beetles
Science and Teaching for Field Instructors

Student Activity Guide

Thought Swap

(formerly known as *Walk & Talk*)

Many field instructors have found this simple routine to be transformative for their field experiences with students because it is so effective at sparking discourse. *Thought Swap* is easy to lead and supports student participation by focusing on one-on-one discussion. The routine is particularly useful at the beginning of an activity or sequence of activities as a way to activate students' prior knowledge or at the end of an activity or sequence of activities to create space for reflection. *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, students discuss prompts and questions in rotating pairs.

This discussion routine helps establish a learning community and a culture of discussion in which students value sharing and listening to one another's ideas, observations, lived experiences, and perspectives. A healthy learning community that centers student discussion and ideas is a key part of an effective, equitable, and inclusive learning environment. *Thought Swap* also supports an inclusive learning experience by scaffolding student skills for participating in large-group discussions and by setting up a structure in which instructors and students are learning from one another.

Students will...

- **Discuss various topics and questions with peers.**
- **Improve listening skills.**
- **Build discussion skills.**
- **Use scientific language to exchange ideas.**
- **Have the opportunity to share ideas with the group.**

Grade Level:
Any age.

Timing:
Flexible timing: ~5–20 minutes

Related Activities:
Thought Swap can be used to begin or end any activity and sometimes works in the middle of an activity.

Materials:
Prepared questions, see pgs. 5-7 for examples.

Tips:
To ensure a successful experience, review the teaching tips found on page 2 and throughout this guide.

Setting:
Stationary version: Choose a spot where two lines of pairs can stand or sit facing one another.
Moving version: Choose a path wide enough so pairs can walk or move side by side.

Equity, Inclusion, and Cultural Relevance (informed by Youth Outside)**:**
This activity has been designed to demonstrate how to create an equitable, inclusive, and culturally relevant teaching and learning experience. Read more on page 11.

NEXT GENERATION SCIENCE STANDARDS

Thought Swap is a discussion routine that can be used throughout an activity or sequence of activities to support the type of learning called for by the NGSS (and Common Core) by providing students the opportunity to talk about science ideas and creating a culture of discourse within a group of students.

For additional information about NGSS, go to page 13 of this guide.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Discussion Routine

Thought Swap (formerly *Walk & Talk*)

ACTIVITY OVERVIEW

Thought Swap	Learning Cycle Stages	Estimated Time
Introducing the Activity	Invitation	3 minutes
Discussing Questions	Invitation, Reflection	2-17 minutes
TOTAL		5-20 minutes

TEACHING TIPS

Read the Instructor Support Section. Beginning on page 8, you'll find more information about pedagogy, equity and inclusion, student misconceptions, science background, and standards.

Ask interesting questions. Students will engage in discussion enthusiastically when offered an interesting or juicy question, and a single question can often sustain their interest for a while. Preplanned and well-tested questions that students find interesting to discuss are essential to leading effective discussions. If a question works well, write it down and use it again with other students. These kinds of questions are gold— the more you experiment with asking different questions, the more you'll be able to collect them for future discussions. If a question doesn't lead to an interesting discussion, try asking follow-up questions, changing the phrasing, or just ditching the question altogether.

Make *Thought Swap* an essential routine. You can offer the stationary version any time that you have enough space for students to face one another. You can use the moving version of this activity whenever you're moving from place to place and want to offer students the opportunity for discussion. Many instructors use it over and over again throughout a field experience. Ask questions at the beginning of a lesson that help students access their prior knowledge. Or, in the middle of a lesson while switching to a new location, offer students a question that connects to the theme of the lesson or gives them an opportunity to apply a concept they've just learned. It's a useful way of keeping students engaged in dialogue about a topic throughout the day and discussing science ideas between different activities.

Why not *Walk & Talk*? Wondering why we changed the name from *Walk & Talk* to *Thought Swap*? We received some feedback from our community partners on using more inclusive language and decided to change the name so we were not normalizing walking as the only way to move and talking as the only way to communicate.

Field Card. On page 15 of this guide, you'll find a condensed, pocket-sized version of the lesson that you can carry in the field.

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Introducing the Activity

1. **Form two equal lines with everyone in the group, including yourself and other adults in one of the lines.** Invite students to form two parallel lines and stand next to each other so each person has a partner in the line across from them. Include yourself and any other adults in one line, so you'll also have a chance to talk to and learn from a few students and to invite adults to be included and engaged with the experience.

2. **Make sure everyone knows who their partners are.** Ask students to look across to the other line, identify their partners, and agree on a greeting/icebreaker such as a fist bump, high five, wave, elbow bump, do-si-do, etc. If you have an odd number of students and chaperones, make one group of three participants at the front or back of the lines.

