beetles

Science and Teaching for Field Instructors

Student Activity Guide

I Notice, I Wonder, It Reminds Me Of...

Many field instructors cite this Exploration Routine as their most effective teaching tool. It helps students develop a mindset of curiosity, and provides language tools to actively and directly engage with the natural world. These are important skills students can carry away and apply in any natural setting. Using this routine makes any field experience more student- and nature-centered. After introducing it, instructors can ask students to apply the routine to deepen their understanding of the natural world during any part of a field experience.

During the activity, students pick up a natural object, such as a leaf, and make "I notice..." statements out loud with a partner, then share some of their observations with the group. They do the same with "I wonder..." questions, and with "It reminds me of..." connections. Then, students practice using these tools while exploring whatever they find interesting. This simple routine can help students get beyond seeing nature as a "green blur," and lead them to never be bored in nature again.

Students will:

- **Increase curiosity for and directly engage with aspects of the natural world.**
- **Make observations, ask questions, and relate findings to past experiences.**
- **Learn that descriptive observations are distinct from statements of opinion or identification.**

Grade Level:
Grades 3-8. Adaptable for younger or older students.

Timing:
30–50 minutes

Related Activities:
This activity initially serves as an invitation to exploring nature, & afterward can be used at any time to enrich student observation and understanding of any part of the natural world.

Materials:
None required
Optional, but highly recommended:
Interesting small natural objects each student can pick up, nets, small collection cups & hand lenses

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

Setting:
Any setting in nature in which students can safely touch & observe will work.

NEXT GENERATION SCIENCE STANDARDS

For additional information about NGSS, go to page 10 of this guide.

FEATURED PRACTICE

(Optional) **Asking Questions**
Students also build skills foundational to all 8 science practices.

FEATURED CROSSCUTTING CONCEPT

(Optional) **Patterns**

FEATURED DISCIPLINARY CORE IDEAS

Specific DCI's will vary depending on activity focus and the guidance of the instructor.

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Exploration Routine

I Notice, I Wonder, It Reminds Me Of

ACTIVITY OVERVIEW

I Notice, I Wonder, It Reminds Me Of	Learning Cycle Stages	Estimated Time
Why Observe?	Invitation	5 minutes
Making Observations (I notice...)	Exploration	5 minutes
Asking Questions (I wonder...)	Exploration	5 minutes
Making Connections (It reminds me of...)	Exploration	5 minutes
Applying the Practice & Inquiry Fever	Application	5–10 minutes
Wrapping Up	Reflection	5 minutes
Optional Extension: Focus on Asking Scientific Questions	Application	15 minutes
TOTAL		**30–50 mins**

TEACHING TIPS

Field Card. On page 13 of this guide, you'll find a condensed, pocket-sized version to use in the field.

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

Make This An Essential Routine. Many instructors say this is their most effective tool for teaching students to observe and focus in nature. It's often introduced on the first day with a group because it helps students engage directly with nature, while internalizing the process of making observations, asking questions, and making connections. Once students are familiar with the language, use these prompts whenever the group finds an intriguing object or organism, or anything they want to learn more about. These tools can also help to re-engage students who may be beginning to lose interest in an activity or discovery.

Keep it interesting. Pay attention to the mood of your group, and don't allow your introduction to the routine to become a chore. The main purpose of the routine is for students to *engage* with nature, and some groups will need a faster pace. The main goal should be to find what is interesting and help students be curious about exploring it. Listen to student ideas and pursue interesting threads. Avoid sharing information during this process, unless it's something that will lead them to more observations and questions. Try to keep the experience focused on discovery through direct student-nature or student-student relationships.

Safety. Choose an area with few hazards, and thoroughly warn students about any local hazards, such as fire ants, etc.

All materials created by BEETLES™ at The Lawrence Hall of Science.
Find the latest activities and information at http://beetlesproject.org.

Why Observe?

1. **Ask students: Who are exceptional observers?** Ask students if they have ever known or heard of someone in books, movies, other media, or their life who was really good at noticing things others didn't. Examples might include trackers, Helen Keller, detectives, coaches, birders, someone they know, etc.

2. **Ask students: What makes some observers better than others?** Ask what they think allows some people to be better observers than others. Listen to their responses and encourage discussion.

3. **Share Sherlock Holmes quote, and ask or explain what it means.** Read the quote below out loud, or give a student a card with the quote on it and tell them to read it to the group. Then, ask students what they think the statement means, or why they think careful observation is important.

