discussion" that makes discussions about emotions, values, and social and emotional issues easier. Encourage your instructors to apply their discussion-leading skills in those situations. If your program uses games or simulations for social and emotional learning, make sure your instructors include opportunities for debrief and discussion afterward, so learners can apply what they noticed to how they participate in groups.

- c. After multiple people in the group have shared, bring up any of the following benefits of *Thought Swap* that have not already been brought up:
 - Opportunity for many learners to share and listen to ideas.
 - Pair discussions allow every learner to contribute if they want to, which is particularly important for individuals or groups who have been marginalized.
 - Helps form social connections in the group.
 - Sets the expectation that everyone can share with and learn from anyone in the group.
 - Allows the group to hear many ideas (during whole-group share-outs) and to witness different ideas being acknowledged.
 - Instructor gets to share with a variety of learners, one-on-one, and hear their ideas.
 - Emphasizes listening when the instructor asks to share something with the whole group that your partner told you.
 - Allows opportunities for peer-to-peer discussion, which is important for learning.
 - Learners can rehearse in a safe two-person discussion before sharing with the whole group.
 - Instructors can invite learners to discuss in whatever language is most comfortable to them, which is important for creating an inclusive space and for promoting language development. Mastery of academic language in learners' home/first language is essential for mastery in their second language.
 - Emerging multilingual learners can practice discussing science in their second language in a low-anxiety, one-on-one setting.
 - Discussions help learners access related prior knowledge and help them get interested in the topic.
 - Keeps the group moving and uses transitions between locations as efficient learning time.

2. Show Slide 6: Science Learning Research. Share that research shows that discussion is a critical component to learning concepts:



slide 6

- a. Many benefits of *Thought Swap* are benefits of discussion in general.
- b. Sharing and exploring ideas with peers and/or an educator encourages learners to think more deeply and support their ideas with evidence and explanations.

TEACHING NOTES

- c. Discussion makes thinking “visible” (or audible!), giving instructors a window to better understand and build on what learners are thinking.
- d. Discussion allows learners to explore and test their assumptions and ideas, learn from one another, and become aware of complexities.
- e. Discussion supports development of language skills, including academic language.
- f. Learners who discuss ideas remember them better.
- g. There’s evidence that discussion in one domain, such as science, benefits learners in other academic domains and learners’ general academic success.

3. Show Slide 7: *Social-Emotional Learning Research*. Share that research also shows a variety of other important benefits of discussion:



slide 7

- a. It supports development of listening skills, social skills, risk-taking, and the development of learning communities.
- b. It also supports development of self-confidence and mutual respect between group members.

4. Show Slide 8: *Kids Discuss Discussion*. Introduce the video: *Kids Discuss Discussion*. Share:



slide 8

- a. To explore some of the benefits of discussion further, we’ll watch two videos.
- b. The first video is of learners after they have done an activity on transpiration and participated in meaning-making science discussion.
- c. The video is of them discussing why and how that follow-up discussion helped them learn.
- d. The discussion takes place in a classroom with a teacher who has obviously put a lot of effort into nurturing a culture of discussion.

5. Invite participants to use a copy of the transcript of the video to take notes:

- a. I’ll distribute copies of the transcript of this discussion so you can read along with the video.
- b. As you watch, record notes and summarize key points that learners make about why the discussion mattered to them.

6. Distribute one copy of *Transcript: Kids Discuss Discussion* to each participant and then play the video.

7. Show Slide 9: *Two Cents Routine*. Share that participants will use the *Two Cents* routine to discuss the video:

- a. To debrief the video, we’ll use the *Two Cents* routine.



slide 9

Transcript: Kids Discuss Discussion: Handout



- b. It's also an opportunity to experience another type of structured discussion.

8. Share procedure for *Two Cents* routine:

- a. The routine's name comes from each person getting two opportunities to share.
- b. In groups of 4, you'll take turns responding to the question. When it's not your turn, you'll listen and not share. You can take notes about what others say, if you want.
- c. **First round:** Each person in the group gets 1 minute (or less) to share their ideas on the topic.
- d. **Second round:** Each person in the group gets 1 minute to respond to what others have said.

9. Give the prompt for this routine. Share:

- a. For this routine, you'll respond to this prompt:
 - ▶ *Based on what you observed, what are some discussion elements that need to exist for successful meaning-making discussions? How might these elements influence your teaching?*
- b. Give participants about 8–10 minutes (depending on the group size—groups will need 2 minutes for each group member) to complete their discussions.

10. Show Slide 10: *Kids Discuss Decomposition*. Introduce the next video: *Kids Discuss Decomposition*. Share:



slide 10

- a. This video takes place on a trail during a day at a residential outdoor science program.
- b. The instructor is leading the optional discussion at the end of the BEETLES *Decomposition Mission* activity. It comes after learners have spent 45 minutes making displays of leaves and wood showing stages of decomposition; learning about fungi, bacteria, and invertebrates; and searching for potential decomposers and evidence of decomposers in the area.
- c. The video shows the first few minutes of a 15-minute discussion.
- d. The purpose of this discussion is to help learners make sense of their observations and challenge some of their assumptions about the definition of a decomposer.

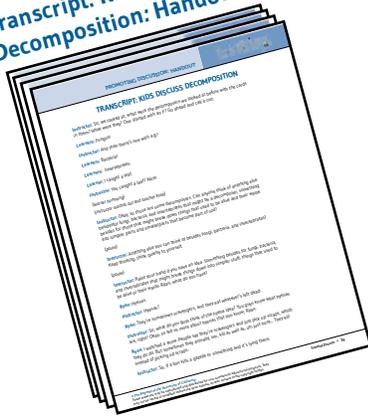
11. Invite participants to use a copy of the transcript of the video to take notes:

- a. I will also distribute a transcript of this discussion. Again, use the transcript to follow along and take notes.
- b. This time as you watch, focus on observing what the instructor and learners are doing. Try not to make inferences or explanations yet.

Decomposition Mission. You can check out the student activity featured here at <http://beetlesproject.org/resources/for-field-instructors/decomposition-mission/>

TEACHING NOTES

Transcript: Kids Discuss Decomposition: Handout

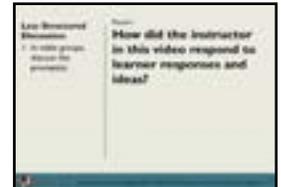


- c. Some examples of observations you could make are: *I noticed that the instructor asked three questions in rapid succession.* Or: *I noticed that Learner 1 used evidence as she shared her idea.*
- d. Make as many observations as possible, jotting down notes to remember for a debrief discussion afterward.

12. Distribute one copy of *Transcript: Kids Discuss Decomposition* to each participant and then play the video.

13. Show Slide 11: *Less Structured Discussion*. Share that participants will use a *Less Structured Discussion* to debrief the video:

- In your small groups, discuss the question on the slide: *How did the instructor in this video respond to learner responses and ideas?*

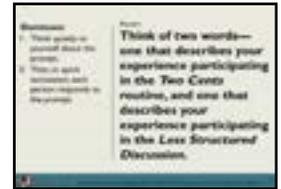


slide 11

14. Refocus the group after ~10 minutes.

15. Show Slide 12: *Dominoes*. Share that another routine, *Dominoes*, will be used to debrief the two previous discussions:

- a. We'll use another discussion routine, *Dominoes*, to do a quick meta-debrief of the discussions so far.
- b. Think back on your own experience during the *Two Cents* routine and the *Less Structured Discussion* and come up with one word that describes each experience for you.
- c. Then, we'll go around the room and each person will say, in quick succession, first: their word describing their experience in the *Two Cents* routine and second: their word for their experience in the *Less Structured Discussion*.



slide 12

16. Go around the room and have each person quickly share their two words.

17. Ask participants to share some reasons for positive and negative experiences (while secretly using the Discussion Map).

- a. Ask participants to share with the whole group. As you facilitate, structure the whole-group discussion, using the Discussion Map (but don't reveal this until later):
 - **Ask a broad question:**
 - ▶ Describe your experience participating in the *Two Cents* routine and the *Less Structured Discussion*.
 - **Ask for evidence and probe thinking:**
 - ▶ Can you say more about your feelings about participating? What makes you say that?



- **Ask for agreement/disagreement:**
 - ▶ *What do others think about that? Does anyone have a different opinion?*
- **Ask a question leading back to the main topic:**
 - ▶ *How might your learners respond to this routine and this discussion?*
- **Summarize main points and/or patterns:**
 - ▶ *Can anyone summarize this discussion for us? What are the main takeaways?*

b. Before stopping the discussion, ask several participants if they have anything to add to the summary.

18. Share that different discussion routines have different purposes:

- a. Routines such as *Two Cents*, *Dominoes*, and *Thought Swap* each have different purposes.
- b. For example, *Two Cents* is often helpful for learners who need practice taking turns, listening to one another, and giving and taking equal time, but some learners might get frustrated or feel constrained by the structure (like some of you did).
- c. We'll discuss more about different routines and their different uses later in the session.

19. Share reasons for the routines and discussions so far:

- a. The routines and discussions so far have been intended to:
 - offer opportunities to discuss important topics related to discussions.
 - experience what it feels like to participate in productive discussions of ideas.
 - model good discussion-leading strategies.
- b. Now, we'll step back and look more metacognitively at what we did.

Take a break or divide the session. If you have time to lead this session in one sitting, a good time for a break is before you begin "Strategies and Tools for Leading Discussions." If the session is too long for the time you have available, you can divide it into two shorter sessions. The first session could stop after "Discussing Discussions." The second session could begin with "Strategies and Tools for Leading Discussions."

Strategies and Tools for Leading Discussions

1. Show Slide 13: *Productive Discussion*. Share that productive, authentic discussions are the ultimate goal, but there are steps to get there:



slide 13

- a. Juicy, authentic, productive discussions are the goal, but you need structure and scaffolding to get there.
- b. Instructors may have a vision for how a discussion should go but may be unsure of how to make it happen.

YOU ARE HERE:



2. Share that the next part of the session focuses on strategies, tools, and “instructor moves” for leading discussions:

- a. Productive discussions of ideas often don’t just happen with a group of learners. Instructors tend to need to actively facilitate discussion.
- b. When a discussion is productive, it’s often because learners are truly making sense of something.
- c. This next section focuses on some instructor moves (the prompts, questions, and follow-up responses that instructors use) and tools that are helpful to promote discussion.

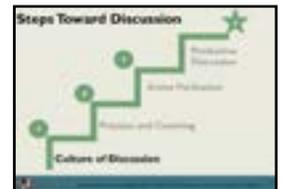
3. Show Slide 14: *Steps Toward Discussion*. Share that to reach a level of productive discussion, you need a culture of discussion, coaching, and facilitation:



slide 14

- a. This diagram shows a simplified map of what learners need and instructors can create to get to productive discussions.
- b. First, facilitators need to create a culture that supports discussion. Second, facilitators need to begin to include opportunities to practice skills as well as intentional coaching and modeling.

4. Show Slide 15: *Steps Toward Discussion: Culture of Discussion*. Ask participants to reflect back on how this session has modeled setting up a culture of discussion:



slide 15

- a. This session has been modeling many of these elements along the way. Let’s think back to what we’ve done so far.
- b. Ask:
 - ▶ *What are some ways this session has nurtured a culture of discussion?*
- c. Listen to participants’ ideas.
- d. Mention the points below, if participants do not:
 - Showed genuine interest and curiosity in participants’ ideas!
 - Established discussion agreements.
 - During *Thought Swap*, asked participants to share what their partner said to show that it’s important to listen and pay attention to peers.
 - Made sure that everyone could hear one another.
 - Asked interesting, broad questions with a variety of acceptable answers.
 - Gave accepting responses to participants’ ideas.

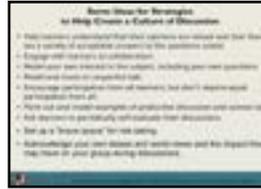
5. Ask participants about other things they can do to set up a culture of discussion. Ask:

▶ *What are some other strategies you could use to help create a culture of discussion?*

- Give participants a few minutes to record a few ideas in their journals.

6. Show Slide 16: *Some Ideas for Strategies to Help Create a Culture of Discussion*. Share:

- Show participants the slide and let them briefly read it.
- If you have decided to facilitate participants sharing their ideas during a follow-up, let them know now.
- If you've decided to create a chart with a list of ideas to post in your staff room for participants to add to, let them know now.



slide 16

7. Show Slide 17: *Steps Toward Discussion: Practice and Coaching*. Share that offering opportunities for learners to practice and helping them develop good discussion habits through facilitation and coaching are critical:

- Even after a culture of discussion has been established, learners may still need guidance to share their evidence and reasoning and to listen carefully and respond to peers.
- Learners need practice through the use of routines and with the help of coaching and facilitation.



slide 17

8. Share that instructors can assess where each group of learners is in terms of discussion practices and help them develop their practices:

- It's important to pay attention to the discussion practices and learning culture of your group to assess where they are when they arrive and areas in which they have room to grow.
- Outdoor science instructors can assess where each group of learners is and figure out appropriate steps to help them improve how they participate in learning discussions and in learning how to think. For example:
 - For a group with less experience with discussion, it can help to focus on getting them to discuss in pairs and to listen to each other. You might start with *Thought Swap* and gradually ask them to discuss and build on each others' ideas.
 - For a group with more discussion experience, you may choose to do more whole-group discussions earlier, using the Discussion Map, while encouraging learners to ask one another more follow-up questions so they can link, build on, and critique one another's ideas.

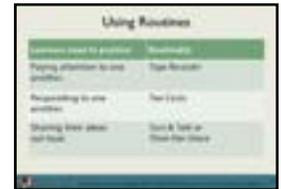
TEACHING NOTES

Sharing participants' ideas about other things they can do to set up a culture of discussion. Participants often come up with a lot of ideas in response to this prompt. To keep this session within the allotted time, the script does not invite participants to share their ideas with one another, but, of course, it's valuable for them to do so. You might choose to allow some time for them to share their ideas during a follow-up session or meeting after this session. If you have enough time during this session, you might choose to give participants time to share now. If not, start a list of ideas to post in your staff room that they can add to.