3. **Share the procedure: students will move or walk forward in lines, discussing questions with their partners until they see the gentle "wave of silence."** Share that you'll give students a question to discuss with the partner across from them. Each pair will discuss the question as the group moves along until they see the "wave of silence." The instructor starts the wave of silence by gently waving at the first two students behind them. These two will then gently pass the wave down the line until the entire group is quiet. Practice this once with your students so they know what to do. (Note: If you're doing a stationary *Thought Swap*, students stand or sit facing one another while discussing the questions.)
   - *I'll give you a question to discuss with your partner as we move along. Then, I will say "Thought Swap!" and you'll have about 1 minute for discussion while we are moving along the trail.*
   - *I'll stop walking and signal for quiet with the "wave of silence," by waving my fingers near the people at my end of the lines.*
   - *When you see the wave, stop talking and pass the wave (gently) down the line until the whole group is quiet.*

4. **Share that the group will stop moving at times to have group discussions and to share ideas and listen to what others say.** Let students know that after the group stops discussion in pairs:
   - *Sometimes we'll stop to share our ideas as a group.*
   - *Sometimes I might invite you to share something you've heard from your partner to encourage good listening, so let your partner know if you'd prefer if they didn't share something you've said. If you do want to share something your partner said, we encourage you to ask for consent before you share it with the group to make sure it's okay.*

Discussing Questions

1. **State the question twice and then say, "Thought Swap!"** Once the group understands the directions, clearly say the first question twice. (See example questions beginning on page 5). Invite students to begin discussing by saying, "Thought Swap!"

2. **Use the wave of silence to get students' silent attention and to signal that it's time to stop discussing.** Allow about 1–3 minutes for partners to

TEACHING NOTES

Listening to students. Discussion offers valuable opportunities for an instructor to hear students' ideas and to be responsive to students. Participating in the activity yourself is an important opportunity to talk to students one-on-one, to listen to their ideas, learn about their experiences and perspectives, and assess their understanding in a low-pressure way. Give your student partner most of the "air time" and ask them follow-up questions to try to understand their ideas, experiences, and reasoning.

Touch consent. Partner greetings in *Thought Swap* can be a great opportunity to model and practice awareness around touch consent. When students get new partners, instead of assigning a way of greeting the new partner (e.g., giving your new partner a fist bump.), invite students 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.

Writing out questions. Consider writing out pre-planned questions as signs ahead of time and holding up the signs as you ask the questions. This gives students more support in understanding the discussion question, especially if the question is complex. Seeing the words in writing can support emerging multilingual learners and provides increased opportunities for all students to participate successfully. To learn more about creating an inclusive learning experience, see page 11 of the Instructor Support section.

discuss the first question. As their engagement in the conversation winds down, wave to the first students at the front of each line and wait for the entire group to become silent. If you're moving, stop the lines before starting the wave of silence.

3. **Ask lines of students to move back slightly and then facilitate a whole-group share about interesting things they or their partner said.** (You don't need to do the whole-group share every time.) Once students have stopped moving and discussing, ask them to move a foot or so backward (depending on how wide your trail is) to make it easier for everyone to see one another. Call on two or three students to share something their partner said about the question. (Remind students to get consent before sharing what a partner said.) Make sure students share loudly or clearly enough for all to hear. You don't need to have a group share for every question. (if you did, it would likely get tedious.) Stopping to share occasionally will help reveal student thinking about concepts relevant to what you're teaching, allows students to learn from one another's comments, and builds a culture of discussion and sharing ideas.

4. **Orchestrate the partner switch.** Your partner goes to the other end of the line, and everyone in that line shifts down one person. Make sure students are clear about which line will shift with each question—not the line you, the instructor, are in! Invite the student 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. Ask students in this line to shift one position toward the front of the line so everyone is facing a new partner.

5. **Repeat the process with a new question.** When students are ready, give them a new question to discuss. Each time you pause the group, always send the front person from the same line (your partner in the other line) to the back of the line, while students in your line stay in the same position.

6. **During group shares, seek out interesting questions/points made and ask what others think, to get whole-group discussions rolling.** When you pause the group and invite students to share ideas, keep an ear out for questions or ideas that seem particularly interesting to your group. When you find them, ask students to share what they think about the question/idea and try to get a discussion going about these ideas.

7. **Vary the way you handle discussions after partner switching.** It works well to have some variation in what you do after each *Thought Swap* rotation, such as the following:
   - Invite a few students to share what their partners said, with consent (good for developing listening skills).
   - Invite a few students to share their own thoughts.
   - See if you can get an interesting whole-group discussion going (good for creating a culture of ongoing discussion of interesting ideas or following student interest).
   - Switch partners without a whole-group discussion (good to keep things moving and avoid tedium).

TEACHING NOTES

Encouraging Listening. Beginning by asking students to share something their partners said encourages listening. It's also important to let students know that they may have an opportunity to share what their partners said, need to ask for consent before sharing another's idea with the group, and can ask that their partners not share something they said with the group. Over time, as interesting whole-group discussions begin, you can shift and invite students to share their own thoughts.