   - *"I see no more than you, but I have trained myself to notice what I see."*
     — Sherlock Holmes (fictional detective, as written by Sir Arthur Conan Doyle)

4. **Tell students you're going to teach them some tricks that will help them be better observers & notice things others don't notice.** Explain that people often don't notice what's around them, so they miss out on a lot of interesting things. Tell them that during this activity they'll focus on developing their observation skills to help them learn to notice things others don't–they will become better observers. They'll also learn some strategies that can change the way they investigate and experience the world.

Making Observations (I notice...)

1. **Ask each student to pick up the same type of natural object, then circle up.** Tell each student to pick up a small natural object, such as a specific type of leaf, then to sit or stand in a circle.

2. **Define observation and introduce the first prompt: "I notice..."** Tell students they'll practice making observations first. Define observation and clarify what kinds of statements are not observations.

   - *An observation is something we notice with our senses (sight, touch, smell, hearing, taste–but please don't taste anything unless you are told you can.*
   - *I know I'm making an observation when I begin a sentence with "I notice," and then describe what I can observe using my senses.*
   - *Observations are what you notice in the moment, not what you already know. Saying "I notice it's a leaf" is identification, not observation.*
   - *Saying "It looks awesome," or "I notice it's gross," is your opinion, not an observation.*
   - *Saying "the leaf has been eaten by bugs" isn't an observation if you can't see any bugs. It's a possible explanation for the observation that it has holes.*

TEACHING NOTES

Quote from a 15-year field instructor after first time using this activity. "[the kids] loved it and won't come in for lunch - made teacher cry - [a good thing]. The kids never saw it coming. [Challenging group] went from blah to wow in 10 minutes. What would normally take hours was 20 minutes in which we couldn't get them out of the forest. Best day ever."

Acting out exceptional observers. One instructor tells students to pose like an exceptional observer to engage students' prior knowledge.

Don't short-cut the introduction of this exploration routine. Attempting to short-cut this activity by just telling students the prompts and having them repeat them, or by printing them in a student journal and having students use them independently is not very effective for their first experience with this routine. Taking time to follow each step as laid out here is essential for students to fully engage with nature and get a chance to practice these skills with guidance from an instructor. It doesn't take very long to introduce this routine well, and this can be considered time well-spent, as it pays off throughout future field experiences.

Why use leaves of the same type? Even though leaves might sound like a "boring" object to observe, they actually tend to have a lot of interesting variations in shape & structure, color, and evidence of organisms eating them. When students all observe the same type of leaf from the same tree, the group sharing can be more interesting as they make comparisons between what others notice and their own leaf. Still, almost any natural object will work for this activity.

TEACHING NOTES

Make adjustments for the needs of your students. For more energetic groups, consider introducing each sentence starter, then giving students a chance to run out and find an intriguing object to practice on. Once they've worked off some energy, they can return to the group to share what they've learned. Students can also share "blab school style," where everyone shouts an observation all at once.

Listening and responding to students. How you respond to student observations matters. Create a culture in which students feel safe sharing ideas by responding enthusiastically and equitably to their comments and letting them know that all their ideas are important, even if there isn't time to hear them all.

Don't be too strict about the format. Students may come up with "I notice" statements during the "I wonder" time, because they noticed something new or their question inspired an observation. That's good stuff! Don't be strict about the categories–engaged student observation is always a good thing.

Assign a "question master." Some instructors ask one student or chaperon to be the "question master" of the day or the week. This person has the responsibility of writing down any questions asked by members of the group and to look for opportunities throughout the day to investigate them further.

3. **Provide some examples of observations.**

   ▶ *Here are some examples of observations: "I notice this is yellowish-green in color, oval-shaped and about the size of my thumb, it's rough in some places and smooth in others..."*

4. **Tell them they'll be saying their observations out loud, taking turns with a partner**. Describe how to make observations about the object out loud with a partner—taking turns sharing observations with each other.

   ▶ *If you get stuck, try observing your object from a different perspective or using different senses. Listen to what your partner says, and see if that helps you notice different things.*

5. **Tell them to partner up with someone standing next to them in the circle.**

6. **Give students ~1 minute to make observations about their object out loud.** Say they will have about a minute to observe, and to keep saying their observations out loud until you say "stop." After about a minute, call for everyone's attention.

7. **Pairs share observations with neighboring pair, then a few with whole group.** Ask pairs to share a few observations with a neighboring pair. Then call on a few individual students to share observations with the whole group. If students are stating opinions or making identifications, gently point this out and ask them to make a concrete observation instead.