Why brave space instead of safe space? The term *safe space* has often been used to describe an atmosphere for leaders to work toward in which participants feel comfortable sharing. In their article "From Safe Spaces to Brave Spaces," Arao and Clemens (2013) question if facilitators can truly make a space safe for all participants and also note that participants sometimes use the "excuse" of a safe space to avoid entering into uncomfortable conversations. The term *brave space* on the other hand, encourages participants to take risks and be vulnerable while emphasizing courage instead of safety or comfort.

9. **Share that while it's important to meet learners where they are at, it's also critical to not fall into a trap of deficit thinking:**
- a. Deficit thinking can lead instructors to think that some learners aren't capable of participating in meaning-making discussions and, therefore, not offer them opportunities to learn how to participate.
 - b. Instead, practice having a growth mindset and remembering that all learners already have discussion abilities that they can build upon and improve and that all learners need opportunities to engage in productive struggle.
 - c. Instructors need to balance meeting learners where they are at and having high expectations for all learners.

10. **Show Slide 18: *Using Routines*. Share that using routines gives learners opportunities to practice different aspects of discussion:**



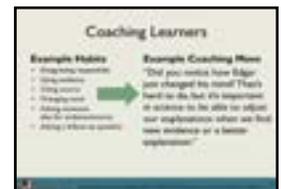
slide 18

- a. Different routines and structures help learners recognize and practice different skills.
- b. By offering structure when needed, striving for high interest and participation, and coaching, learner discussions can eventually be more guided by the learners themselves.
- c. Discussion, in general, will get easier for learners as they become more familiar with sharing their ideas, listening to one another, and responding to prompts and to one another.

11. **Share that using routines often supports struggling learners:**

- a. It's easier for learners (and instructors) to start with pair discussions and work up to larger, whole-group discussions.
- b. When an instructor repeats routines, learners are able to jump into a discussion already knowing how to participate.
- c. The more discussion routines you're familiar with as an instructor, the more you can "mix things up" and adjust to your group's needs.
- d. After the session, you'll get a handout that includes more discussion routines and that highlights some of their strengths and purposes.

12. **Show Slide 19: *Coaching Learners*. Share that while learners are becoming comfortable with discussion, it's useful to coach them on positive discussion habits:**



slide 19

- a. As learners gain more experience in discussion through routines and facilitation, it can be helpful to encourage positive discussion habits through coaching.
- b. Pointing out to the group when learners use any of these habits can encourage other learners to begin using them more often.

Brainstorming more discussion habits and coaching moves. If you have time, you might ask participants to brainstorm other discussion habits that they can encourage in learners and ways that they can think of to coach learners on productive participation in discussions.

13. Show Slide 20: *Steps Toward Discussion: Active Facilitation* and introduce active facilitation. Share:

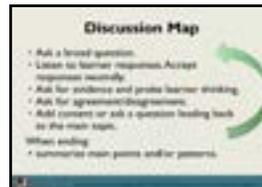
- a. Active facilitation is often an important component of productive discussions.
- b. Active facilitation can help keep discussion moving and focused and help ensure inclusivity.



slide 20

14. Show Slide 21: *Discussion Map* and introduce the Discussion Map. Share:

- a. Using the Discussion Map is an effective strategy for facilitating discussion. It helps instructors guide and encourage cross talk (learners discussing with each other) rather than only encouraging learners to answer questions from the instructor.
- b. This map comes from analyzing patterns of good discussion leaders.
- c. This straightforward map can be applied to discussions with any age group.



slide 21

15. Share the steps of the Discussion Map:

- a. The Discussion Map starts with a broad question. Give enough time for learners to think and respond. Narrow questions are fine for other goals, but you usually need a broad question to start a discussion.
- b. Next, the instructor listens to one or more learner responses and reasoning while giving accepting, neutral responses—not praise, agreement, or disagreement.
- c. Neutral responses do not mean showing no emotion; they mean not showing signs that you are evaluating the response as right or wrong or good or bad.
- d. Responding to learners by evaluating their answers can derail discussion. By showing preference for some responses over others (e.g., *Yes, that's right.* Or: *No, but keep thinking.*), instructors send the message that only some learner thinking is acceptable or that there is a right answer, which once perceived by learners discourages further discussion.
- e. Then, the instructor asks for further explanation or evidence.
- f. Then, the instructor asks for different or additional ideas.
- g. The instructor may add content to give learners more evidence. Or they may ask a new follow-up question that's related to learners' ideas but leads back to the main topic.
- h. When the instructor is ready to end the discussion, they briefly summarize the main points and patterns of what has been said or ask a participant to do so.
- i. In a few minutes, you'll get a handout that includes each of these steps and more information and examples.

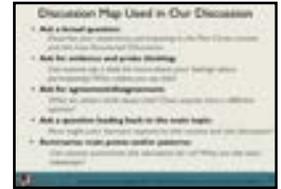
TEACHING NOTES

Flexible use of the Discussion Map.

Like other instructional tools, the Discussion Map works best when used as a flexible model to guide discussions, rather than rigidly following it step-by-step. Ideally, each step of the map involves multiple learner responses, as well as learner-to-learner exchanges without the instructor speaking between each response.

Attending to all students, not just “science kids.” Often, whole-group science discussions are dominated by one or more “science kids” while the rest of the class defer to them. Instructors may help perpetuate this dynamic by asking mostly narrow questions and by responding more favorably to answers they think are more “right.” This favors learners who have more factual knowledge and are better at memorizing, but it can discourage learners with less factual knowledge who may have great ideas and excel at higher-level thinking. Instructors can help break up this dynamic by asking broad questions, calling on a diversity of learners, listening carefully, and responding similarly to all responses.

16. Show Slide 22: Discussion Map Used in Our Discussion. Share how you used the Discussion Map:



slide 22

- a. The whole-group discussion about the reasons you shared for your positive or negative experiences during the *Two Cents* routine and the *Less Structured Discussion* was structured, using this Discussion Map.
- b. You can see on the slide how the prompts I used during that discussion were structured, using the Discussion Map.

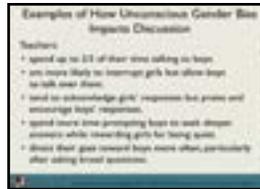
17. Share the value of the Discussion Map as modeled throughout BEETLES sessions:

- a. Many discussions in BEETLES Professional Learning Sessions and student activities were designed using this Discussion Map in mind.
- b. This Discussion Map model works well for educators interested in helping learners build their own conceptual understanding.
- c. It helps keep discussions grounded in evidence and reasoning.
- d. It encourages diverse ideas and for learners to compare evidence from different points of view.
- e. It helps keep the discussion flowing and interesting for participants.
- f. Sometimes, a discussion can feel like it didn’t go anywhere, especially if the group doesn’t come to an agreement on an idea.
- g. Summarizing, or asking someone in the group to summarize some of the main points or patterns that were discussed, can help recognize what was accomplished during the discussion, even if that understanding is that there is disagreement among participants. This helps learners reflect on their learning. While good discussions advance our thinking and understanding, they don’t bring closure to learning complex ideas.

18. Share that the Discussion Map is a tool that can help promote equity and inclusion in discussion:

- a. Using the Discussion Map can help instructors rely less on less productive habits and make instruction more effective.
- b. Using the Discussion Map can help make sure that instructors don’t just call on a few “science kids” who may raise their hands first or dominate a conversation.
- c. Using the Discussion Map helps keep the discussion learner-centered as the instructor asks learners to comment on one another’s ideas.
- d. Using the Discussion Map can also help instructors not fall into traps caused by unconscious biases.

19. Show Slide 23: Examples of How Unconscious Gender Bias Impacts Discussion. Point out that impacts of gender and racial biases on teaching practices are well-researched and documented.



slide 23

- a. Give participants time to read the slide.
- b. Share: Using a tool such as the Discussion Map, which encourages the use of broad questions, neutral responses, participation from learners, and asking all learners to use evidence can combat some of the impacts of unconscious biases that we all have.

20. Show Slide 24: Zaretta Hammond Quote. Give participants time to read the quote and then share:



slide 24

- a. Many emerging multilingual learners, learners of color, and learners from low-income families have not had the support to become independent learners, which is routinely offered to English-only learners, white learners, and learners from more affluent families.
- b. These learners may have school experiences high in lecture and rote memorization, with few opportunities for applying knowledge and for engaging in higher-level thinking.
- c. This may lead to learners remaining as dependent learners with shallow knowledge, a lack of experience applying learning, and a lack of experience taking ownership of their own learning. This may further lead to learners disengaging from an education system that has failed them.
- d. This may deprive learners of opportunities to develop independent learning skills with deep knowledge, experience applying learning, and experience with taking ownership of their own learning.
- e. During science discussions, you're not just helping learners learn whatever content they are discussing, you are offering opportunities for them to think, reason, and discuss academic ideas.

21. Share that using best practices in discussion benefits all learners, but particularly those who have been historically marginalized or oppressed:

- a. These strategies and approaches are all part of good teaching, and good teaching is good for all learners.
- b. When we rely on instructor-centered teaching (e.g., telling and not offering time for learner discussion, asking only narrow questions, or not allowing all learners to participate in discussion), some learners might excel, particularly those who have grown up with explicit and implicit messages that they are or can be "good students."
- c. But learners who have been historically marginalized, learners with learning differences, and learners who don't already see themselves as "good students" may be excluded from opportunities to learn.

TEACHING NOTES

Unpacking your unconscious biases. We all have unconscious biases, and they can impact others around us when they come out in things we say or do. For instance, many educators are not aware that during discussions, they call on boys more often than girls and on white learners more than learners of color. To be a thoughtful discussion leader, it's important to spend time exploring your own unconscious (or implicit) biases. For guidance on how to do this, see *Culturally Responsive Teaching & the Brain* by Zaretta Hammond, Chapter 4: Preparing to Be a Culturally Responsive Practitioner.

Learning Cycle for equity and inclusion. If your instructors have already experienced the BEETLES Professional Learning Session *Teaching and Learning*, you can reference how using the Learning Cycle to design learning experiences also promotes more equitable and inclusive environments.

TEACHING NOTES

- d. Research-based practices, such as using the Discussion Map and other discussion strategies, benefit all learners and especially learners who are systemically disadvantaged by our current education system.

OPTIONAL: Introduce the Ready for Rigor Framework. The following step and accompanying slide (Slide 25) highlight a framework designed to help students become independent learners. It also helps summarize how discussion supports these four core practices. If you choose to use the framework, we recommend spending more time digging into it in a follow-up session (see page 31).

Show Slide 25: Ready for Rigor Framework. Share how this framework mirrors some of what has already been discussed related to discussions:



slide 25

- a. In Zaretta Hammond's book *Culturally Responsive Teaching & the Brain*, she outlines a framework for what is needed to help dependent learners become independent learners.
- b. Hammond calls this the Ready for Rigor Framework. It includes these four core practices: Community of Learners and Learning Environment, Awareness, Learning Partnerships, and Information Processing.
- c. Discussion—and the practices and tools that come with it—can play a critical role in implementing this framework to nurture culturally responsive learning environments.
- **Community of Learners and Learning Environment:**
 - creating an atmosphere that is low in stress and conducive to learning
 - making space for student voice and agency
 - building a community of learners supporting one another with distributed expertise
 - **Awareness:**
 - instructors becoming aware of their own unconscious biases that may affect the way they interact with students, such as who they call on during discussions.
 - **Learning Partnerships:**
 - instructors shifting their relationship to be partners in learning with students
 - **Information Processing:**
 - engaging with students in instructional conversations to help them process content
 - helping students make connections between what they know and what they are learning



22. Share that using all these different strategies and tools takes practice:

- a. It takes practice to lead effective discussions—to incorporate instructor moves, keep goals in mind, use the Discussion Map, and encourage good discussion habits.
- b. This next activity is a chance to practice using some of the routines, strategies, and instructor moves discussed throughout the session.

Discussion Lab

1. Share that participants will be putting discussion strategies into action, using outdoor science discussion topics:

- a. So far, you’ve been discussing discussion—engaging in important instructor-level discussions about topics relevant to this valuable and challenging teaching practice.
- b. Now you’ll try putting some of these strategies into action by trying them out with discussion topics you might use with learners in the field.
- c. The goal is to walk away with a plan for leading a discussion with learners and to have some practice leading that discussion with adults.
- d. Leading discussions with adults isn’t the same as with kids, but it’s valuable practice and can give you useful feedback.

2. Show Slide 26: Discussion Goals. Share that when facilitating discussions, here are some goals you might have in mind:



slide 26

- a. These five foundational elements are supported by research and lead to productive academic discussions.
- b. Making these elements a priority when leading discussions helps learners apply what is discussed to deep learning.
- c. These elements can be translated into goals for discussion leaders.
- d. Each goal builds on the previous goals. Instructors may not accomplish all five goals in every discussion, especially with groups that have less experience with academic discourse.

3. Read the goals out loud and briefly share:

- a. First, learners need to be interested and curious about having productive discussions. No one wants to discuss questions they’re not interested in!
- b. Instructors need to ask interesting, relevant questions related to learners’ prior knowledge; facilitate learners coming up with their own questions; and use them in discussions. This often takes place in the first phase of the Learning Cycle—Invitation.
- c. Second, learners need to be able to share their own thinking with other members of the group.
- d. Third, learners need to listen and pay attention to one another to be able to participate and add to the conversation.