Cheering for the person who is switching. It's fun to invite the rest of the group to cheer for the person as they go to the other end of the line.

***Thought Swap* without the lines.** The orchestrated partner switch can be more challenging to participate in for students in grade 3 and younger. Instead, just have students pair up and discuss one question while walking or moving and then pair up with a different person and discuss the next question. This also can work well with any age when you have only one or two questions to ask and don't want to deal with setting up the lines.

Some time without *Thought Swap*. Make sure students' time moving from place to place isn't always structured and that during extended field experiences, they also have time to just walk or move along in silence or have self-directed discussions.

Facilitate, don't dominate. During whole-group shares, be curious and accepting of all student responses. You might occasionally restate what a student said to check to make sure that's what they meant (especially if the student spoke too softly for all to hear). Try to avoid answering the questions yourself, commenting on every response, or evaluating responses as right or wrong. Instead, prompt respectful discussion by occasionally asking students to build on one another's' ideas and to respond to one another's' thinking.

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Thought Swap Questions for Multiple Contexts

During the introduction of an ecosystems, matter, and energy–themed learning experience:

- Find as many ways as you can think of that you and your partner are connected. Music? Activities? Interests? People you know?
- Who lives here? Look around. What organisms do you see? What organisms do you think live here that you're not seeing?
- Discuss as many ways as you can think of that organisms in this ecosystem might be connected with one another.
- Look at that (stump/tree). Discuss as many ways as you can think of that other organisms might use that stump/tree to survive.
- What do you think organisms would need in order to survive in this ecosystem?
- What organisms do you think we might find when we explore the creek/pond?
- How do you think the ground here might be different if there were no decomposers?

During a more challenging learning experience focused on ecosystems, matter, and energy:

- How do you think air cycles and changes in ecosystems like this one?
- A study on a rabbit farm found that In one year, an average 8 lb. rabbit will eat and drink about 400 lbs. of plants and water. About 140 lbs. comes out as poop and pee. What happens to the other 260 lbs.?

During the introduction of an adaptations-themed learning experience:

- Describe an adaptation of an organism.
- What are some structures and behaviors that humans have that help us survive?
- What are different ways animals protect themselves?
- What are different ways plants protect themselves?
- What colors do you think might help animals in this area survive?
- What are different ways animals have of getting around?
- What do deer need to survive?
- What does that tree need to survive?
- If this habitat were to become much dryer, what behaviors or body structures might help some organisms survive better than others?
- What are some questions you have about adaptations?
- What are different ways plants have of reproducing?

TEACHING NOTES

The value of pair talk. Discussion gives students authentic opportunities to process content, formulate and share ideas, and make meaning. Pair talk gives every student in the group the chance to talk about and process their ideas and to listen to those of a peer. Giving students the chance to share ideas in pairs or in smaller groups before a large-group discussion also increases student participation and leads to a more equitable and inclusive learning space. This provides the opportunity to think through ideas and rehearse what students might share with the whole group in a safe, low-stakes situation and offers important verbal processing time. This also supports emerging multilingual learners and provides increased opportunities for all students to participate successfully. To learn more about creating an inclusive learning experience, see page 11 of the Instructor Support section.

Meaning-making discussions. Discussion is a key part of learning. It's also an important part of creating an equitable, inclusive learning environment. Meaning-making discussions like this one offer opportunities for students to make connections to prior knowledge, share their lived experiences, and create an environment in which they get to see themselves and one another as sources of expertise. Participating in meaning-making discussions also helps students grow their capacity to take on more challenging learning tasks in the future. To learn more about creating an inclusive learning experience, see page 11 of the Instructor Support section.

TEACHING NOTES

Broad questions and the nature of science. Make sure your questions are broad enough to ignite an exchange of ideas between students. Broad questions have more than one possible response and are key to making science experiences more inclusive. Many students (and adults) view science as a collection of facts to memorize. However, science is not just a body of knowledge; science is a way of knowing and a process for thinking and learning. A focus on memorization, recall of facts, or narrow questions tends to invite one right answer and doesn't tend to lead to rich discussions. On the other hand, broad questions encourage discussion and welcome diverse perspectives and differing ideas. When science learning focuses on memorizing definitions or recalling facts, students who struggle with those skills might see themselves as not good at science, even if they are great at creative thinking, making observations, asking questions, and collaboration—all of which are essential skills in science. Recognizing how students' existing skills and learning behaviors mirror those of scientists builds students' identities as learners, expands their definition of science, and makes the field more accessible. To learn more about creating an inclusive learning experience, see page 11 of the Instructor Support section.

Building a learning community and a culture of discussion. A group culture in which students value their own ideas, value one another's' ideas, and want to share their thinking through discussions supports an equitable and inclusive learning environment by putting students' ideas at the center of the learning experience.