8. **Monitor student energy & keep things moving.** Keep the energy up when students are sharing in the large group. You don't need to hear from every student or follow up on every idea. While many may want to share, they'll get a lot of practice using the language while observing with their partners. The group will stay engaged and excited if you move on *before* they get restless.

Asking Questions (I wonder...)

1. **Introduce asking questions with the second prompt: "I wonder...".** Say they'll now ask questions about their object out loud. Tell them to use the sentence starter, "I wonder" with their partners, and to ask as many questions out loud as possible.

2. **Students ask questions out loud for ~1 minute.** Give student pairs about a minute to ask questions out loud. Then call for the group's attention.

3. **Pairs share questions with a nearby pair, then a few share with the whole group.** Ask pairs to share some of their questions with their neighbor pair. Then ask a few to share some of their most interesting questions with the whole group.

Making Connections (It reminds me of...)

1. **Introduce making connections and the last prompt: "It reminds me**

of..." to describe what it looks like, an experience, or information. Tell students they have one more tool to practice that helps make connections to things they already know: "It reminds me of..." This can be something the object looks like, an experience it makes them remember, or some information they know about it. Give examples of different kinds of "It reminds me of..." statements so they get the idea. For example:

- *The veins on this leaf remind me of the lines on the palm of my hand.*
- *This leaf reminds me of the time I collected leaves at my grandmother's house.*
- *My leaf reminds me of a TV show about uses for native plants.*

2. **Tell them it can be helpful to focus on one part of the object.** Explain that sometimes you can think of more comparisons if you focus on one part of the object, like the edge of a leaf, the petal of a flower, the shaft of a feather, or the bottom of an insect's abdomen.
3. **Students say "It reminds me of..." statements out loud for ~1 minute.** Challenge pairs to come up with and say out loud as many "It reminds me of..." statements as possible. After a minute, get the group's attention.
4. **Pairs share connections with a neighboring pair, then a few share with whole group.** Invite students to share some interesting connections, first with their neighboring pairs and then with the whole group.

Applying the Strategy & Inquiry Fever

1. **Help students think about how much they can discover in nature.** Ask students to look at their leaves/objects. Point out how much they learned in a short time about one leaf! Then invite them to look around at how much more there is to discover in nature.
2. **Explain that they'll look for anything they find interesting in nature, then make observations, ask questions & make connections out loud.** Tell them to hold onto the mindset they now have, and to get ready to use it more. They'll look for anything they find interesting, then use the observation routine they just learned.
3. ***[Optional Next Generation Science Standards (NGSS) crosscutting concept]* Ask students to pay attention to *patterns.*** If you'd like to emphasize the *NGSS* crosscutting concept of *Patterns* in this activity, tell students to pay attention to patterns, and explain that this is one way scientists focus their observations in nature.
   - *When scientists observe and investigate nature, they often look for patterns.*
   - *This leads to more observations and interesting questions about why the pattern occurs.*
   - *Try to find interesting things to practice observation/investigation skills with and look for patterns.*
4. ***[Optional NGSS crosscutting concept]* Provide examples of patterns from the field.** It's important to provide examples here of the kinds of patterns

TEACHING NOTES

Creating Inquiry Fever. "Inquiry fever" happens when a group of students is enthusiastically investigating nature, feeding off of each others' discoveries, ideas, and excitement. *I Notice, I Wonder, It Reminds Me Of...* is designed to set students up with an inquiry mindset and skills. Add the other 2 ingredients, and your students can catch the fever. The 3 ingredients for inquiry fever are: *inquiry mindset and skills; permission and encouragement; interesting stuff or ideas to explore.*

Internalizing the process. Encouraging students to use these prompts to explore things they find in nature will help them internalize the language & routine. This practice with exploring independently helps them build their investigation skills, so they're more likely to keep exploring when they are on their own without an instructor telling them what to do or how to engage with nature.

Introducing the Optional NGSS Crosscutting Concept. The optional steps here are for instructors who want to integrate the NGSS crosscutting concept of Patterns into this activity. For students to appreciate this big idea of science, they'll need to have multiple experiences with using this lens to explore nature. See the Instructor Support section for more information about making connections between this activity and the NGSS.

TEACHING NOTES

Quiet or shy students. Some students may be reluctant to say their observations out loud in the whole group. Opportunities to use the routine in small groups, pairs or individually encourages more sharing from students who might be reluctant to speak.