TEACHING NOTES

YOU ARE HERE:



40 minutes



TEACHING NOTES

Quote about the importance of topics that are interesting to learners. "The most powerful phenomena from an educational perspective are culturally or personally relevant or consequential to students." (from a Next Generation Science Standards resource on phenomena available at <https://www.nextgenscience.org/resources/phenomena>)

- e. Fourth, learners need to deepen their own reasoning during discussion, using evidence or thinking through examples.
- f. Finally, the pinnacle of a learning discussion is when it becomes learner-driven, when learners respond to and participate in the thinking of other learners.

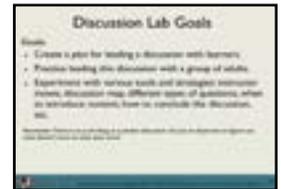
4. Show Slide 27: Discussion Goals and Talk Moves. Share that each goal has instructor moves that go with it:



slide 27

- a. Each of these goals has instructor moves (strategies and prompts) that go with it that help learners reach that goal.
- b. For example, for the goal of igniting curiosity, you might ask a broad question or introduce some really interesting content and ask learners how it connects to their daily life.
- c. For the goal of helping individuals clarify their own thinking, you might ask them to say more or to think of an example that supports what they said.
- d. In a few minutes, you'll get a handout that includes these goals and their corresponding instructor moves.

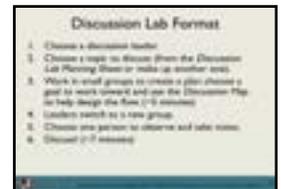
5. Show Slide 28: Discussion Lab Goals. Share that the Discussion Lab is meant to be a time for practice and experimentation:



slide 28

- a. The lab is a chance to experiment with types of questions and instructor moves to encourage meaning-making discussions.
- b. It's also a chance to try out the Discussion Map together with your peers.
- c. It's important to explore what works AND what doesn't work so well. There's no such thing as a perfect discussion. In our brave space, we hope you'll volunteer and take some risks!

6. Show Slide 29: Discussion Lab Format. Share the format:



slide 29

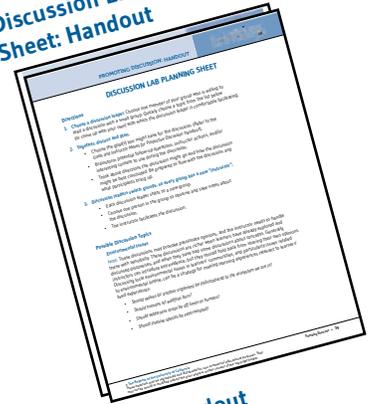
- a. In small groups, you'll choose one person to be the instructor/discussion leader.
- b. Next, your group will choose a discussion topic or question. You can choose one from the *Discussion Lab* handout or pick something else you'd like to discuss with learners.
- c. Then, work together to make a discussion plan. Use the *Goals and Instructor Moves for Productive Discussion* handout to choose a goal to focus on. Then use the Discussion Map to design your discussion.



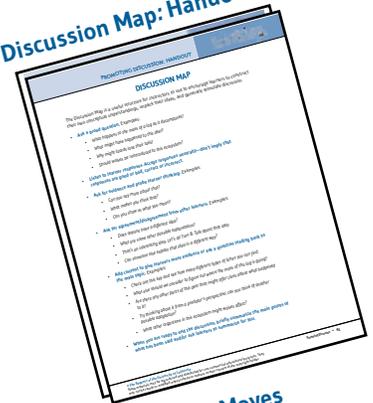
TEACHING NEWS

About time. In order to keep the length of this session reasonable, the time allotted for planning and the practice discussions is very short. If you have more time available, you may want to lengthen these activities.

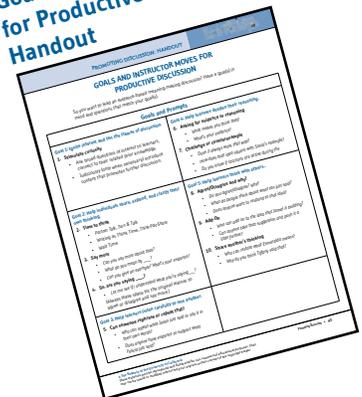
Discussion Lab Planning Sheet: Handout



Discussion Map: Handout



Goals and Instructor Moves for Productive Discussion: Handout



- d. While everyone in the group will be responsible for metacognitively thinking about the discussion, each group will also choose one observer whose job will be to take notes on the discussion.
- 7. Share with participants the handouts they will get and the timing of the activity:**
 - a. You'll have three handouts to help you: *Discussion Lab Planning Sheet* that includes the information on this slide, with some added suggestions; *Discussion Map*; and *Goals and Instructor Moves for Productive Discussion*.
 - b. You'll have ~5 minutes to make a plan you'd be excited to use with learners.
 - c. When it's time, volunteer instructors/discussion leaders will rotate to another group to practice leading the discussion. Leaders will have ~7 minutes to lead the discussion.
- 8. Distribute one copy of the following three handouts to each participant:**
 - a. *Discussion Lab Planning Sheet*
 - b. *Discussion Map*
 - c. *Goals and Instructor Moves for Productive Discussion*
- 9. Divide participants into small groups of 4–6 and begin planning:**
 - a. Choose a person to prepare to be the discussion leader. The remaining group members will help in the planning.
 - b. Quickly choose a question your discussion leader feels fairly comfortable with.
 - c. Then, your small group will help the discussion leader plan a main goal and actions the discussion leader might take during the discussion to accomplish that goal.
 - d. You'll have 5 minutes for planning.
- 10. Ask the volunteer discussion leader from each group to switch to a different small group.**
 - a. After ~5 minutes of planning, ask the discussion leader from each group to switch to another group to lead the discussion.
 - b. Ask the discussion leaders to share what their primary goals are with their new groups.
 - c. Then, ask each new group to choose an observer.
- 11. Remind participants about their role and have them begin:**
 - a. The topics are all youth-appropriate but to have an authentic discussion, you should discuss at an adult level.
 - b. Try to get into the topic of the discussion and to observe the flow of the discussion itself.

PROMOTING DISCUSSION

TEACHING NOTES

Seating arrangement. If possible, have discussion participants and the discussion leader seated in a circle on the floor/ground, as learners might be in the field, with the observer standing or sitting outside the circle.

More Discussion Lab. If it seems like your staff might benefit from another round of the Discussion Lab, consider running more discussion lab experiments with your staff at another time, or do more rounds now.

YOU ARE HERE:



- c. Hold your comments about leading the discussion until later.
- d. Choose one observer to take notes about productive and less productive instructor moves and prompts.
- e. Remind everyone that the instructor/discussion leader will be in charge of leading the discussion.
- f. Have groups begin.

12. Remind discussion leaders to try to conclude their discussions.

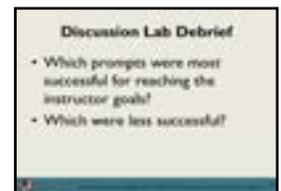
- After about 5 minutes, remind discussion leaders that they should try to conclude their discussions as best as possible in the remaining 2 minutes.

13. Bring everyone's focus back to the whole group.

- After discussion leaders have had a chance to conclude their discussions, bring the focus back to the whole group

14. Show Slide 30: *Discussion Lab Debrief*. Give small groups a chance to debrief. Share:

- a. Before we have a whole-group discussion, you'll debrief in your small groups about how the discussion went.
- b. Use the prompts on the slide to guide your debrief. Give the observer, leader, and discussion participants each a chance to share what they noticed.
- c. You'll have about 5 minutes to discuss in small groups. Then, we'll share as a whole group.



slide 30

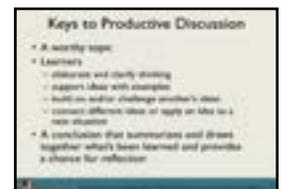
15. Lead a whole-group debrief of the discussion, sharing productive and less productive instructor moves.

- a. Ask participants to share observations they discussed in their small groups.
- b. Refer back to the discussion questions on the slide, as necessary.
- c. Remind participants that some prompts that were unproductive in this situation might be productive in a different situation with different discussion topics.

Making Sense of the Session

1. Show Slide 31: *Keys to Productive Discussion*. Share that not all discussions are productive, but productive discussions have some key elements in common:

- a. Productive discussions have common elements, shown on this slide.
- b. The tools and resources in this session are designed to support these elements, to encourage more productive discussions to take place during outdoor learning.



slide 31



Using a different metaphor. If the river rafting metaphor doesn't seem culturally relevant to your participants, you might choose a different metaphor. You could use a sports coach coaching a game or team, a mother duck leading ducklings across a marsh, a video director directing a film, or a hunting guide leading a group on a hunt.

- c. Ultimately, though, it's up to the instructor to choose what moves to make in the moment. There's no way to script a productive discussion.

2. Show Slide 32: *River Rafting as a Metaphor for Discussion-Leading*. Share how guiding a boat through rapids in a river can be a metaphor for leading discussions:



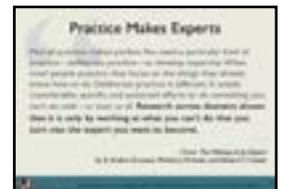
slide 32

- a. A good discussion flows like a river. Making decisions about discussions is not all in your head—you've also got to learn to sense the flow of the discussion.
- b. In most rapids there are different possible routes, just as learners may bring up different directions the discussion could go. As an instructor, you have to constantly choose routes based on what seems interesting to learners, what might lead to misconceptions, and what your goals are for the discussion. If you don't choose, you could end up "on the rocks."
- c. You might be taken off course temporarily by an eddy (a circular current), and you may need to take some strokes to get back into the downstream current. Learners may come up with off-topic or off-the-wall comments, but a skillful discussion leader can gently guide the discussion back on topic with a few strategic moves.
- d. A discussion leader has to be ready to improvise and shift course if the chosen route isn't working out, or if unexpected currents, obstacles, or turbulence cause problems.
- e. The instructor needs to pay attention to the emotional, social, physical, and intellectual needs of their "passengers" (i.e., learners).
- 3. Ask participants to think of other ways river rafting can be a metaphor for leading discussions:**
- a. Ask:
- ▶ *Are there any other ways you can think of that the river-rafting metaphor applies to discussion leading?*
- b. Listen to participants' ideas. Laugh at the ones that are funny.
- 4. Share how outdoor science programs can be productive settings for instructors to experiment and refine their craft:**
- a. At outdoor science programs, instructors often get many opportunities to repeat and refine activities and to teach learners of varying ages and backgrounds.
- b. In this way, an outdoor science program can be a great education lab in which to experiment and improve your instruction skills.
- c. Discussion-leading is valuable for learning and teaching, and it takes practice to do it well.

5. **Share that it's helpful to begin slowly and to choose routines to fit learners' needs:**
 - a. With a new group of learners, try starting off with simpler, easier routines such as *Thought Swap*, *Dominoes*, and *Turn & Talk*. Save whole-group discussions for when you've had some practice with them.
 - b. Choose discussion routines that fit your learners' needs. If it seems like they could benefit from work on listening skills, try using the *Tape Recorder* routine. If they could use help on taking turns, try using the *Two Cents* routine.

6. **Share that instructors need to develop their discussion-leading and should "go slow to go fast" with the routines they try out:**
 - a. Some instructors get excited, they try leading a discussion, it doesn't go well, and then they become reluctant to use discussion in their teaching. Eek! It's better to try a routine, stick with it until you've mastered it, and then try another.
 - b. If you lead a discussion and it doesn't go well, don't give up. Adjust your approach and try again.

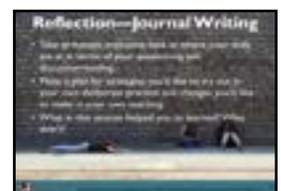
7. **Show Slide 33: *Practice Makes Experts*. Allow participants to read the slide. Then, share that opportunities for growth as educators are endless, but you need *deliberate* practice:**



slide 33

- a. After some time being an instructor, it's easy to plateau at a functional level of teaching.
- b. The beauty and challenge of being an educator is that you never "arrive," and there's always room to grow.
- c. If you want to grow and improve as instructors, research shows that practice alone is not enough—you need *deliberate* practice, and you need to challenge yourself.
- d. Choose something you want to work on, such as leading whole-group discussions, and then break it down into smaller steps such as those on the *Goals and Instructor Moves for Productive Discussion* handout (e.g., asking more relevant and broad questions of interest to learners or helping individual learners share, expand, and clarify their own thinking).
- e. Make a plan, try it out, see how it goes, rinse and repeat!

8. **Show Slide 34: *Reflection—Journal Writing*. Participants write in journals about the session, using reflection prompts.**



slide 34

- a. Invite participants to take a few minutes to write their reflections about where they are as far as leading discussions, to describe any changes they'd like to make in their teaching, and to make note of what helped them to learn and what didn't during this session.

b. Optional: Ask participants to team up with 1–2 others to meet up on an ongoing basis for planning, debriefing, and processing their efforts, using discussion strategies with learners.