During a more challenging learning experience focused on adaptations:

- Some banana slugs are bright yellow. Some are greenish-yellow with black spots. Do you think banana slug coloration is for camouflage or for warning?
- Common loons are known for their loud (and funny sounding!) calls and songs, which they can make when they are alarmed, to announce their presence at a lake, to establish territories, or to figure out the location of another loon. How could making loud calls be advantageous to a loon or to birds in general? What are some disadvantages of making loud calls?
- The oils from poison oak/ivy make some (not all) people itch. Deer eat it, and it doesn't make them itch. Do you think this oil is an adaptation to protect itself, or do you think it's not an adaptation, and the itching is just a coincidence?
- The rough-skinned newt and the California newt are slow and easy to catch, but they are so poisonous to eat that one could kill 20 people. Yet common garter snakes can eat these newts and survive. Why and how might newts have become so poisonous?
- [Describe an interesting structure or behavior of an organism.] How do you think that adaptation may have evolved over many generations? [You could also ask a student to describe something interesting they've seen in nature before as the lead-in to this question.]

To invite sharing of students' outdoor experiences and perspectives:

- What are some ways your family or people in your community enjoy spending time outdoors? Being outdoors doesn't just mean hiking; it can be things such as playing sports, having picnics, gardening, hunting, fishing, etc.
- What are some environmental challenges facing your community?
- What are some areas in your neighborhood where you enjoy being outside?
- How do you feel when you spend time outdoors?

To invite reflection at the end of an outdoor learning experience:

- What were some interesting things about anything we experienced today?
- Share about things you've enjoyed.
- Share about things you've learned.
- What did you do that helped you to learn today?
- How did your ideas about ___ change throughout the day?
- How might you describe what you did on this learning experience to someone else?
- What were some ideas that made you think in different ways?
- What are some questions you have about organisms or anything else we saw?

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- Think quietly to yourself about things you did today that make you feel proud, as well as things you could do better.
- What are some skills, such as asking good questions, that you got better at today?
- Did you notice anyone else doing something today that impressed you?
- What are some examples of how people treated one another well today?
- Describe some things you learned today that are not facts. Like different ways to look at or think about things or an idea that made you think in a different way.
- Pretend you're talking to a younger sibling, friend, or family member. Describe to them how to make observations in nature.
- Where are places near your home where you could explore nature in this way?
- Replay some of the funniest moments of the day.

Examples of improvised questions:

Situation 1: Student points out a tree to the group that has caught their interest, and the other students are also intrigued.

- Discuss with your partner any interactions you think other organisms in this ecosystem might have with that tree.

Situation 2: After you've found a "nature mystery" such as some animal bones, interestingly shaped icicles, a tree growing in an interesting pattern, etc. and students have come up with some possible explanations about what happened:

- Discuss which explanations seem the most likely and include evidence to support your position.

Resources for more questions:

A list of questions that invite students to engage in NGSS Science and Engineering Practices as they use Crosscutting Concepts to guide their thinking can be found here: [https://drive.google.com/file/d/1nh2OacMOjXrta0ImCY7basYVrNMKRsoC/view]

TEACHING NOTES

Improvised questions. Questions made up on the spot have the advantage of connecting the discussion to specific surroundings and experiences and to ideas that students bring up themselves. A student may say something interesting in response to one question that inspires the next question for the group. A nearby organism noticed by the group may also inspire good questions.

Who is speaking? Who isn't? In a discussion, it's important for each voice to have the opportunity to be heard. However, research summarized in the book *Failing at Fairness: How Our Schools Cheat Girls* by Myra and David Sadker shows that girls are called on significantly less than boys. Promote equitable participation by using wait time, including time for pair talk, and intentionally calling on a range of different students. Toward the end of a discussion, try pausing and saying, "I'm going to wait for a moment in case anyone who hasn't spoken up yet has something they'd like to share." Use the activity *Group Agreements for Science Discussions* to offer your group of students the skills to notice how their participation might be affecting the group and to enlist them in working together to create an environment in which everyone feels supported to share their ideas.

TEACHING NOTES

Quote: "I love *Thought Swap*! I use it all the time. It works great before and after activities. It's also a great way to keep kids engaged while hiking, especially when going up steep hills. I came up with a way for all students to partner with all other students—I am always in the front of Line #1, and when it's switching time, the person behind me (in Line #1) goes to the front of Line #2 and is my new partner, and the person in the back of Line #2 goes to the back of Line #1 . . . kind of like a rotating rectangle after every switch. Everybody except me moves each time. You can also do it where each adult chaperone also has a designated place in line where they stay while students rotate. That way, adults will always be partnered with students." —Lucy Clark, Former Field Instructor, Walker Creek Ranch

Instructor Support

Thought Swap works great at the start of field experiences to invite students into the mindset of being active participants in their own learning and the learning of the group. It can get students immediately discussing and thinking about topics relevant to the upcoming activities or theme of the day. It helps establish your group as a learning community in which everyone is learning from one another, learners build on one another's ideas, and all voices and perspectives are welcomed. When instructors partner with individual students and also listen thoughtfully to group responses, they can get a sense of students' prior knowledge, experiences, and perspectives. The moving version of *Thought Swap* is also a great way to use time productively while the group is walking or moving from place to place. *Thought Swap* also works really well as a reflection activity toward the end of field experiences, especially if you're pressed for time returning from a field experience.