Observing as if it's the first or last time. You may need to "trick" students into observing more deeply. Ask them to imagine they've never seen an object or organism like this, or imagine that this is the last time they'll ever see it, so they need to take in as much as they can. Or challenge students to come up with an observation no one else in the group has made, or if its something they are familiar with, something they've never noticed before.

field scientists might look for. Many students have only been introduced to the idea of patterns in the context of math, so they think of them as repetitive sequences of numbers or shapes. Provide these or other relevant examples:

- *Is there a pattern to the height of woodpecker holes on trees? Is there moss growing all over the rocks, or only on the tops, or another growth pattern? Is there a general rule about where we can usually find water striders in the stream and where we don't?*

5. **Explain boundaries for inquiry fever; students practice strategies in pairs or small groups.** Tell students that now that they know these strategies for investigating nature, they can observe and find out interesting information about anything. Take them to a nearby area rich for exploration, explain boundaries, and send them out to explore. Say they can explore in pairs or in small groups. Encourage students to use their new tools to talk to and learn from one another.
6. **Give students at least 5–10 minutes to explore & offer materials if available.** Allow enough time for exploration, so students can find and engage with something that interests them. Offer tools like cups, bug boxes, nets, or hand lenses to enrich their exploration experiences.
7. **Circulate, model strategies, help students engage with each other's discoveries.** Help focus students who may be disengaged by temporarily partnering with them or drawing their attention to something interesting. Try to engage students with each other's discoveries. Model how to make discoveries and use observational and questioning language as you explore.
8. **Lead the whole group in practicing strategies together.** At the site of something particularly cool or easy to see, call the whole group over. Give students the opportunity to make observations, ask questions, and come up with connections out loud—but one at a time instead of all at once.

Wrapping Up

1. ***[Optional NGSS crosscutting concept]* Ask students what kinds of patterns they noticed, and how this impacted their investigations.** If students don't answer right away, try asking some specific pattern-related questions that follow up on their observations. For example: *"I noticed you were looking at those orange flowers–did you notice a pattern in where they grow and where they don't? How did that help you learn about the flowers?"*
2. ***[Optional NGSS crosscutting concept]* Explain that looking for patterns can help us get more out of science investigations.** Let students know that focusing on patterns is something all different types of scientists do, and students can practice looking for patterns and coming up with interesting questions no matter what they're looking at. If possible, give them a chance to look for patterns in another context during their field activities and discuss how it impacted their experience.

TEACHING NOTES

3. **Ask, "Did you learn anything that surprised you when you were exploring and observing?"** Listen to responses, and ask others if they had similar experiences.

4. **Ask students to reflect on how they've learned to be better observers, what kinds of things they noticed, and how there are interesting things everywhere.** Ask: "Do you feel like better observers now? Why or why not?" Remind them that even parts of nature that at first might not seem cool or interesting, like a leaf, can become exciting if they take the time to really look.

5. **Say they can use these strategies with anything they are curious about in nature—or anywhere.** Tell students that when they find anything cool during their field experiences, they can all observe, ask questions, and make connections so they can learn together as a group. Remind them that even if there is only a brief sighting of an organism, like a snake slithering away or a hawk flying by, saying observations out loud will help the whole group notice more and remember the experience more deeply.

Codeword "observation." You might want to come up with a phrase or codeword you or a student can use to signal that there's something cool to check out—when anyone in the group hears the code word, they know to use these observation tools.

Optional Extension: Focus on Asking Scientific Questions

1. **Explain that questions can be sorted into "testable," "researchable," and "not testable, but interesting to think about."** Explain that some questions are "testable" (or "investigable"), and can be answered through conducting tests or investigations in science. There are also questions that can be looked up in books or online, that we can call "researchable" (or "look-up-able"). And then there are questions that are not knowable through science, but are interesting to think about and could be explored through the lenses of literature, philosophy, religion, or other fields.

2. **Sort some of students' questions into "testable," "researchable," and "not testable, but interesting to think about."** Ask students to volunteer some of the questions they had, and to say in which category they think the question belongs. You might choose to write down the testable ones.

3. **Sort their "testable" questions into "testable right now through further observations," & "testable through longer investigations."** Take a few of the questions they labeled as "testable," and ask whether they think they could be answered through further observations right now, or if they might require longer investigations to answer.

4. **Try to answer some of their questions through immediate observations, and consider answering other(s) through longer investigations.** If student interest is there, try answering one or more of their questions through further observations. You might also choose to have them conduct longer investigations either now, or later in their field experience (consider the BEETLES activity, *Exploratory Investigation* for guidance with this).