9. Distribute final take-away handouts while participants are reflecting. For each participant, distribute one copy of each of the following handouts:

- *Tips for Promoting Discussion*
- *Research Related to Discussion*
- *Steps Toward Discussion*
- *Discussion Routines*

TEACHING NOTES

Tips for Promoting Discussion: Handout



Research Related to Discussion: Handout



Steps Toward Discussion: Handout



Discussion Routines: Handout



APPLYING SESSION TO INSTRUCTION

The session is not over! A critical phase of learning anything new is *application*—when the learner takes new knowledge and applies it. There is some application included in the session, but, as with all professional learning for instructors, the rubber meets the road (or trail) when instructors apply what they've learned to their teaching and when they keep thinking about it and discussing it with their peers. If you want your instructors to try out new activities/approaches, program leader support is crucial. Even if instructors are excited by new ideas, it's easy for them, especially veteran instructors, to keep doing what they've been doing successfully and not try out new activities/approaches. Following are a variety of follow-up activities and discussions to dig deeper into the topic and help you facilitate thoughtful implementation:

- **Staff brainstorm on what they and you can do to encourage incorporation of discussion strategies.** After the session reflection, your staff will have already written ideas they have about implementation into their instruction. You can tap into these and other ideas through a brainstorm of what they might do and how you can support them in doing it.
- **Sharing ideas about how to create a culture of discussion.** Offer more time for staff to brainstorm and share their ideas. You might want to create a poster list of ideas and post it in your staff room for them to add to.
- **Discussing implementation of discussion routines** During your next student program, invite each of your instructors to try out one or more of the discussion routines featured in the session and have them write in their journals about how it went. Then, during a meeting, lead your instructors in a discussion about the routine at the end of the program. Following are some suggested questions on which to focus a reflection or discussion:
 - *What were some interesting learner ideas that came up?*
 - *What surprised you?*
 - *Did you notice evidence of learner meaning-making?*
 - *What was successful about the activity?*
 - *What might you do differently the next time you lead it and why?*
 - *How did you incorporate the routine into learners' other field experiences? What ideas do you have about incorporating it in the future?*
- **Watch the BEETLES discussion strategy videos.** Choose one BEETLES [video](#) to watch together as a staff, using the corresponding [How to Use Videos for Building Reflective Practice](#) guide. We don't recommend watching all the videos at one time; rather, space them out and give instructors opportunities to apply new ideas to their teaching practice.
- **Instructor observations.** If you conduct observations of instructors, discuss how you might incorporate elements from this session into the observations.



- **Using *Culturally Responsive Teaching & the Brain*, by Zaretta Hammond, to help your staff improve their understanding and implementation of culturally responsive teaching.** (For more ideas, see *Culturally Responsive Teaching & the Brain: Book Study Guide [Facilitator's Version]* <https://www.filepicker.io/api/file/mJHNhJxRRMGoHXjotzGG>).
- **Read and discuss Chapter 1: Climbing Out of the Gap: Understanding the Nature of the Achievement Gap.**
- **Explore the Ready for Rigor Framework.** Make a copy of the Ready for Rigor Framework (pages 14–15 in the book) for each participant and invite them to read it.
- **Show Slide 25 (again): *Ready for Rigor Framework*. Share how this framework for culturally responsive teaching mirrors some of what has been discussed related to discussions:**
 - Zaretta Hammond outlines a framework of what is needed to help dependent learners become more independent learners.
 - She calls this the Ready for Rigor Framework, and it includes these four core practices: Community of Learners and Learning Environment, Awareness, Learning Partnerships, and Information Processing.
 - Discussion—and the skills and tools that come with it—can play a critical role in implementing this framework in order to nurture culturally responsive learning environments.
 - **Community of Learners and Learning Environment:**
 - creating an atmosphere that is low in stress and conducive to learning
 - making space for student voice and agency
 - building a community of learners supporting each other with distributed expertise
 - **Awareness:**
 - instructors becoming aware of their own unconscious biases that may affect the way they interact with students, such as who they call on during discussions
 - **Learning Partnerships:**
 - instructors shifting their relationship to be partners in learning with students
 - **Information Processing:**
 - engaging with students in instructional conversations to help them process content
 - helping students make connections between what they know and what they are learning
- **Give time for your staff to discuss these four core practices further.** Refer to the book for clarification as needed.

- **Continuing a discussion.** If there was a topic that came up during the session that you had to cut off and it seems that your staff is interested in and would benefit from continuing the discussion, set aside some time to do so.
- **Model the Think-Pair-Share routine while leading a discussion with your staff about delivery of content in a discussion.** Share that the following questions are important for science discussions because how we use and introduce content can completely change the flow and nature of a discussion. Introducing content can ignite learners' curiosity and wonder or shut it down. Model the routine.
 - Ask:
 - ▶ *How does content delivery influence a discussion?*
 - ▶ *When might it be appropriate or not appropriate to directly deliver content to students?*
 - **Think:** Think silently to yourself about these questions. You may want to record notes or sketches.
 - **Pair:** Discuss your thoughts with a partner. Remember to switch roles so each partner gets a chance to share their ideas.
 - **Share:** Lead a whole-group discussion about the questions, using the Discussion Map.
- **Read and discuss the *Talk Science Primer*.** The *Talk Science Primer*, by Sarah Michaels and Cathy O'Connor, TERC, is available at: https://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf
- **Make a discussion routine chart.** Together, make a chart of different discussion routines, including the advantages, challenges, and uses of each.
 - Title the first column of the chart "Routines," the second column "Advantages," the third column "Challenges," and the fourth column "Uses."
 - Lead your group to fill in the chart by brainstorming a list of routines, their advantages, challenges, and uses.
 - Make this list available to the team on chart paper or by creating a handout so they can use it when choosing which discussion routines to learn/use.
 - This is an application in which instructors immediately apply what they have learned, think more deeply about each routine, and practice making informed choices about what to do with their learners.
- **Discuss research findings on discussion.** The information on the *Research Related to Discussion* handout can be discussed and rediscussed over many months or years. It's worth spending time discussing the information during short staff meetings or longer training sessions or retreats. We



recommend assigning your staff to read one of the topics and then thinking about it for a week or so of instruction before discussing what the research shows and how to apply it to their teaching practice.

- **Brainstorm site-specific broad questions for discussion.** Assign your instructors to brainstorm and record broad questions that could serve as good discussion prompts in the specific program and locations of your site. Collect these in a binder for all to share and use.
- **Follow up with the *Evidence and Explanations* session.** Once staff are feeling more comfortable with leading learner science discussions, use the [Evidence and Explanations](#) Professional Learning Session to continue discussing building a culture of science discussion and encouraging more learner discussion.

TRANSCRIPT: KIDS DISCUSS DISCUSSING

Teacher: Okay, I want to stop there, and I want you to think about this question: *Did having the opportunity to talk about your ideas and to talk about this in a group, did that help you get a better grasp on this whole thing?* So think about it for a second, and who would like to speak to that? Okay, let's pass it to people who haven't had much of a chance.

Bahia: I think it did help because usually I'm kind of shy about showing my other—showing my answers—sharing my answers with other people, but a lot of the other people had the same idea like me, so I think that helped.

Teacher: Does that give you more confidence when other people have the same idea?

Bahia: Yeah.

No name: So, I think it helped because at first I thought that it was just one reason, but then I realized that everybody was talking about different things, and I realized that no one thing could have taken that much water, so then I realized that it was all those things put together.

No name: I think it helped a lot because before, I had almost no idea how it could escape, and now I think that I understand it a lot better.

Teacher: Noel had his hand up.

Noel: For me this helped because you could, before it be only like our group and stuff, so it only had like a couple people to talk to. It wasn't as much variety of reasons and stuff we can hear from.

No name: I agree with Bahia, and I also want to say that you never know when you can, like, change your mind. So if you have an idea and you don't think there's enough evidence, you always have somebody who can add, find evidence for you.

No name: I also think that lots of people that don't really like to share their ideas, they're really quiet, and when we're in a circle like this, you can share whatever ideas you have and people can add onto them, and I feel like that gives them more confidence to share their ideas.

Teacher: Okay, do we have any final comments?

No name: I also agree with Noel because when everybody has their L-group and when one person from that group shares, it's kind of like hearing from the entire class, and you get ideas from everybody, and that's a lot of ideas.

Jackson: Yeah, I'm pretty sure everyone would agree with this that there's a lot more ways that we could have thought of in just an L-group or by ourselves, how and why the water evaporated or got used from the vial, so I think this is really helpful that we have more people, and it's easier to learn what would've been harder to come up with in just an L-group or by ourselves.

No name: Adding on to what Jackson said, in our L-groups usually there's like when one person speaks, then like everybody adds on and doesn't share their ideas, and so here people will respectfully disagree and share their other ideas that we might of not shared in our L-groups.

Note: In this classroom, L-groups refer to small groups meeting at L-shaped tables.



TRANSCRIPT: KIDS DISCUSS DECOMPOSITION

Instructor: So, we looked at, what were the decomposers we looked at before with the cards in them? What were they? One started with an F? Go ahead and call it out.

Learners: Fungus!

Instructor: And then there's one with a B?

Learners: Bacteria!

Learners: Invertebrates.

Learner: I caught a leaf.

Instructor: You caught a leaf? Nice!

(learner humming)

(instructor reaches out and touches knee)

Instructor: Okay, so those are some decomposers. Can anyone think of anything else besides for fungi, bacteria, and invertebrates that might be a decomposer, something besides for those that might break down things that used to be alive and their waste into simpler parts and smaller parts that become part of soil?

(pause)

Instructor: Anything else you can think of besides fungi, bacteria, and invertebrates? Keep thinking, think quietly to yourself.

(pause)

Instructor: Raise your hand if you have an idea. Something besides for fungi, bacteria, and invertebrates that might break things down into simpler stuff, things that used to be alive or their waste. Ryan, what do you have?

Ryan: Hyenas.

Instructor: Hyenas?

Ryan: They're sometimes scavengers, and they eat whatever's left dead.

Instructor: So, what do you guys think of the hyena idea? You guys know what hyenas are, right? Okay, so tell us more about hyenas that you know, Ryan.

Ryan: I watched a show. People say they're scavengers and just pick up scraps, which they do do. But sometimes they actually, um, kill as well as, uh, just hunt... They kill instead of picking up scraps.

Instructor: So, if a lion kills a gazelle or something and it's lying there.

TRANSCRIPT: KIDS DISCUSS DECOMPOSITION (continued)

Ryan: Then the hyena comes over and...

Instructor: Comes afterward?

Ryan: Yeah.

Instructor: And eats the scraps that are leftover?

Ryan: Yeah.

Instructor: Or are you saying they sometimes kill the animal and eat it?

(Ryan nods)

Instructor: Okay, what do you guys think? Would you call that a decomposer? Are they breaking things that used to be alive down into simpler and smaller parts that become part of the soil? What do you guys think? Talk to the person next to you. *Turn & Talk.*

(kids talking)

Instructor: Do you think hyenas break things that used to be alive down?

Learner 1: Yeah, 'cause, yeah 'cause they...

Learner 2: Yeah.

(instructor hand motions for them to continue)

Learner 1: When they....

Learner 2: I think they might be decomposers because, like, sometimes they get in fights to get like some things to eat too, so then when they're done, other animals can also come and eat and stuff.

Instructor: But are they breaking down something that used to be alive into smaller and simpler parts?

Learners: Cricket! I see a cricket!

Learner: It's right there!

Learner: Can we catch it?

Instructor: Okay, next discussion question: Do you think that that cricket is a decomposer?

Learners, many at the same time: Yes, yes.

Instructor: *Turn & Talk* to the same person, do you think that cricket is a decomposer, and say what your evidence is.

(lots of learners talking)



TRANSCRIPT: KIDS DISCUSS DECOMPOSITION (continued)

Learner: I remember watching a TV show.

Instructor: That's your evidence, because you saw it somewhere?

Chaperon: It's an interesting question.

(learner shakes head)

Chaperon: You don't think it eats dead things?

Learner: No, it just eats grass.

Instructor: So the question is: Is it a decomposer? Does it eat things that were dead and break them down into things that are simpler and smaller that could be part of the soil? So, let's do it with the talking stick. Who's ready to talk to the whole group here? Let's talk about the cricket. Do you think the cricket is a decomposer? Here ya go.

Learner: Um, no, because I believe that crickets only eat like, grass.

Instructor: So, maybe crickets eat grass, so you'd say that it's not a decomposer if it eats grass?

Learner: Yeah.

Instructor: If it eats grass, do you think it's breaking things down that used to be alive down in simpler parts that might be part of the soil?

Learner: Yeah.

Instructor: Oh, you do.

Learner: No...

Instructor: No? Oh, sounds like you're a little conflicted, huh? That's okay. Let's take the talking stick, or why don't you pass it to the next person. Raise your hand if you want to add to the conversation, and you'll toss the stick to him gently.

Learner: Tiger.

(learner throws talking stick)

Tiger: Ow! It's heavy. Alright, so, I think the cricket is a decomposer, and I think that everything that eats is a decomposer even if it's a vegetarian or a, like, a carnivore or meat-eater.

Instructor: You just said something really provocative. You just said, "I think that anything that eats other things is a decomposer."

Tiger: That eats anything.

TRANSCRIPT: KIDS DISCUSS DECOMPOSITION (continued)

Instructor: That eats anything. Okay, so say more about that. What makes you say that?

Tiger: It's because even if you're a vegetarian, like you're eating veggies and plants and plants can decompose and if you eat meat, that could decompose.

Instructor: So you're saying that even if you eat meat or plants, anything that eats those things is a decomposer.

Tiger: Anything that eats at all is a decomposer.

Instructor: Anything that eats all. What do you guys think? Agree? Disagree? Raise your hand if you've got something to say, to add to this conversation. This is a pretty interesting idea he just brought up there. Right behind you, pass the mic.

Ryan: I agree.

Instructor: Say why you agree. What's your evidence?

Ryan: Because technically, that is right because everything has to eat to survive. And no matter if you're just like a little fish in the water, you still have to eat something.

Learner: But trees cannot decompose.

Instructor: But remember, the main question is: Are you breaking things that used to be alive down into something that is simpler and smaller parts, becoming part of the soil?

(Ryan nods)

Instructor: You think so, yeah?

Learner: The cricket's on your leg.

Instructor: Where?

Learner: Catch it, catch it!

(instructor tosses cricket out of the circle)

Instructor: Oops, cricket flew. So, let's go back to his point. He says, anything that eats anything is a decomposer. Turn & Talk to the person next to you about whether you agree with that statement or not and say why you agree or you disagree with that statement.

(learners talking)

Learner: Because that thing used to be alive.

Learner: It's like a cycle.