Teaching Knowledge

The moving version of *Thought Swap* can be a useful device for moving a group of students up steep terrain or anytime you want to engage students in thinking and sharing ideas as they move along a wide trail. Pausing the group for each new question helps prevent faster-moving students from leaving students who move at a slower pace behind, and it helps keep the group moving together. Switching partners allows different students to be at the front of line. Switching pairs also helps create community. *Thought Swap* also works as a stationary activity in which students discuss ideas in two lines and then switch partners, without walking or moving between locations.

Developing the spirit of inquiry and investigation. Beginning a field experience with students discussing interesting questions sets a tone of inquiry, exploration, and exchange of ideas. Students are invited into the experience by thinking about what they know and how it may apply to the activities in which they will take part. Inviting students' ideas at the beginning of the experience also sets them up to be active participants in exploring nature and making sense of their discoveries.

Encouraging peer-to-peer discussion . . .

- . . . supports deep conceptual learning. Learning occurs through discourse within social interactions (Rogoff, 1998; Vygotsky, 1978). When students share what they already know about something, it helps them get ready to make connections between new ideas and what they already know and to build a more accurate understanding. Engaging in discussions and conversations about ideas supports creative and complex thinking. When students make connections between their own ideas and those of their peers, they create more meaningful conceptual frameworks. Noticing disagreements between their ideas and those of others supports students to build common understanding and develop more accurate understandings of concepts. Research has found that giving students opportunities to discuss ideas and analyze the arguments of others helps them

develop more accurate scientific knowledge than they get through memorization.

- . . . increases student participation. Partnering students to discuss ideas provides a way for everyone to participate. When students discuss ideas with one another, they are more likely to share ideas freely. The rotating structure of *Thought Swap* gives students opportunities to discuss ideas with people with whom they may not usually interact. As emerging multilingual learners and more reticent students have a chance to hear what others have to say and share their ideas with just one peer, they may be more willing to contribute ideas in the larger group.
- . . . establishes a culture of discussing ideas. When all student ideas are validated by the instructor and when discussions center around finding the strongest ideas, students learn the importance of argumentation and discourse in science. If the instructor and other adults participate in discussion alongside students, the discussion can feel authentic to students as they witness adults engaged in learning with them. If adults show equal curiosity and interest in the ideas being expressed, students may feel that their contributions are valued and affirmed.
- . . . is a productive use of time. The moving version of *Thought Swap* is a great way to keep students engaged with the group and with ideas as you move between locations. Interesting questions engage students in the practice of explaining their ideas about the natural world. Students will typically want to talk to one another during a field experience, and offering a few questions or prompts can support students to discuss ideas related to the learning experience in which they're participating.
- . . . fosters student-centered learning. When student ideas and input are at the heart of learning environments and science experiences, students get the message that their thinking counts and that they are capable of making sense of the natural world. Student-centered instruction and discussion-based learning takes into account the importance of the social context of learning, plays to the strengths of students from cultures that particularly emphasize verbal processing, and promotes collaboration as students co-construct understanding with their peers.

Science Language

Thought Swap is a great ongoing discussion routine in which students process ideas and make explanations from evidence. Science is about coming up with the best explanation based on all the available evidence. It's also about being open-minded about other explanations that could be better. In science, nothing is ever finally proven. That's why scientists tend to use language of uncertainty when discussing ideas and explanations. Try to use sentence starters such as: *Maybe . . . , I wonder if . . . , That evidence makes me think . . . , The evidence seems to show . . .* and encourage students to phrase their statements using similar language. *Thought Swap* is chock full of opportunities for the instructor to coach the group on using science language and making explanations from evidence and for students to practice using science language.

TEACHING NOTES

About argumentation in science. "In science, reasoning and argument are essential for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon. Scientists must defend their explanations, formulate evidence based on a solid foundation of data, examine their own understanding in light of the evidence and comments offered by others, and collaborate with peers in searching for the best explanation for the phenomenon being investigated." –Next Generation Science Standards

TEACHING NOTES

Common Relevant Misconceptions

Misconception. If you let students share their ideas about academic content, they'll learn inaccurate information from one another; instead of student discussion, instructors should just tell students accurate information.