Examples of sorting questions. Here's some examples of how an instructor might approach sorting questions:

"Some questions can be answered through further observation, like Jordan's question about whether the color was the same underneath his leaf. What are some other questions like that? (let students respond)

"Elisha's question about whether all leaves of this kind have spines couldn't be answered by observing this leaf for more time- it might take a more planned investigation that includes other leaves. How could we work together as a group to investigate this?" (let students respond)

"Juan wondered how long these leaves take to break down into soil. That would be hard for us to figure out right now, but maybe someone else has wondered the same thing and studied it. Let's write down that question and look it up online or in a book."

"Tina's question, 'What do dragonflies dream about?' is pretty fun to think about, but it's not something we can investigate or ever know because we can't talk with a dragonfly."

NOTES

An abbreviation for the long activity name. When this routine becomes integral to a program, and comes up in discussion a lot, it can be cumbersome to refer to it as "I Notice, I Wonder, It Reminds Me Of..." all the time. Instead, some affectionately abbreviate it by pronouncing the acronym INIWIRMO as "innie worm-o."Some instructors call this routine "The 3 'I's' of a scientist" which includes a play on the word "eyes."

For Spanish speakers. For those who work with Spanish-speaking students who are struggling with English, "I Notice, I Wonder, It Reminds Me Of..." is particularly useful because it has sentence starters that can help out an English Language Learner. But for students who speak very little English, you might want to share Spanish versions with them. Here are some suggested translations: I notice: "Yo noto...," or "noto...," or "observo..." I wonder: "me pregunto...," It reminds me of: "Me recuerda a... " or "me parece," or "me hace pensar..."

Instructor Support

Teaching Knowledge

Processing Information. We are surrounded by huge amounts of information, and our brains are capable of taking in and making sense of much of what we are exposed to in our environment. Yet, processing every bit of available information all the time would be overwhelming. We continually make unconscious decisions about the appropriate level of detail and priority of the information we attend to. We often ignore details that are not necessary for our immediate goals. In our deep history, this sorting system has been an efficient way to sift through large amounts of extraneous input in order to prioritize what might be useful for the survival of the species. For our ancestors living more closely with nature, the most important information was probably often simplified to, "Can it hurt me?" and "Can I eat it?" One way to improve our ability to make observations is to remember that our brain is constantly tuning out "unnecessary" observations, but we can intentionally broaden or focus our attention to try to unearth new observations. Using the "I notice" prompt to pay attention forces your brain to continually make new observations.

Scientists who study memory function in the brain have found that making connections is what keeps our memories stable and accessible. Accessing memory involves making associations between new information and what we already know. The more connections made to prior knowledge, the more stable the memory, as it is more firmly placed within an existing conceptual framework. The "It reminds me of" exercise specifically helps students make connections to what they already know. This creates relevance for students by allowing them to bring in their prior knowledge and connect to the experience of their own lives. Creating metaphors and analogies also helps to generate more interesting questions. It can also be easier to remember things that you've said out loud, because information is processed in both the speech and the auditory centers of the brain.

Deep observation is a skill that must be learned, and a field experience with students is a perfect opportunity. You may find that you can observe a bird with a group of students until it flies away, and when you ask them what they saw, they give only a few superficial responses. Telling them to "look carefully," or "look hard" is generally not very helpful advice. It's not just a matter of looking "harder," it is a matter knowing how to look- or in the context of this activity, how to use the three prompts.

Developing these skills can change the way you and your students experience the world. When you move through the natural world making deep observations, generating questions and making connections, you experience wonder and curiosity. You are directly engaged and interacting with nature. Providing students with opportunities to spend time focused on one thing in nature tends to help students forge emotional connections with nature. Naturalist/field guide author/instructor/great guy John Muir Laws says, "a useful definition for love is sustained compassionate attention." Giving students the tools to focus deeply on different aspects of nature helps them build their own emotional connections, and "fall in love" a little with whatever they're

spending time with. Do this with different aspects of nature, and students build emotional connections with the natural world and environmental literacy, in general."

Saying observations, questions & connections out loud can be powerful. Students (and adults) may become bored in nature if they don't have the skills to make observations. The simple act of stating your observations, questions and connections out loud can be very powerful. Students (and you) will find that they're actively engaging with an organism or object, and noticing more things. They'll also tend to remember much more after using these prompts. Even when alone in nature, naturalist and field guide author John Muir Laws keeps up a stream of observations, questions and connections, saying them quietly under his breath.