DISCUSSION LAB PLANNING SHEET

Directions

- 1. Choose a discussion leader.** Choose one member of your group who is willing to lead a discussion with a small group. Quickly choose a topic from the list below (or come up with your own) with which the discussion leader is comfortable facilitating.
- 2. Together, discuss and plan.**
 - Choose the goal(s) you might have for the discussion. (Refer to the *Goals and Instructor Moves for Productive Discussion* handout).
 - Brainstorm potential follow-up questions, instructor actions, and/or interesting content to use during the discussion.
 - Think about directions the discussion might go and how the discussion might be best concluded. Be prepared to flow with the discussion and what participants bring up.
- 3. Discussion leaders switch groups, so every group has a new “instructor”:**
 - Each discussion leader shifts to a new group.
 - Choose one person in the group to observe and take notes about the discussion.
 - The instructor facilitates the discussion.

Possible Discussion Topics

Environmental Issues

Note: These discussions may provoke passionate opinions, and the instructor needs to handle these with sensitivity. These discussions are richer when learners have already explored and discussed discoveries, and when they have had some discussions about concepts. Generally, instructors can introduce key evidence, but they should hold back from sharing their own opinions. Discussing local environmental issues in learners’ communities, and particularly issues related to environmental justice, can be a strategy for making learning experiences relevant to learners’ lived experiences.

- *Should wolves (or another organism) be (re)introduced to the ecosystem we are in?*
- *Should humans let wildfires burn?*
- *Should wilderness areas be off limits to humans?*
- *Should invasive species be exterminated?*

DISCUSSION LAB PLANNING SHEET (continued)

Conceptual Development

Note: It can be challenging during these discussions to juggle learners' accurate and inaccurate developing ideas. Generally, instructors may occasionally introduce information to inform the discussion, but they should not offer a "right" answer to the main question being discussed at the moment or hint that a learner's answer is correct or incorrect. It may be appropriate to do so later.

- *Can humans be considered decomposers? What about other animals?*
- *How do you think decomposition might happen in the ocean?*
- *When the Texas Horned Lizard feels threatened, it shoots blood out of its eyes (or name any other interesting animal adaptation). How do you think this adaptation developed over many generations?*
- *What are some examples of organisms' characteristics that are NOT adaptations?*
- *How do fungi get energy and matter to survive?*

Nature Engagement

Note: These discussions are appropriate when your group has just observed an interesting nature interaction or has compelling evidence of a nature interaction available so all learners have had a shared experience and have something to contribute. They tend to be the easiest type of discussion to lead and participate in and can serve as a good way to introduce learners to discussion and for instructors to get used to leading discussion. (These types of discussions likely aren't appropriate for the Discussion Lab experience, unless you have something specific to observe.)

- *What happened here (at site of evidence of interesting interaction, such as a bird kill, bones, tracks, etc.)?*
- *What are some possible explanations for what we just observed (after observing an interesting nature interaction, such as predator-prey interaction, interesting animal behavior, etc.)?*

Tips

- **Listen and probe.** Most important is to carefully listen to what discussion participants have to say and what they are interested in, and let that guide the discussion. Be authentically curious about and probe to find out more about what participants are thinking.
- **Plan and improvise.** Don't get stuck on where you think the discussion should go. But be prepared to refocus the discussion if it wanders too far afield or to ask another question if participants are losing interest.



DISCUSSION MAP

The Discussion Map is a useful structure for instructors to use to encourage learners to construct their own conceptual understandings, unpack their ideas, and generally stimulate discussion.

- **Ask a broad question.** Examples:
 - *What happens to the mass of a log as it decomposes?*
 - *What might have happened to this deer?*
 - *Why might lizards lose their tails?*
 - *Should wolves be reintroduced to this ecosystem?*
- **Listen to learner responses. Accept responses neutrally—don't imply that responses are good or bad, correct or incorrect.**
- **Ask for evidence and probe learner thinking.** Examples:
 - *Can you say more about that?*
 - *What makes you think that?*
 - *Can you show us what you mean?*
- **Ask for agreement/disagreement from other learners.** Examples:
 - *Does anyone have a different idea?*
 - *What are some other possible explanations?*
 - *That's an interesting idea. Let's all Turn & Talk about that idea.*
 - *Can someone else explain that idea in a different way?*
- **Add content to give learners more evidence or ask a question leading back to the main topic.** Examples:
 - *Check out this key and see how many different types of lichen you can find.*
 - *What else should we consider to figure out where the mass of this log is going?*
 - *Are there any other parts of this deer that might offer clues about what happened to it?*
 - *Try thinking about it from a predator's perspective; can you think of another possible adaptation?*
 - *What other organisms in this ecosystem might wolves affect?*
- **When you are ready to end the discussion, briefly summarize the main points of what has been said and/or ask learners to summarize for you.**

DISCUSSION MAP (continued)

Cut out this pocket-sized version to carry with you in the field.



Discussion Map

- Ask a broad question.
- Listen to learner responses. Accept responses neutrally—don't evaluate!
- Ask for evidence and probe learner thinking.
- Ask for agreement/disagreement from other learners.
- Add content to give learners more evidence.
- Ask a question leading back to the main topic.

- At the end of the discussion, briefly summarize the main points.

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GOALS AND INSTRUCTOR MOVES FOR PRODUCTIVE DISCUSSION

So you want to lead an evidence-based meaning-making discussion? Have a goal(s) in mind and questions that match your goal(s).

Goals and Prompts

Goal 1: Ignite interest and fan the flames of discussion.

1. Stimulate curiosity

- Ask broad questions of interest to learners, connect to their related prior knowledge.
- Judiciously (only when necessary) introduce content that promotes further discussion.

Goal 4: Help learners deepen their reasoning.

6. Ask for evidence or reasoning

- *What makes you think that?*
- *What's your evidence?*

7. Challenge or counterexample

- *Does it always work that way?*
- *How does that idea square with Sonia's example?*
- *Do you know if raccoons are active during the daytime?*

Goal 2: Help individuals share, expand, and clarify their own thinking.

2. Time to think

- *Partner Talk, Turn & Talk*
- *Writing as Think Time, Think-Pair-Share*
- *Wait Time*

3. Say more

- *Can you say more about that?*
- *What do you mean by ___?*
- *Can you give an example? What's your evidence?*

4. So, are you saying ___?

- *Let me see if I understand what you're saying ___?*
(Always leave space for the original learner to agree or disagree and say more.)

Goal 5: Help learners think with others.

8. Agree/Disagree and why?

- *Do you agree/disagree? Why?*
- *What do people think about what Ian just said?*
- *Does anyone want to respond to that idea?*

9. Add-On

- *Who can add on to the idea that Jamal is building?*
- *Can anyone take that suggestion and push it a little further?*

10. Share another's thinking

- *Who can restate what Esmeralda means?*
- *Why do you think Tiffany said that?*

Goal 3: Help learners listen carefully to one another.

5. Can someone rephrase or repeat that?

- *Who can repeat what Javon just said or say it in their own words?*
- *Does anyone have evidence to support what Felicia just said?*

TIPS FOR PROMOTING DISCUSSION

Practice, Practice, Practice

Discussions are messy. As a discussion facilitator, there's always room for improvement, and there are always many different pathways you could choose. A productive discussion moves steadily toward a consensus understanding of concepts by the group, but it doesn't always end with a neat, tidy conclusion. Embrace the idea that learning is a process. Discussions bring accurate and inaccurate ideas into the open to be examined by the group and to help the instructor learn more about what's going on in learners' minds.

Be self-evaluative, but recognize that leading and participating in meaning-making discussions takes practice. If your first attempts are disappointing, keep at it! Discuss with others about what you might do differently and try again. Learners need practice with discussion, and instructors need practice leading discussions.

Nurturing a Culture of Respect and Curiosity

Introduce group agreements and model respectful discussion. Group agreements are helpful for building a learning community throughout the time a group is together, and they are particularly important during discussions. Group agreements might include the following:

- Listen actively and share ideas.
- Share and ask for evidence.
- Disagree productively to deepen understanding.
- Take space, make space.
- Keep an open, curious mind.
- Build on others' ideas.
- Take responsibility for your impact on others.

The goal is for learners to feel that their ideas are valued by peers and their instructor and to create a "brave space" for the whole group in which learners take risks and are vulnerable with sharing tentative ideas. For support in setting up group agreements with your students, see the BEETLES [Group Agreements for Science Discussions](#) Student Activity Guide.

Nurture a culture of intellectual curiosity. Your learners are already curious when they come to you—it's part of being human. They still may need some modeling and coaxing before they share the sorts of tentative questions and ideas necessary for intellectual inquiry and discussion. They may be reluctant to admit what they don't know in the presence of peers and instructors. Model your own interest in the subject, including your own questions and confusions. Show similar interest in the ideas and contributions of learners and encourage others to do the same. Participate in conversations and investigations by actively trying to figure things out together as a fellow naturalist. Trust that learners will become enthusiastically curious about nature and one another when a culture of intellectual curiosity exists. Remember to learn from your learners—they have lived experiences and expertise that you don't have!



TIPS FOR PROMOTING DISCUSSION (continued)

Encourage participation from all learners, but don't require equal participation from all. Just because some learners aren't speaking as much doesn't mean they're not engaged. Some learners happily discuss in pairs but are reluctant to speak in a larger group. With some encouragement and straightforward prompts (e.g., *What do you think of what June just said?*), quieter participants may start to share, and you can build from there. Forcing participation is rarely successful in discussions.

Point out and model examples of productive discussion and science discussion. To help learners improve their participation, it's useful to point out examples when you or others model good discussion practices, such as asking for evidence or building on someone else's idea. Also encourage learners to respectfully practice offering feedback on one another's discussion practices.

Periodically ask learners to self-evaluate their discussions. After or midway through a discussion, ask the group what aspects of discussion they have done well so far (see the list of group agreements on the previous page) and which ones could use more attention.

Pay attention to unconscious biases that might emerge in discussions, and be aware of your own personal biases. Pay attention to including participation from learners who may have been marginalized. Make sure that all learners' lived experiences and opinions are valued.

Avoid calling mostly on the same learners, encourage participation from others, and accept all responses without showing preferential excitement about particular learners' responses.

Starting Small

Start out with mostly pair discussions and work up to larger group discussions as you and your group get more comfortable with discussion. Discussing in pairs is much easier for most learners *and* instructors to manage.

Give options. Offer many opportunities for learners to discuss in pairs and in small groups to encourage peer-to-peer learning and to prepare them for whole-group discussions. Break up large group discussions with *Turn & Talks*.

Mix discussion with activity. Moving around physically and back and forth from active, hands-on activities to discussion can reinvigorate learners and jumpstart discussions.

Use rich experiences of learner-centered exploration of nature to develop science language and conceptual vocabulary.

Asking Questions

Plan thoughtful questions in advance, but also plan to improvise. Small adjustments in phrasing can sometimes make or break a discussion question, so it pays to plan and be thoughtful with your questions. But sometimes, great questions are improvised on the spot. A great discussion-inspiring question is "gold," so record them when you find them, use them again, and share them with others. Ask engaging broad questions and be ready to modify them or shift to another question if interest decreases. Try to figure out

TIPS FOR PROMOTING DISCUSSION (continued)

what makes a question interesting to learners, such as questions about topics that have a variety of interesting ways to think about them. Try to find questions that elicit nuances, details, and gray areas to make discussion interesting.

Accept and probe thinking. Ask mostly broad questions. In general, give neutral accepting responses to learner statements (e.g., *Thanks for sharing that. Interesting. What do others think? Okay, I can see that you have given that some thought.*) and invite feedback from the group by asking learners to respectfully agree, disagree, or expand on what others have said.

Wait time. Pause approximately 3–5 seconds after asking a question before calling on anyone to respond. This allows more thinking time and for more learners to respond. Don't always call on the first hand that goes up. Reward thoughtfulness and risk-taking rather than speed. Encourage learners to struggle with questions and ideas rather than answering immediately.

Guiding and Concluding the Conversation

Moderate, don't dominate. Pay attention to the group dynamics. Instructors need to balance offering guidance while also allowing learners to drive the discussion.

Keep discussion as learner-driven as possible. Make sure learners have the opportunity to share their lived experiences and prior knowledge. Avoid getting carried away with interjections of your own stories and perspectives.

Conclude the conversation by summarizing what has been discussed (or ask a learner to summarize) and any consensus understanding of concepts that has emerged. Offer learners a chance to reflect on what they have learned and what helped them to learn. Ask them to think about what surprised them, new questions they have, what has changed in their thinking, or to respond to the prompt: *I used to think _____. Now, I think _____.*

Thinking Metacognitively

Make choices. Many different threads tend to come up during a discussion, and you can't pursue them all as a group. Although you want to make sure every idea is heard and acknowledged, you can keep the group focused and on-topic by choosing which paths to spend more time pursuing with follow-up questions. It's easy to follow interesting tangents, but it is unsatisfying to come to the end and realize the main topic was never fully explored. Try writing interesting but off-topic ideas in a visible "parking lot" or "bike rack" for future discussions and then refocusing the group on the main topic. Everyone will know they are being heard, even if their topic is not immediately discussed.

Seek out the edges of your own understanding. When discussions steer toward topics and questions that you don't fully understand, embrace the opportunity! Let learners see you grappling with ideas, too. Figuring things out together makes you a "guide on the side." Some educators avoid discussing unfamiliar topics because they think they will lose respect from their learners, but the reverse is often true. Learners often respect teachers more for being curious and engaged alongside them, and they are more likely to engage with what they see as authentic inquiry.



TIPS FOR PROMOTING DISCUSSION (continued)

Research in advance known common misconceptions. Knowing that many learners think soil is the main “ingredient” of trees can help you frame and guide a discussion about where the mass of a tree comes from, perhaps by bringing pivotal pieces of evidence into the discussion. Awareness of common misconceptions can also help you recognize and understand them in statements made by learners. When these ideas emerge, listen carefully and ask probing questions.

If there is a specific answer or response you are looking for from the group, and you’re asking leading questions, the discussion may seem inauthentic and not very lively. In those cases, you might be better off just telling the group what you want them to know—a discussion may not be the right strategy.