More accurate information. It's important for educators to offer opportunities for students to share ideas and to pay attention to what students say. At any given time, students have many ideas and interpretations in their heads about the world—some accurate, and some inaccurate (but based on experience and logical thinking). Whether or not you provide opportunities for students to share these ideas out loud, they are there; if these ideas are not brought out into the open, they will likely remain unchallenged. Without opportunities to discuss their ideas, students may be able to memorize more accurate ideas (and even pass tests), but they still may privately hold onto their original inaccurate beliefs unless they encounter convincing reasons to let them go. When students share ideas out loud, it draws attention to potentially conflicting ideas and inconsistencies. It also provides students with the opportunity to evaluate their ideas against other's thinking and to compare them with the available evidence. For instructors, student-centered discussion can provide insights into student ideas, which can then be used to guide instruction. For example, it can help an instructor think of particular evidence that may benefit student thinking and help their ideas evolve.

Misconception. If you let students discuss ideas with one another, you'll lose control of the group, and they'll talk about off-task topics.

More accurate information. Students enjoy talking and sharing ideas with one another, and whether or not you use discussion routines, they will want to find opportunities to discuss ideas with their peers. During *Thought Swap*, we've observed that students mostly do stay on topic—as long as the questions are interesting to them. We've also observed that students who participate in *Thought Swap* tend to talk more about science ideas during unstructured time throughout a learning experience. As an instructor, it's impossible to listen in on every conversation between students; in that sense, you can't control everything that's going on—and that's okay. Routines like *Thought Swap* do give students more control and ownership of their own learning. This autonomy is more engaging for students and supports their development as learners. Researchers think that having a more student-centered structure for participation in a discussion (e.g., when the teacher gives up some control to the students) promotes more active cognitive involvement as students see their ideas valued and are more encouraged to speak up.

Misconception. Science is a collection of facts.

More accurate information. When science classes are centered around dense textbooks and fact memorization, this approach to teaching can communicate the idea that this is what science is about: facts in a textbook. Field experiences that are centered around sharing facts can communicate similar ideas. However, facts are only part of the picture.

TEACHING NOTES

Science is a body of knowledge, and it's also a process and way of thinking, of figuring things out, and of knowing. Science is an exciting and dynamic process for discovering how the world works. Learning to observe, ask questions, make explanations, and exchange ideas are critical parts of the scientific process.

Misconception. The best way to learn is to be told lots of information.

More accurate information. We often assume that when we tell someone something, they'll learn it. At best, this tends to result in rote learning, often without conceptual understanding, and can be easily forgotten over time. Research summarized in the book *How People Learn: Brain, Mind, Experience, and School* describes how for deep learning to occur, students need opportunities to engage prior knowledge, explore ideas, start to develop a conceptual framework, apply that framework to new settings, and reflect on the process. When students observe and ask questions, they're engaging their curiosity. When students are curious about something, they're more likely to keep learning. Investigating the natural world leads to deeper understanding. When instructors give students a quick answer or a set of facts, this tends to shut down the spirit of inquiry.

Supporting Equitable, Inclusive, and Culturally Relevant Learning Experiences

This BEETLES student activity has been intentionally designed to create an equitable, inclusive, and culturally relevant learning experience for a community of learners. BEETLES design principles [http://beetlesproject.org/about/how-do-we-approach-teaching/] ensure that each student activity is student-centered and nature-centered. This enables all learners to access, participate, and engage in the learning experience.

When learners engage directly with nature, they all have access to learning, regardless of their prior knowledge or experiences. Centering learning on students' in-the-moment observations of nature builds an inclusive learning experience by focusing the conversation on an experience shared by every student, as opposed to relying on students' prior knowledge or past experiences. As students engage with nature, instructors are in the role of the "guide on the side." This approach shifts power from the instructor to learners, challenges the typical learning situation in which the instructor is the only expert, encourages students to share their ideas and experiences, and makes learning a more decentralized and collaborative experience.

When learners think like a scientist and practice academic language, they develop critical thinking skills that support them to become more independent learners—learners who have skills and thinking tools they use to learn, regardless of the level of support available from a teacher or instructor. Giving students the opportunity to think like a scientist by making observations, asking questions, and constructing explanations supports students' growth as learners, offering them the opportunity to build critical thinking skills and learning behaviors they can apply in any context. Many students in schools that have historically been under-resourced due to racist school

"Classroom studies document the fact that underserved emerging multilingual learners, poor students, and students of color routinely receive less instruction in higher-order skills development than other students." (Allington and McGill-Franzen, 1989; Darling-Hammond, 2001; Oakes, 2005) —Zaretta Hammond, *Culturally Responsive Teaching & the Brain*

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funding policies, redlining, income inequality, and police profiling have fewer opportunities to develop as independent learners. Specifically ensuring that students in these kinds of schools have opportunities to develop as independent learners is an issue of equity. Learning and practicing critical thinking skills in an engaging outdoor context supports students to succeed back in their classrooms, in science, and in other academic disciplines. Offering opportunities for students to discuss ideas with their peers and knowledgeable adults makes science more accessible by connecting it to students' own actions and discoveries in the moment—not to knowledge they may not have or experiences they may not have had.