Introducing Content. Avoid providing information that students could find out through their own observations; this might discourage students from investigating for themselves. Focusing on facts can often switch students into a more passive mode of being in nature.

In this activity, concepts discussed will vary depending on whatever the particular "find" is. The good news is the instructor doesn't need to have specific knowledge about the find for it to be successful. In fact, it's quite engaging for students to explore something that the instructor is authentically curious about and is investigating along with the students. Encouraging students to make observations, ask questions, come up with connections and talk with one another are the most important goals of this activity. Sharing your knowledge or facts about a particular object is optional, and should only be done after students engage in some exploration. Sometimes sharing a bit of information at the right time can incite more curiosity and allows students to apply their thinking in a new way.

Common Related Misconceptions.

Misconception. Identifying organisms should be a primary goal for outdoor experiences.

More accurate information. Once we have identified something in nature, often we don't notice anything else about it. In this way, identification sometimes substitutes for deeply observing something. When organisms are reduced to a name or species, we can fail to notice the details of the individual we are observing. Exploring the complexity and nuances of nature by observing and asking questions can be more useful than just receiving an answer. Names are very useful, but are usually best introduced (and more memorable) after students have the chance to observe the organism.

Misconception. Observing in nature means being still and quiet.

More accurate information. You don't have to be quiet and still to observe. Saying things out loud helps cement ideas in our memories. Talking with peers sparks new ideas and opens windows for new observations and connections. Sometimes, being quiet and still in nature is the perfect tool for observing, but sometimes thinking out loud and discussing is also the perfect tool.

NOTES

Using the routine in other disciplines. The steps and spirit of this routine, used here to actively engage students with the natural world, can also be used in other disciplines. In *Active Reading*, a strategy used to engage students with reading, students underline what seems important in text (I Notice), & write questions and connections (I Wonder & It Reminds Me Of) in the margins. Sticky notes can be used when the page shouldn't be written upon. The routine can also be used to engage students with art pieces in art appreciation. The possibilities are endless! Explaining these connections to classroom teachers can encourage them to carry the routine back to the classroom as part of classroom culture.

Writing prompts. "I notice; I wonder; It reminds me of..." can be offered as a writing prompt to students who are doing a solo sit or taking reflection time, helping them produce writing rich in detail and meaning. You can also encourage students to reflect on their own experience and write what they notice about they're feeling, what they're wondering about, and what their experience or feelings remind them of.

NOTES

About the Next Generation Science Standards (NGSS) The development of the Next Generation Science Standards followed closely on the movement to adopt nationwide English language arts and mathematics Common Core standards. In the case of the science standards, the National Research Council (NRC) first wrote a *Framework for K-12 Science Education* that beautifully describes an updated and comprehensive vision for proficiency in science across our nation. The *Framework*–validated by science researchers, educators and cognitive scientists–was then the basis for the development of the NGSS. As our understanding of how children learn has grown dramatically since the last science standards were published, the NGSS has pushed the science education community further towards engaging students in the practices used by scientists and engineers, and using the "big ideas" of science to actively learn about the natural world. Research shows that teaching science as a process of inquiry and explanation helps students to form a deeper understanding of science concepts and better recognize how science applies to everyday life. In order to emphasize these important aspects of science, the NGSS are organized into three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas (DCI's). The DCI's are divided into four disciplines: Life Science (LS), Physical Science (PS), Earth and Space Science (ESS) and Engineering, Technology and Applied Science (ETS).

Read more about the Next Generation Science Standards at http://www.nextgenscience.org/ and http://ngss.nsta.org

Why teach science 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*. Focus on these science practices will help to ensure a more scientifically literate public who will, hopefully, be better able to make thoughtful decisions.

Connections to the Next Generation Science Standards (NGSS)

BEETLES student activities are designed to provide opportunities for the "three-dimensional" learning that is called for in the *NGSS*. To experience three-dimensional learning, students need to engage in practices to learn important science concepts (Disciplinary Core Ideas) and relate that content to big ideas in science (Crosscutting Concepts). In simple terms, students should be exploring and investigating rich phenomena, trying to figure out how the natural world works.

I Notice, I Wonder, It Reminds Me Of... features the scientific practice of *Asking Questions* and the crosscutting concept *Patterns,* as optional enhancements or extensions. Students also have the opportunity to build some understanding of relevant Disciplinary Core Ideas (DCIs) depending on the natural phenomenon they explore, the observations they focus on, their prior knowledge, and the guidance of the instructor.

Featured Science and Engineering Practices.