RESEARCH RELATED TO DISCUSSION

Research About Pedagogy

These short excerpts from educational research highlight some important findings and conclusions.

The value of “wrong” answers. “...Knowing why the wrong answer is wrong in academic discourse can be just as important as knowing why the right answer is right” (Osborne, 2010). Deep understanding of science concepts comes from examining evidence that allows us to eliminate possible explanations. This process of moving ever closer to accurate explanations by eliminating inaccurate ones is at the heart of reasoning and science discourse. Critique and challenging ideas with evidence is central to science and is just as central to science education. Even when learners are not certain of the “right answer” (or the right answer is not knowable), they learn tremendous amounts by understanding why some explanations are not possible. This process takes place most effectively through discussions.

Henderson, J. B., MacPherson, A., Osborne, J., & Wild, A. (2015). Beyond construction: Five arguments for the role and value of critique in learning science. *International Journal of Science Education*, 37(10), 1668–1697.

Osborne, J. (2010). Arguing to learn in science: The role of collaborative, critical discourse. *Science*, 328(5977), 463–466.

Discussion increases cognitive abilities. Early evidence indicates that opportunities to discuss ideas in one discipline can have positive impacts on student achievement in other disciplines, as well. In essence, discussion “grows the mind.”

Resnick, L. B., Michaels, S., & O’Connor, C. (2010). How (well-structured) talk builds the mind. In D. D. Preiss & R. J. Sternberg (Eds.), *Innovations in educational psychology: Perspectives on learning, teaching, and human development* (pp. 163–194). Springer Publishing Company.

Peer-to-peer discussion deepens learning. Research shows that peer-to-peer discussion is a critical component of the learning process. Learners who reason and discuss together often come up with more accurate ideas than they can as individuals, even when no one in the group enters the discussion with the “right answer.” Studies show that scientifically accurate ideas tend to come out of peer discussions, even if each individual originally had inaccurate conceptions. Peer discussion between pairs or groups of learners is less hindered than adult–child interaction. Peer groups seem to support both divergent thinking and the development of new ideas. The perceived superiority of adults sometimes intimidates children from freely expressing their ideas, while peer groups can offer more opportunity for discussion and reciprocal exchanges. This promotes the types of social interaction that support construction of understanding.

Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why peer discussion improves student performance on in-class concept questions. *Science*, 323(5910), 122–124.



RESEARCH RELATED TO DISCUSSION (continued)

Smith, M. K., Wood, W. B., Krauter, K., & Knight, J. K. (2011). Combining peer discussion with instructor explanation increases student learning from in-class concept questions. *CBE-Life Sciences Education*, 10(1), 55–63.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. NY: Oxford University Press.

Wait time improves and increases participation. The concept of “wait-time” as an instructional variable was originated by Mary Budd Rowe (1972). The “wait-time” periods she found—periods of silence that followed teacher questions and students’ completed responses—rarely lasted more than 1.5 seconds in typical classrooms. She discovered that when these periods of silence lasted at least 3 seconds, many positive things happened to students’ and teachers’ behaviors and attitudes. To attain these benefits, teachers were urged to “wait” in silence for 3 or more seconds after their questions and after students completed their responses (Rowe 1972; Stahl 1990; Tobin, 1987). With this undisturbed wait time, the length and correctness of responses increase; the number of *I don’t know*-responses and no-answer responses decreases; the number of volunteered, appropriate answers and the number of students volunteering them greatly increases; and the scores for students on academic achievement tests tend to increase. When teachers wait patiently in silence for 3 or more seconds at appropriate times, there are also positive changes in their own behaviors: their questioning strategies tend to be more varied and flexible; they decrease the quantity and increase the quality and variety of their questions; they ask additional questions that require more complex information processing and higher-level thinking; and they call on a wider variety of students to respond.

Cohrssen, C., Church, A., & Tayler, C. (2014). Purposeful pauses: Teacher talk during early childhood mathematics activities. *International Journal of Early Years Education*, 22(2), 169–183.

Rowe, M. B. (1972). “Wait-time” and rewards as instructional variables: Their influence in language, logic, and fate control. Paper presented at the National Association for Research in Science Teaching, Chicago, IL.

Rowe, M. B. (1986). Wait time: Slowing down may be a way of speeding up! *Journal of Teacher Education*, 37(1), 43–50.

Stahl, R. J. (1990). Using “think-time” behaviors to promote students’ information processing, learning, and on-task participation: An instructional model. Tempe, AZ: Arizona State University.

Tobin, K. (1987). The role of wait time in higher cognitive level learning. *Review of Educational Research*, 57(1), 69–95.

Research About Equity and Inclusion

Boys are given more opportunities than girls. Research confirms that teachers call on boys more often than girls, accept more called-out responses from boys than girls, give boys more wait-time to respond, and give boys more praise and remediation than girls (Lavy & Sand 2015; Lindberg, Hyde,

RESEARCH RELATED TO DISCUSSION (continued)

Peterson 2010; Sadker & Sadker, 1994 and 2010; Biklen & Pollard, 1993). Teachers usually are not aware that they favor the boys over girls in this way and are genuinely surprised when they learn of these inequities when they confer with trained observers or watch videotapes of their own teaching (Wellhausen & Yin, 1997).

Educators need to acknowledge that they play an ongoing role in perpetuating racial inequality in schools, experts say. Teachers' racial biases tend to influence the expectations they have for their students, the quality of their teaching, and the choices in how they manage their classrooms. Research has found that black students are **less likely to be placed in gifted education classes** and **more likely to receive exclusionary discipline** (such as detentions and suspension) when they have white teachers. White teachers also tend to have **far lower expectations** for black students than they do for white students, which can contribute to high school graduation rates and college enrollment rates. Teachers' bias levels are related to student outcomes—the more biased teachers are, the worse students' outcomes are.

Biklen, S. K., & Pollard, D. (1993). Sex, gender, feminism, and education. In *Gender and education: Ninety-second yearbook of the National Society for the Study of Education*, 1–11. Chicago: The University of Chicago Press.

Sadker, M., & Sadker, D. (1994). *Failing at fairness: How America's schools shortchange girls*. New York: Scribner.

Sadker, D., & Zittleman, K. R. (2009). *Still failing at fairness: How gender bias cheats girls and boys in school and what we can do about it*. New York: Simon and Schuster.

Starck, J., Riddle, T., Sinclair, S., & Warikoo, N. (2020). Teachers are people, too: Examining the racial bias of teachers compared to other American adults. American Educational Research Association (AERA). (<https://www.aera.net/Newsroom/Teachers-Are-People-Too-Examining-the-Racial-Bias-of-Teachers-Compared-to-Other-American-Adults>)

Wellhausen, K., & Yin, Z. (1997). "Peter Pan isn't a girls' part": An investigation of gender bias in a kindergarten classroom. *Women and Language*, 20(2), 35. VA: George Mason University.

Will, Madeline (2020). Teachers are as racially biased as everybody, study shows. *Education Week*. (<https://www.edweek.org/teaching-learning/teachers-are-as-racially-biased-as-everybody-else-study-shows/2020/06>)

A few students will dominate, if you let them. As reported in "The One or Two Who Talk Too Much" (1988), researchers Karp and Yoels found that in classes with fewer than 40 students, 4 or 5 students accounted for 75 percent of the total interactions per session. In classes with more than 40 students, 2 or 3 students accounted for 51 percent of the exchanges. Instructors can play an important role in ensuring more equitable discussions by forming group agreements (e.g., Take space, make space) and facilitating contributions (e.g., "Is there anyone who hasn't spoken yet who would like to?")

Karp, D., & Yoels, W. (1988). The one or two who talk too much. *Teaching Professor*, 2(7).



RESEARCH RELATED TO DISCUSSION (continued)

All students have the capacity and the right to be independent learners. “Classroom studies document the fact that English learners, poor students, and students of color routinely receive less instruction in higher order skills development than other students. Their curriculum is less challenging and more repetitive...This type of instruction denies students the opportunity to engage in what neuroscientists call **productive struggle** that actually grows our brain power. As a result, a disproportionate number of culturally and linguistically diverse students are dependent learners.”

Hammond, Z. (2015). *Culturally Responsive Teaching & the Brain*. CA: Corwin

STEPS TOWARD DISCUSSION

Types of Science Discussions

- **Direct Engagement with Nature**
 - Using observations and making explanations based on evidence.
- **Environmental Issues**
 - Discussing choices about human impacts and policy.
- **Conceptual Development**
 - Building a better understanding of specific science concepts.

A Productive Discussion Requires:

- a worthy topic.
- learners to
 - elaborate and clarify thinking.
 - support ideas with examples.
 - build on and/or challenge another's ideas.
 - connect different ideas or apply an idea to a new situation.
- a conclusion that paraphrases or summarizes what's been discussed and/or learned and offers a chance for reflection.

Practice Makes Experts

"Not all practice makes perfect. You need a particular kind of practice—*deliberate practice*—to develop expertise. When most people practice, they focus on the things they already know how to do. Deliberate practice is different. It entails considerable, specific, and sustained efforts to do something you can't do well—or even at all. **Research across domains shows that it is only by working at what you can't do that you turn into the expert you want to become.**"

Ericsson, K. A., Prietula, M., & Cokely, E. (2006). The Making of an Expert. *Harvard Business Review*, July–August 2007.



DISCUSSION ROUTINES

An important part of the learning process is having opportunities to discuss with others. The activity structures—or routines—that follow offer opportunities for learners to discuss while in the field. These routines can be used to discuss virtually any topic.

Turn & Talk

Procedure: Pairs of learners discuss one or more questions. This very simple strategy can be done with planned questions, or it can be improvised at any point. The instructor says, “Turn to a partner and discuss [insert question here].” This routine offers opportunities for everyone to discuss what they’re thinking, as well as to hear ideas of others.

Purpose: Offers 1:1 thinking and discussing time for learners; practice listening and responding to peers. It helps keep everyone engaged in large groups. When a large-group discussion stalls because no one has a response to a question, the instructor can say, “Okay, let’s all discuss our ideas about this for X minutes. Turn and Talk!”

Dominoes

Procedure: Quickly go from person to person in the group. When it’s each learner’s turn, they say one or two words to answer the prompt. The instructor can ask follow-up questions to a few learners or to the group to go a little deeper.

Purpose: A quick and efficient check-in to get a baseline level of understanding from the whole group and to seek out provocative statements to pursue more deeply.

Thought Swap (formerly known as Walk & Talk)

See BEETLES [Thought Swap](#) Student Activity write-up for a thorough description and question sets.

Procedure—Moving Version:

- **Choose a series of broad questions.** Choose a series of broad questions on a topic that will be interesting to discuss.
- **Arrange participants in two parallel lines.** Participants in each line stand shoulder to shoulder, with the two lines facing each other. Each person partners with the person directly across from them in the other line. Include yourself in one of the lines so you have a partner.
- **Share the procedure for discussing questions.** You’ll offer a question for pairs to discuss as they are moving side-by-side along a trail. They will have a few minutes to discuss. You will signal them with a “wave of silence” to stop and be quiet and then call on a few people to share some of what their partner told them. Then, prepare everyone for the next question or statement.
- **Change partners before you give the next prompt.** Let participants know which of the lines will shift with each question while the other line remains in place. Tell the person at the end of one line to move down and rejoin the line at the opposite end. Have this line now shift one position forward so everyone is facing a new person who becomes their partner. Pose the next question or prompt.
- **Do the same with the other questions.** It’s good to start the whole-group sharing by asking people to share something interesting their partner said, to encourage listening, and then sometimes ask

DISCUSSION ROUTINES (continued)

learners to voice their own thoughts. For the moving version it is ideal, but not necessary, if some of the questions relate to the place you are moving through, so you are encouraging participants to look around.

Procedure—Stationary Version:

Everything is the same as in the Moving Version, except that participants remain in place in their lines during pair discussions and are not moving to another location while discussing.

Purpose: Facilitates 1:1 peer discussions and gives the leader an opportunity to engage in discussions with individual learners. Also reveals interesting ideas to pursue with follow-up questions to ignite discussion with the whole group. Asking learners to share something their partner told them helps learners practice listening, which is an important foundation to good discussions and a key strategy for promoting language development. The Moving Version helps learners remain focused on topics during transitions. It also distracts learners while covering territory, such as a steep hill, and helps keep the group together.

Think-Pair-Share

Procedure:

- **Think.** Give learners an interesting, broad question to think or write about briefly.
- **Pair.** Pair learners and ask them to discuss their responses to the question(s) with their partners.
- **Share.** Learners share their discussion ideas with another pair, or the instructor leads a whole-group discussion about the topic.

Purpose: Gives learners individual thinking and reflection time as well as 1:1 peer discussion before sharing with the whole group.

Tape Recorders

Procedure:

- **Pair up learners.** Assign partners, with one learner as “talker” and the other as “tape recorder.”
- **Share roles.** The “talker” role will be to say all they can about the topic (of the prompt you will offer) for 2 minutes, until you say, “Stop.” The “tape recorder’s” job will be to listen to everything their partner says without saying anything until you announce, “Stop.” Then you’ll say, “Rewind” and a few seconds later, “Play back!” The “tape recorder” will have 2 minutes to try to repeat back as much of what their partner said as possible, just like a tape recorder.
- **Begin talking and recording.** Offer a prompt or a question and have learners begin. After 2 minutes, stop and play back. After 2 more minutes, get the group’s attention and ask them to switch roles. Repeat the process with a different prompt.



DISCUSSION ROUTINES (continued)

- **Discuss the process.** Now, tell learners to discuss in groups of four how it felt to be a “talker” and a “tape recorder.” After a few minutes, ask for a few comments to be shared with the whole group.

Purpose: Gives learners opportunities to practice listening to and understanding each other. Highlights abilities that some learners didn’t know they had (some might be remarkably proficient at remembering and repeating back verbatim) or abilities they need to work on.