Through discussion, learners make connections to prior knowledge, share their lived experiences, listen to different perspectives, and have time to process the material. Productive discussions in which many voices are heard, and the group builds off one another's ideas, create an experience in which students see themselves and one another as sources of expertise. This ensures that instructors don't fall back on positioning themselves as the only source of accurate or important information. Participating in discussions also supports students to develop cognitive rigor and the ability to take on more advanced learning tasks. Discussions make student thinking and ideas visible to the instructor. When instructors value, appreciate, better understand, and connect to students' lived experiences, they create a more inclusive and culturally relevant learning space. Finally, multiple opportunities for discussion provide time and space for neurodiversity—allowing students to process information in different ways. Using discussion strategies such as *Turn & Share* or *Thought Swap* that are part of every BEETLES student activity can help ensure that students have these kinds of opportunities for discussion.

Specifically, this activity promotes an equitable, inclusive, and culturally relevant learning experience by:

- supporting a collaborative learning culture in which students and the instructor value and learn from one another's ideas, observations, and perspectives through discussion.
- offering a structured routine for pair talk that promotes equitable participation by making sure each student has the chance to share their ideas.
- giving students multiple opportunities to connect to and share their lived experiences, and for students and the instructor to listen to and learn from these experiences and perspectives.
- providing space for students to come up with connections between what they are observing and learning and prior experiences and knowledge.
- using broad questions to invite students to share their observations, prior knowledge, and experiences with one another and with the instructor.
- engaging students in meaning-making discussions in pairs, scaffolding students' skills for participating in discussions, and preparing them to take on increasingly rigorous learning tasks in the future.

- giving instructors an adaptable routine they can use to support student-centered learning throughout a field experience.
- contradicting the exclusionary idea that science is a set of facts to memorize by offering a science learning experience that is centered around student discussion, ideas, and perspectives and frames science as a process and way of thinking about and increasing understanding of the world.

Overall, these factors contribute to creating a student-centered approach in which "the ultimate goal . . . is to help students take over the reins of their learning." (Zaretta Hammond, *Culturally Responsive Teaching & the Brain*, 2014). This approach to teaching supports students in becoming independent learners who are able to succeed, regardless of any individual teacher or learning context. BEETLES has intentionally designed the sequence and structure of this activity to support learning experiences in which all students feel capable of success and have the tools to carry that success into other domains.

Using student-centered and nature-centered learning approaches is just one piece of the work we can do to create equitable, inclusive, and culturally relevant learning experiences. Instructors must also work to become more aware of their own unconscious biases and triggers around culture, identity, and race that impact their interactions with students and affect their students' sense of inclusion.

Connections to the Next Generation Science Standards (NGSS)

BEETLES student activities are designed to incorporate the three-dimensional learning that is called for in the Next Generation Science Standards (NGSS). Three-dimensional learning weaves together Science and Engineering Practices (what scientists do), Crosscutting Concepts (thinking tools scientists use), and Disciplinary Core Ideas (what scientists know). Students should be exploring and investigating rich phenomena and figuring out how the natural world works. The abilities involved in using Science and Engineering Practices and Crosscutting Concepts—looking at nature and figuring things out, using certain lenses to guide thinking, and understanding ecosystems more deeply—are mindsets and tools students can take with them and apply anywhere to deepen their understanding of nature, and they're interesting and fun to do!

Thought Swap is a routine that can be used throughout instruction to support the kinds of three-dimensional learning experience called for by the NGSS. To experience three-dimensional learning, students need to engage in practices to learn important science concepts (Disciplinary Core Ideas) and make connections to the big ideas in science (Crosscutting Concepts). In short, students should be using the tools of science to explore and investigate rich phenomena, trying to figure out how the natural world works.

This activity is not a three-dimensional learning experience in and of itself, but it can be used as a tool within an activity (and during a sequence of activities) to give students opportunities to discuss their emerging ideas. Students can also engage in Science and Engineering Practices, apply Crosscutting Concepts, and build understanding of Disciplinary Core Ideas as they participate

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Resources on unconscious bias. There are many great resources on understanding and shifting unconscious bias. Here are a few books and organizations we have looked to consistently to work on our own unconscious bias and to better understand how it can affect teaching and learning in the outdoors:

- ***White Fragility: Why It's So Hard for White People to Talk About Racism* by Robin DiAngelo**
- ***Culturally Responsive Teaching & the Brain* by Zaretta Hammond**
- **Youth Outside** (http://www.youthoutside.org/)
- **The Avarna Group** (https://theavarnagroup.com/)
- **Center for Diversity & the Environment** (https://www.cdeinspires.org/)

Importance of teaching science and engineering practices. "Engaging in the practices of science helps students understand how scientific knowledge develops . . . It can also pique students' curiosity, capture their interest, and motivate their continued study . . ." –National Research Council *Framework for K-12 Science Education*. Focusing on these science and engineering practices will help to ensure a more scientifically literate public who will, hopefully, be better able to make thoughtful decisions.