Building a Foundation for Engaging in all Science Practices. According to the National Research Council's (NRC's) *A Framework for K-12 Science Education,* "The two main goals of science are (1) to systematically describe the world and (2) to develop and test theories and explanations of how the world works...careful observation and description often lead to identification of features that need to be explained." All aspects of systematically describing the world and developing explanations for how the world works rely on the ability to make observations. "Making Observations" is not one of the highlighted *NGSS* science practices because it's considered essential for competency in other practices. As students develop their observation skills through *I Notice, I Wonder, It Reminds Me Of,* they prepare to engage in other practices of science. For example, to be engaged in the practice of "Constructing Explanations," they need to make explanations about the world based on the available evidence; in the natural world, the evidence for explanations is usually what is directly observable. The more specific, accurate observations students can make, the more nuanced and evidence-based their explanations will be.

Engaging Students in Asking Questions. According to the *Framework,* students not only need to ask questions about the phenomena they see in the natural world, they also need to categorize questions as "scientific" (or, testable, answerable through observations and experience) or "non-scientific" (questions that aren't answerable through direct observation). To fully engage in this practice, students need to consider how they might answer their own questions. During *I Notice, I Wonder, It Reminds Me Of,* students get plenty of opportunity to develop their ability in asking their own questions while observing natural phenomena. At the end of the activity write-up we provide a description of how to more fully engage students with the practice of Asking Questions, by sorting their questions based on which are testable or not, then discussing how they might approach answering some of them. Students benefit from the activity regardless of whether or not they take part in the optional extension

activity, but you should make a decision about presenting this part based on your goals for your students. Learning more about Asking Questions is especially useful if it is a goal for students to focus on planning investigations.

Featured Crosscutting Concepts.

Learning Science Through the Lens of Patterns. The idea that patterns exist everywhere, and that taking note of them can lead to questions about why they occur, is an important lens for scientific investigations. According to the NRC's *A Framework for K–12 Science Education,* students should be using patterns to think about their observations and explanations across different disciplines of science (and mathematics!). In the optional steps provided during *I Notice, I Wonder, It Reminds Me Of,* students practice recognizing patterns during their "Inquiry Fever"investigations and discuss what those patterns might tell them about the natural world during the "Wrapping Up" section. If integrating this crosscutting concept and helping students make more focused observations is a goal for you and your students, include these optional steps in the activity.

When students are prompted to notice patterns in the "Inquiry Fever" stage of the activity, they move from making general observations to making more focused observations that might lead to interesting questions and explanations about phenomena in the natural world. Discussion of the patterns students observe during the "Wrapping Up" section is an opportunity for them to go beyond just recognizing patterns, to begin thinking about how the pattern might occur, and to understand the natural phenomenon more deeply in the process. For students to benefit fully from the crosscutting concept of Patterns, they need to also learn that looking for patterns is useful in all disciplines of science. If Patterns is a theme that will guide your field experience, ask students to notice patterns elsewhere, and remind them it's a useful way for scientists to approach their investigations of the natural world.

Applying Other Crosscutting Concepts. Although Patterns is the featured crosscutting concept in this activity, a different crosscutting concept could be incorporated to meet other learning goals. For example, if your focus is on the crosscutting concept of Structure and Function, you could instead ask students to: "Pay close attention to the structures of organisms as you do Inquiry Fever. See if you can notice how they are similar and different, and what questions or connections this makes you think of. How do the structures relate to what they do for the organism?" This kind of focus on structure and function can prepare students to engage in more activities relating to that theme. If you use an alternate crosscutting concept, be sure to point out to students that it is a "big idea" that is also useful in other disciplines of science, or when investigating any part of the natural world.

Featured Disciplinary Core Ideas

Building an Understanding of Disciplinary Core Ideas. The *NGSS* make it clear that students need multiple learning experiences to build their understanding of disciplinary core ideas. *I Notice, I Wonder, It Reminds Me Of* provides students with an opportunity to build knowledge that might relate to some disciplinary core ideas. The specific ideas students engage with will vary depending on what they explore, the observations they make, their prior knowledge, and

NOTES

More on scientific/non-scientific questions. In *The Laws Guide to Nature Drawing and Journaling,* John Muir Laws writes "Science is a tool for studying observable experiences and phenomena–the stuff you can see, hear, taste, feel, or measure. 'How many holes are in this tree?' 'What time do moths begin to fly in the evening?' 'How long is this earthworm?' These questions can be explored and in some cases answered through observation and experimentation. Some things cannot be observed, measured, or tested. 'What is God?' 'What is kindness?' 'How do trees feel about the wind?' 'Does the Gray Wolf have a soul?' These questions are outside the realm of science. It's an important part of the human experience to consider them, and you can use disciplines like poetry, theology, and philosophy to do so."