Two Cents

Procedure:

- **Form small groups of about 4–6 learners.** Learners take turns speaking. When it’s not their turn, they listen and don’t speak.
- **First round (1 cent).** Each learner in the group gets 1 minute to say what their ideas are on the topic or prompt offered by the instructor.
- **Second round (2 cents).** Each learner in the group gets 1 minute to respond to what others have said.

Purpose: Gives learners an opportunity to practice listening to one another and letting everyone speak in turn.

BACKGROUND INFORMATION FOR PRESENTERS

Facilitating discussions of ideas can result in powerful learning experiences. Discussion and discourse play an important role in meaning-making and developing ideas and concepts. Learning takes place through discourse within social and cultural interactions (Rogoff, 1998; Vygotsky, 1978). Vygotsky emphasized the importance of discourse by arguing that higher mental functions have social origins that are first expressed between individuals before they are internalized within the individual—that learning relies on discourse. For learners, engaging in discussions can foster more creative, complex thinking and offer opportunities to practice crucial abilities such as asking questions and communicating ideas effectively. For teachers, all types of talk and discussion in the classroom can offer a window into learners' prior knowledge, level of understanding, personality, lived experience, and ability to articulate ideas and reasoning.

Sometimes, however, discussions can be frustrating experiences. From the learner perspective, being told one's idea is wrong (or even not quite right) can discourage further participation; being singled out for an answer can be embarrassing; being constantly overlooked in favor of a more vocal learner can decrease confidence and self-efficacy. Discussions in which many ideas are voiced without moving toward a shared conceptual understanding can seem confusing or pointless. From the instructor perspective, it is easy to allow a few vocal learners to dominate a discussion; it can be challenging to engage reluctant-to-speak learners in discussion; off-topic responses, if not handled well, can derail a discussion; and it can be tricky to know when to communicate accurate information while also providing space for learners to share some of their own inaccurate ideas as they construct their own understanding.

Note: As a leader of this session, don't forget to refer to the *Tips for Promoting Discussion* handout. It was designed primarily for instructors interested in leading discussions with children, but most of the tips apply to presenters leading discussions with other adults.

Patterns of Discourse During Instruction

In BEETLES learning experiences, learners continually engage in collaborative science discussions. Learner-to-learner talk is a key component of a productive learning environment (Rivard & Straw, 2000; Duschl & Osborne, 2002; Varelas & Pappas, 2006; Varelas, et al., 2008), and BEETLES features learner talk as a key modality for instruction. We hope this helps instructors create learning environments that are both collaborative and inquisitive—where learners feel comfortable challenging assumptions, probing for information, and ultimately learning from one another. Becoming a skeptical thinker takes practice, so discussions should happen frequently (Driver, Newton, & Osborne, 2001; McNeill & Krajcik, 2008; Osborne, 2010).



Researchers have mapped out common patterns of discourse during classroom instruction. These patterns can be illuminating for teachers and program leaders thinking about promoting discussions in the outdoors. Some patterns work well for generating discussions, while others are appropriate for checking for understanding or other purposes. **Monologic** instruction is essentially a lecture in which the teacher does almost all the talking. **IRE**, in which the teacher **I**nitiates, student **R**esponds, teacher **E**valuates, includes more student speaking than monologic instruction, but the teacher is generally still speaking more than students, students only respond to the teacher, and the talk tends to be focused on students answering questions with the teacher evaluating student responses. In **IRF**, the teacher **I**nitiates, student **R**esponds, teacher **F**ollows up/gives **F**eedback, there's a bit more opportunity for students to talk, and it can be useful for finding out more about a student's thinking, but it still tends to focus on right answers evaluated by the teacher. Neither IRE nor IRF tends to allow students to fully express their ideas. IRE and IRF are common in instruction and tend to offer the illusion of interactivity, but they are not very different from when teachers ask a series of narrow questions (Thornbury, S. 1996). Monologic instruction, IRE, and IRF are all based on the teacher primarily transmitting information to students. Both **reflective discourse** and **dialogic instruction**, on the other hand, engage students in authentic discussion. In these patterns of discourse, broad questions with more than one acceptable answer and teacher responses to students that encourage divergent thinking generate lively and authentic discussion among students. Students get to share their thinking, ideas, and lived experiences; topics of discussion can be guided by student interests, increasing intrinsic motivation. Although research has found that discussion involving someone who knows more about a subject than a student (e.g., a teacher) is one important factor for learning, research also highlights the benefits of **peer-to-peer discourse** in learning. Students need opportunities to try out their ideas in the less intimidating context of discussing with peers.

Reflective Discourse

When a teacher facilitates a free-flowing exchange during which students and the teacher pose questions, respond to one another's comments and questions, and seek to understand one another's ideas, this exchange can be called reflective discourse. Students have the freedom to express their own authentic thoughts, ideas, and questions, which stimulates curiosity about the discussion itself (Van Zee & Minstrell, 1997).

Dialogic Instruction

In a dialogic learning environment, the teacher uses reflective discourse to validate and elaborate student ideas and guide them to "negotiate" their understanding with other students in the group. The teacher uses strategies such as uptake (Collins, 1982) in which a particular student's response is incorporated into a question to the group, to encourage students to build on one another's ideas. Student responses help shape the discussion, as opposed to relying on the teacher asking questions to drive the exchange. A

dialogic approach to instruction is often characterized by the use of broad questions, which do not have pre-specified answers. The questions reflect a genuine interest by the teacher in students' thoughts and ideas. The discourse in these learning situations is less predictable and repeatable because it is mutually determined by both teachers and students, as teachers pick up on, elaborate, and question what students say (Nystrand, 1990a, 1991a). Dialogic conversations engage students because they validate the importance of students' contributions to learning and instruction. The purpose is not for the teacher to transmit information, but for students to collaboratively co-construct understanding themselves—through talking (Gomorra & Nystrand, 1992). Monologic instruction (also see below) offers students fewer chances to construct and articulate their own understandings of scientific ideas. It reflects the viewpoint that scientific knowledge comes primarily from the teacher (or another expert source) and does not give students the chance to learn science by thinking scientifically and by evaluating ideas against evidence as scientists do. Monologic instruction can achieve learning that consists of memorizing facts and information, but it can hinder deeper, more conceptually focused types of learning.

Monologic Instruction

In monologic instruction, the teacher shares, describes, clarifies, identifies, and questions. In this type of instruction, the main goal is for the teacher to present scientific views and explanations. The teacher is doing most of the talking.

IRE and IRF

There are variations in teacher-directed talk. In one pattern, abbreviated as IRE, the teacher initiates the conversation with a question or comment (I), the student responds (R), the teacher evaluates the response (E), and then repeats the pattern with another question (Lemke, 1990; Mehan, 1979), usually to a different student.

Example of IRE (Initiate, Respond, Evaluate):

Teacher: What kind of flower is this? (Initiate)

Student: It's a trillium. (Respond)

Teacher: Yes, it is trillium. It is white and has flower parts in threes. (Evaluate)

Teacher: What about this one? What kind of flower is this? (Initiate)

Student: It's a daisy. (Respond)

Teacher: No, this one is Fleabane. You can tell because it has a taller stalk. (Evaluate)

Student responses may be short answers, while the teacher's evaluations of the responses may be long and elaborate. In another variation, often called IRF, the teacher initiates the conversation with a question or comment, the



student responds, the teacher seeks follow-up ideas and comments from the student, and then the pattern repeats with response and follow up (Sinclair & Coulthard, 1975).

Example of IRF (Initiate, Respond, Follow up/give Feedback):

Teacher: What kind of flower is this? (Initiate)

Student: It's a trillium. (Respond)

Teacher: What makes you say that it's a trillium? (Follow up)

Student: Because it has three leaves and three petals. (Respond)

Teacher: You're right. It is a trillium. (Feedback)

In both cases, the turn-taking switches back and forth between teacher and student regularly, and the teacher directs the conversation and makes knowledge public. These patterns often fail to offer students opportunities to articulate their own understanding and express themselves in the language of the discipline (Alexander, 2005; Wellington & Osborne, 2001) or to engage in discourse with other students. On the other hand, such interactions can be a way to extend the student's answer, to draw out its significance, or to make connections with other parts of the student's total learning experience (Wells, 1999).

Peer-to-Peer Discourse

Peer discussion takes place in pairs or groups of students where adults are either not present or are refraining from full participation in the discussion. Researchers find that having a more equal structure for participation in a discussion (i.e., when the teacher yields control to the students) promotes more active cognitive involvement, as students may not be as intimidated from freely expressing their ideas (Rogoff, 1990; Piaget 1977). Studies on discourse patterns have found that discussion between children can offer the opportunities for social interactions that help support student learning (Blum-Kulka & Snow, 2004).

Instructors' Role in Science Discussions

Learning science adds more complexity to the practice of leading discussions, because it also involves learning the language and tools of science and the accepted methods of reasoning in science (Anderson, Holland, & Palincsar, 1997; Kuhn, 1962). This process of acculturation is not possible without guidance and assistance from a more expert mentor, such as an instructor (Scott, et al., 2006). "Learning science...is seen to involve more than the individual making sense of his or her personal experiences but also being initiated into the 'ways of seeing' which have been established and found to be fruitful by the scientific community. Such 'ways of seeing' cannot be 'discovered' by the student—and if a student happens upon the consensual viewpoint of the scientific community they would be unaware of the status of the idea" (Driver, 1989, p. 482). That's why science teachers need to engage students in dialogue about their everyday views of phenomena and to introduce the perspective and conceptual understandings adopted by the scientific community (Scott, et al., 2006).

It's important that students have opportunities both to make their everyday ideas explicit and to apply and explore newly learned scientific ideas through discussion and other actions for themselves (Scott, et al., 2006). "Meaningful learning involves making connections between ways of thinking and talking... between everyday and scientific views" (Scott, et al., 2006, p. 622). This type of discussion offers students the opportunity to voice their everyday views of the world in common language, but they also need the assistance and guidance from more knowledgeable individuals to make connections between everyday views and scientific views (Scott, et al., 2006). Analyzing the patterns of discussion and insights from student conversations during the session offers participants information about the benefits of discussion with students and the benefits of allowing students to articulate their own thinking.

Giving students an opportunity to discuss their ideas in the context of analyzing the arguments of others significantly helps them to develop scientific knowledge. (Osborne, Erduran, & Simon, 2004).

Equity, Inclusion, and Discussion

Discussions can increase equity or can reinforce existing inequities and power dynamics. Discussions offer great opportunities to increase equity and inclusion, but they can also reinforce existing inequitable power relationships and the marginalization of some participants. Discussions can be inequitable when certain students dominate discussions, while others may be largely left out (Karp & Yoels, 1988). Discussions may also reinforce dominant cultural values while neglecting or undermining cultural values of more marginalized populations. With guidance about discussion-leading strategies, instructors can avoid contributing to these inequities.

Inequity that takes place during discussions often isn't noticed by participants or instructors. Inequity is what we have become used to in many contexts. It feels normal to many of us, especially to those who are more privileged and may benefit from it. Once we become aware of inequities, we can work to undo them.

...the "normalization of inequity" created by the dynamics of race and social class in education needs to be addressed. This is often difficult because the normalization process renders the dynamics of race and social class "invisible" to privileged members of society (also along gender lines) who are not faced with the daily injustices of inequity or are denied an accurate account of our collective history. It also obscures the emancipatory necessity of our work as educators. Thus, considerable work needs to be done to educate ourselves as to the significance of race and social class in the structure of education and in the complex process of self-formation. (Brown, 2005)

Discussions are opportunities for instructors to increase equity. This takes increased awareness on the part of the instructor of how race, gender,



culture, social class, and language affect interactions during discussions. Instructors can examine their own unconscious biases and become ever more thoughtful and intentional about their facilitation moves. Equity and inclusion in discussions can be increased by encouraging those who may be participating less to move forward and by encouraging those who are participating a lot to move back some. These, and other strategies in this session, help instructors facilitate more culturally relevant, equitable, and inclusive discussions.

- **Broad questions.** Using broad questions can help promote equitable and inclusive learning environments. Broad questions have many acceptable answers, and they encourage divergent thinking, multiple perspectives, and increased participation from group members. When students are encouraged to share their own perspectives and lived experiences, cultural relevance increases. Using broad questions also contributes to a group culture in which students value one another's ideas and share and relate learnings to their lived experiences.
- **Wait time.** When instructors wait ~3–5 seconds before calling on anyone (and do not ultimately always call on the first person to raise their hand), participation increases, and the depth of student responses improves.
- **Pair talk.** Regular opportunities for pair talk (e.g., *Turn & Talk*, *Thought Swap*, *Think-Pair-Share*) and small-group discussions (e.g., *Two Cents*, *Less Structured Discussion*) allow all students to share their perspectives, opinions, and ideas, and they offer students practice for participating in larger group discussions. Instructors can listen in on pair talk and encourage reluctant students to share in the large group.
- **Different ways of participating.** It's also important not to force students to participate all in the same ways and to allow for students' different levels of comfort participating and reasoning together. "Sometimes silence and listening are fine" (Bacolor, Cook-Endres, Lee, & Allen, 2014–18). By varying between pair talk, small-group discussions, and large-group discussions, every student will likely find circumstances in which they are comfortable sharing ideas with peers. Students' comfort will likely grow and expand over time—at all different rates.

Cultural Considerations

An instructor who understands a bit about the cultures of their students can communicate better with them and is better able to offer relevant, meaningful learning experiences. Culture is at the heart of learning. "Culture, it turns out, is the way that every brain makes sense of the world" (Hammond, 2015). Culture influences how instructors understand and interpret students' responses and interactions, the ways they communicate with students, and the ways they perceive their students. Culture also influences how students communicate, receive, and process information.

When instructors have some understanding of the cultures of their students, they can craft learning experiences that are more nuanced and relevant to their students' lived experiences. This is particularly important for students whose culture differs from the dominant culture. Culturally responsive teaching involves awareness that the culture and lived experience of students are assets that can *enhance* learning.