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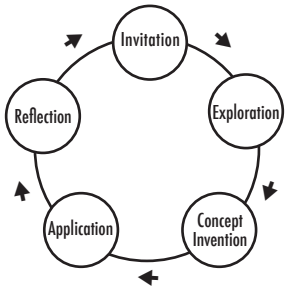

This activity can be incorporated into any stage of the learning cycle.

in a *Thought Swap*. A *Thought Swap* gives students opportunities to engage in the following NGSS Science and Engineering Practices *Constructing Understanding and Obtaining, Evaluating, and Communicating Information*. When students discuss questions that delve into complex science concepts (such as the question about rabbits in the list of possible questions on page 5), this can support their incremental understanding of Disciplinary Core Ideas. Instructors can offer questions—such as *Do you notice any patterns?* or *What might be some possible impacts of this?*—that invite students to make meaning by using different Crosscutting Concepts.

Thought Swap also supports the Common Core State Standards for English Language Arts Literacy in History/Social Studies, Science, and Technical Subjects, which state that students of all ages should be engaged in many discussions on a variety of topics relevant to understanding the concepts at their grade level. Participating in *Thought Swap* throughout a program will give students opportunities to engage in discussions with many different peers about a range of topics and will help prepare them for contributing to discussions in other educational settings.

Activity Connections

Thought Swap works well as an Invitation at the beginning of a field experience or any new activity, in the middle of a field experience to keep students engaged in a discussion relevant to the activities, and as a Reflection at the end of a field experience or activity to give all students a chance to process the experience and discuss their ideas.

FIELD CARD

Cut out along outer lines and fold along the centerline. This makes a handy reference card that will fit in your pocket.

Thought Swap (Walk & Talk)

Introducing the Activity

1. Form two equal lines with everyone in the group, including yourself and other adults in one of the lines.
2. Make sure everyone knows who their partners are.
3. Share the procedure: students will move or walk forward in lines, discussing questions with their partners until they see the gentle "wave of silence."
   - *I'll give you a question to discuss with your partner as we move along. Then, I will say "Thought Swap!" and you'll have about 1 minute for discussion while we are moving along the trail.*
   - *I'll stop walking and signal for quiet with the "wave of silence," by waving my fingers near the people at my end of the lines.*
   - *When you see the wave, stop talking and pass the wave (gently) down the line until the whole group is quiet.*
4. Share that the group will stop moving at times to have group discussions and to share ideas and listen to what others say.
   - *Sometimes we'll stop to share our ideas as a group.*
   - *Sometimes I might invite you to share something you've heard from your partner to encourage good listening, so let your partner know if you'd prefer if they didn't share something you've said. If you do want to share something your partner said, we encourage you to ask for consent before you share it with the group to make sure it's okay.*

Discussing Questions

1. State the question twice and then say, "Thought Swap!"
2. Use the wave of silence to get students' silent attention and to signal that it's time to stop discussing.
3. Ask lines of students to move back slightly and then facilitate a whole-group share about interesting things they or their partner said. (You don't need to do the whole-group share every time.)
4. Orchestrate the partner switch. Your partner goes to the other end of the line, and everyone in that line shifts down one person.
5. Repeat the process with a new question.
6. During group shares, seek out interesting questions/points made and ask what others think, to get whole-group discussions rolling.
7. Vary the way you handle discussions after partner switching.

Write questions you plan to use here:

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

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BEETLES Team: **Craig Strang**, **Kevin Beals**, **Jedda Foreman**, and **Emilie Lygren**
Additional Contributers: **Emily Arnold, Lynn Barakos, José González, Catherine Halversen**, *and* **Emily Weiss**
Research Team: **Mathew Cannady, Melissa Collins, Rena Dorph, Aparajita Pande,** and **Valeria Romero.** Emeritus: **Bernadette Chi, Juna Snow**
Project Consultants: **John (Jack) Muir Laws, Penny Sirota,** and **Mark Thomas**
Advisory Board: **Nicole Ardoin, Kevin Crowley, José González, Maggie Johnston, Celeste Royer, Bora Simmons,** and **Art Sussman.** Emeritus: **Kathy DiRanna, Kathryn Hayes, April Landale, John (Jack) Muir Laws, Jack Shea, Penny Sirota, Drew Talley,** and **Mark Thomas**
Editor: **Trudihope Schlomowitz**
Designer: **Barbara Clinton**

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To contact BEETLES™, email beetles@berkeley.edu