While traditional classroom practices have been found to be successful for students whose discourse practices at home resemble those at school—mainly students from middle-class and upper-middle-class European/American homes—this approach does not work very well for individuals from historically nondominant groups. For these students, traditional classroom practices function as a gatekeeper, barring them because their community's sense-making practices may not be acknowledged... Recognizing that language and discourse patterns vary across culturally diverse groups, researchers point to the importance of accepting, even encouraging, students' classroom use of informal or native language and familiar modes of interaction... An emerging consensus in education scholarship is that the diverse knowledge and skills that members of different cultural groups bring to formal and informal science learning contexts are assets to build on. (A Framework for K–12 Science Education, 2012)

Every instructor cannot become familiar with, much less conversant in, all the cultures of their students. Building an educational team that together has a range of cultural, racial, and linguistic backgrounds roughly mirroring those of students is as important to the quality of programming as the degrees, content background, and teaching expertise that instructors bring. As BEETLES advisor and partner José González, founder of Latino Outdoors, says, “You don’t have to be Latinx to teach Latinx kids. It helps though, if you are curious about the lived experiences they bring with them to your program.”

It’s important that science discussions are inclusive of different perspectives, cultural viewpoints, and ways of expressing ideas. By asking broad questions, listening acceptingly to student responses, and modeling genuine curiosity, instructors can encourage a full range of ideas and contributions. By offering different ways of participating, such as emerging multilingual learners using their first language, instructors can help students become more comfortable sharing ideas. “Research suggests that educators should accept, even enlist, diversity as a means of enhancing science learning” (A Framework for K–12 Science Education, 2012). Students benefit from being encouraged to express themselves in ways they find most comfortable. This helps students feel comfortable sharing and refining ideas (Bacolor, Cook-Endres, Lee, & Allen 2014–18).

Students benefit from an instructor who recognizes and welcomes their assets. A culturally responsive instructor will encourage and focus on

the strengths and assets students bring to the learning environment (G. Ladson-Billings 2017). “I define culturally responsive teaching simply as...an educator’s ability to recognize students’ cultural displays of learning and meaning-making and respond positively and constructively with teaching moves that use cultural knowledge as a scaffold to connect what that student knows to new concepts and content in order to promote effective information processing. All the while, the educator understands the importance of being in relationship and having a social-emotional connection to the student in order to create a safe space for learning.” (Hammond, 2015). Culturally responsive teaching has been shown to strengthen student connectedness with school and improve learning (Kalyanpur, 2012; Taum, 2009).

Science has a culture. During science education discussions, it’s important to recognize that science itself has a culture and that some students may struggle with this culture, particularly if they perceive it as clashing with their home culture and if science is portrayed as superior to other perspectives. Science is an extremely useful, evidence-based way of understanding the natural world (not the supernatural world), but it should not be portrayed as *the way*, or the only way. For example, Traditional Ecological Knowledge (TEK) is an evolving body of knowledge based on hundreds or thousands of years of close observations of ecosystems by Indigenous peoples. TEK includes Indigenous views on ecology, spirituality, and human and animal relationships. TEK overlaps with traditional western science in some ways and is unique in many others (Barnhardt, Kawagley, 2005; Kimmerer, 2013; Margolin, 2021). TEK and other non-Western approaches can enrich science discussions.

Emerging Multilingual Learners

Students who have language abilities in a range of languages can all participate in a productive science discussion! Research has shown for decades that science discussions are great for language development. There are significant benefits to emerging multilingual learners when they speak with one another in their primary language or when they engage in discussion in English. Any time learners are making sense of ideas through discussion, they are improving their language development. When learners improve their fluency and academic literacy in their primary language, they greatly increase their ability to do the same in a second language. Listening and responding to authentic academic (science) discussions in English greatly accelerates English language development. Language learners come out winners no matter what language they use to engage in discussions.

Emerging multilingual learners whose first language is not English can fully engage in discussion. A fifth-grade learner who speaks English at a second-grade level still processes information and understands science concepts at a fifth-grade level! Participation from a wide range of learners enriches science discussions—so inclusion of emerging multilingual learners benefits everyone. If emerging multilingual learners struggle or are reluctant to communicate their ideas verbally in English, instructors can offer encouragement, highlight the value of their contributions, offer

opportunities to communicate in their primary language and in English, offer less intimidating opportunities to discuss with a partner or in a small group (a whole group can be intimidating), and use visuals and graphics to scaffold discussions to facilitate their participation.

NGSS instruction is largely dependent on language, and it may inadvertently exclude English Learners from full participation if steps aren't taken. Multilingual students have important insights to contribute to learning, and scientific communities greatly benefit from the diversity of thought and experience these students bring. Second language learners often have rich family and community practices and histories that can be leveraged to more deeply engage these students in STEM learning. Keep "big ideas" in science grounded in everyday examples that are accessible to all learners. (Wingert & Podkul, 2014–18)

Participation in outdoor science discussions is beneficial for all learners, but it is particularly valuable for emerging multilingual learners.

- **Rich environment.** The outdoor environment is rich in interesting things to explore, investigate, wonder about, and share. Learners are surrounded by stimulating phenomena, so there are lots of interesting things to communicate about. Since using language is the best way to develop language, motivation to communicate is particularly important.
- **Low-stress environment.** Language is learned by discussing, listening, reading, and writing about things of interest to the learner in a low-stress environment. The outdoors can feel less stressful than the classroom for those who might be reluctant to speak. Outdoor science programs, where learners get to explore and discuss ideas, can be an ideal environment for emerging multilingual learners to practice using academic language. They're surrounded by stimulating phenomena, so there are always interesting things to communicate about.

A classroom rich in discourse is also a classroom that offers particular challenges for students still learning English. On the other side of the coin, engagement in the discourse and practices of science, built as it is around observations and evidence, also offers not only science learning but also a rich language-learning opportunity for such students. For both reasons, inclusion in classroom discourse and engagement in science practices can be particularly valuable for such students. (A Framework for K–12 Science Education, 2012)

Strategies to encourage participation by emerging multilingual learners in discussion. All learners benefit from scaffolding and modeling of how to take part in science discussions, but emerging multilingual learners in particular may need these in order to be able to participate successfully.

- **Model what you mean.** Before a discussion, model what a science discussion might look and sound like. This may include basing explanations on evidence (*I think ____, because I observed ____.*),



respectful disagreement (*I think I understand what Marta is saying, but my observation was different.*), building on one another's ideas (*I agree with what Marta said because ____.*), and using appropriate language of uncertainty (*I'm not sure, but it seemed like ____.*).

- **Use real objects.** Whenever possible, use the real thing in nature to introduce questions or prompts. Objects and phenomena speak louder than words!
- **Show graphic organizers.** On large sheets of paper, cards, manila folders, or sentence strips, create graphics, cartoons, or written-out key words or questions to prompt discussion so all learners can see them. Whenever possible, use cognates (words that look similar in two languages, such as *decomposition/descomposición, ecosystem/ecosistema, ocean/océano*) to help learners recognize words.
- **Offer sentence starters.** Offer learners optional sentence starters or useful phrases to make it easier to share their ideas (*My evidence seems to show that ____ I respectfully disagree because ____ I want to build on something that you said ____ I agree because ____.*).

School science has a language all its own. Its vocabulary and sentence structure is complex—and aspects of argumentation and reasoning in science are different than in other disciplines. This can be troublesome for language learners if teachers do not make these differences apparent and explicit (e.g., compare and contrast argumentation in science and in other parts of students' lives). (Wingert & Podkul, 2014–18)

- **Make connections to what learners already know.** Learning (language and science concepts) is about making connections, and part of learning something new is connecting it to something we already know (Cross, 1999). "Teachers must draw out and work with the pre-existing understandings that their students bring with them." (Bransford, Brown, Cocking, 2000, p. 19). To help learners with this aspect of learning, offer regular opportunities for them to discuss their prior knowledge about a topic (e.g., *What does this remind you of? Turn and Talk to a partner: What are some things you already know about waves?*). This is important for all learners, but especially for those who are still learning the language of instruction. This helps them connect what they're learning with experiences and ideas they already have.
- **Be flexible with modes of participation.** Encourage learners to communicate however they feel most comfortable: in their first language, in imperfect English, through gestures, by writing, etc. "Students often continue to think in their first languages for years after they begin to learn a second language. Help students build on their first language skills to gain deeper science understanding" (Wingert & Podkul, 2014) and give them time to translate in their head, if they need to, before responding.
- **Use hard words.** Don't avoid using relevant academic language with learners but avoid single-use hard words, which can be confusing. It

takes about seven meaningful exposures to a new hard word for it to become part of a learner’s vocabulary. Choose a few key academic words and introduce them in context when learners have a need to understand and use them. Use these words multiple times, out loud and in writing. Encourage learners to use them in context.

- **Practice in pairs.** Use discussion routines such as *Turn & Talk* and *Thought Swap* for learners to have practice putting their ideas into words. Give learners lots of opportunities to discuss in pairs before sharing in a large group.
- **Plan for clarity.** When possible, write out your prompts and questions in advance to make sure they’re clear. Try stating them in different ways to offer more than one way to understand your intent.
- **Ask for rephrasing and paraphrasing.** Ask learners to rephrase questions and instructions in order to check for understanding.
- **Consider hand signals.** Try having learners use hand signals during discussions (e.g., touch their nose if they agree, wiggle their fingers to show appreciation, tap their head if they want to build on someone’s ideas) and include other ways that learners can participate nonverbally. In some settings, this can be very helpful; in others, it can be distracting to the person speaking.

Developing Independent Learners

Learners from lower economic backgrounds, students of color, and emerging multilingual learners are often offered more remedial instruction and fewer opportunities for developing as independent learners. Instructors can remove barriers and encourage learners to engage in productive struggle to learn and to learn how to learn. Participating in academic discussions supports learners to develop higher level cognition and the ability to take on more advanced learning tasks. Discussing ideas helps learners see themselves as independent learners and members of an intellectual community.

By reimagining the learner–teacher relationship as a partnership and encouraging and respecting learner contributions, instructors can decenter the learning experience to be less focused on the instructor and more focused on learners. Instructors can support learners to be “ready for rigor” by creating an environment that is intellectually and socially safe for learning, making space for learner’s voice and agency, offering appropriate challenge to stimulate brain growth to increase intellectual capacity, helping learners process new content by using methods from oral traditions, and by offering learners authentic opportunities to process content (Hammond, 2015).

Classroom studies document the fact that underserved English learners, poor students, and students of color routinely receive less instruction in higher order skills development than other students (Allington & McGill-Franzen, 1989; Darling-Hammond, 2001; Oakes, 2005). Their curriculum is less challenging and more repetitive... This type of instruction denies students the



opportunity to engage in what neuroscientists call productive struggle that actually grows our brainpower (Means & Knapp, 1991; Ritchhart, 2002). As a result, a disproportionate number of culturally and linguistically diverse students are dependent learners (p. 12)... As educators, we have to recognize that we help maintain the achievement gap when we don't teach advanced cognitive skills to students we label as "disadvantaged" because of their language, gender, race, or socio-economic status (p. 14) (Hammond, 2015).

Increasing Equitable Participation in Discussions

Group Agreements

The use of group agreements helps learners pay attention to their own participation and the participation of others during discussions. Group agreements help set up a "brave space" in which learners feel comfortable and accountable to participate. Ideally, learners help generate and decide on the agreements they will be using. By helping set up the agreements, learners tend to be more invested in holding themselves and one another accountable. Learners will be more likely to engage, try out new ideas, ask questions, challenge their thinking, and be more inclusive and welcoming of participation by their peers (Alvarez, 2016).

Group Agreements Help Create a "Brave Space"

Creating a brave space for science learning discussions involves a variety of factors. The term *brave space* refers to a place and state of mind in which participants are courageous in the face of discomfort, rather than feeling entitled to being comfortable. Use of the term acknowledges that group members often confuse discomfort with a lack of safety. Establishing group agreements helps learners understand how to participate productively in discussion even when they are uncomfortable and how to contribute to a brave space. Asking mostly broad questions contributes to creating a brave space, but so does listening to and responding acceptingly to learner responses to broad questions. If learners sense that the instructor is trying to lead them to a "correct" answer, or the instructor judges or privileges certain participants or ideas over others, or the discussion of ideas is not genuine, they may become reluctant to participate. It's important that members of the group are not asked to speak for a whole group with which they are perceived to identify (race, nationality, religion, etc.). That means that no presumptions should be made about identity (Alvarez, 2016).

TEACHING NOTES

How to introduce science discussion group agreements. Check out the BEETLES [Group Agreements for Science Discussions](#) Student Activity Guide.

Agreements vs norms. We chose not to use the term *norms* because it can imply one normal/accepted way to participate in discussions. This can lead to marginalization of learners who don't identify with the assumed "normal" culture, which is typically white (Solomon, et al., 2005). Group (or community) agreements can shift the culture to be more inclusive, deliberately highlighting different acceptable ways of being and acting, and placing value on hearing and integrating different perspectives.

Additional resources:

Anti-Oppressive Facilitation for Democratic Process: Making Meetings Awesome for Everyone. Accessed online: <http://infoshop.io/media/Aorta%20Anti-Oppressive%20Meeting%20Facilitation.pdf>

The Adaptive School: A Sourcebook for Developing Collaborative Groups, 3rd edition, by Garmston & Wellman.

Group Agreements for Workshops and Meetings. Seeds for Change: <https://www.seedsforchange.org.uk/groupagree>

From Safe Spaces to Brave Spaces: A New Way to Frame Dialogue Around Diversity and Social Justice. Accessed online: <https://www.anselm.edu/sites/default/files/Documents/Center%20for%20Teaching%20Excellence/From%20Safe%20Spaces%20to%20Brave%20Spaces.pdf>

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