Adding a 4th Prompt to "I Notice, I Wonder, It Reminds Me of…". Part of the beauty of this routine is that the 3 prompts focus students on making close observations. But science is also about constructing explanations. This can serve as a nice next-level addition to the routine, that's particularly interesting if students are focusing on patterns. You can just simply introduce a 4th prompt, such as: "Could it be..." or "I think that..." that will focus them on coming up with explanation that are based on their observations. To engage students further with making explanations, consider using the NSI: Nature Scene Investigators activity.

guidance from their instructor.

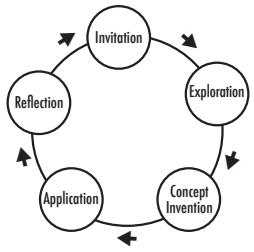
Students learn how to make observations, ask questions, and make connections in the first part of this activity. Although they might make observations related to certain DCI's during that time, the real opportunity for students to build understanding of science concepts is during and after "Inquiry Fever." With the additional focus on a crosscutting concept during "Inquiry Fever," their observations can be focused on particular ideas that will help them to make sense of their observations. For example, if students notice a pattern for where stones are found on a riverbank, the instructor can ask some questions about what might be causing this pattern, which may lead to an investigation related to understanding *erosion* or *deposition*. By paying attention to students' emerging ideas during the activity, you can try to connect them to an important scientific concept (or DCI) that can become the focus of the field experience and discussed more thoroughly during the final "Wrapping Up." It's important to provide students with multiple opportunities to deepen their understanding, by making sense of these ideas in different ways and revisiting them in other field activities.

Activity Connections

Once they have done *I Notice, I Wonder, It Reminds Me Of*, students can be reminded to use these prompts at almost any "Exploration" phase of a BEETLES activity to deepen their literacy with a phenomenon, and encourage them to engage in meaning-making.

Using "I notice," "I wonder," and "It reminds me of" prompts can also make an excellent segue into poetry and creative writing. Consider having students write down as many of their ideas as possible. Later ask them to combine their sentences into a poem. Often, their observations, questions, and connections, when read, come off as pretty darned "poetical." Like saying things aloud, writing and drawing helps embed ideas in our memory.

This activity is based on an observation routine generously shared with us by John Muir Laws, naturalist, field guide author, great guy, and illustrator. For more information please see his website: http://www.johnmuirlaws.com and download his free curriculum, *Opening the World Through Nature Journaling*.



I Notice, I Wonder, It Reminds Me Of **completes a full learning cycle as a discrete activity.**

Within the sequence of many activities, *I Notice, I Wonder, It Reminds Me Of* is primarily an Invitation, but students could also use these prompts to deepen their observations during the Exploration phase of any activity.

FIELD CARD

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

I Notice, I Wonder, It Reminds Me Of

Why observe?

1. Ask: Who are exceptional observers?
2. Ask: What makes some observers better than others?
3. Share Sherlock Holmes quote; ask or explain what it means.
   - ▶ *"I see no more than you, but I have trained myself to notice what I see."*
4. Tell students you are going to teach them some tricks that will help them be better observers and notice things others don't notice.

Making Observations (I notice…)

1. Ask each student to pick up the same type of natural object, then circle up.
2. Define observation and introduce the first prompt: "I notice…"
   - ▶ *An observation is something we notice with our senses (sight, touch, smell, hearing, taste–but please don't taste anything unless you are told you can.*
   - ▶ *I know I'm making an observation when I begin a sentence with "I notice" and then describe what I can observe using my senses.*
   - ▶ *Observations are what you notice in the moment, not what you already know. Saying "I notice it's a leaf" is identification, not observation.*
   - ▶ *Saying "It looks awesome," or "I notice it's gross," is your opinion, not an observation.*
   - ▶ *Saying "the leaf has been eaten by bugs" isn't an observation if you can't see any bugs. It's a possible explanation for the observation that it has holes.*
3. Provide some examples of observations.
   - ▶ *Here are some examples of observations: "I notice this leaf is yellowish-green in color, oval shaped and about the size of my thumb, it's rough in some places and smooth in others…"*
4. Tell them they will be saying observations out loud, taking turns with a partner.
   - ▶ *If you get stuck, try observing your object from a different perspective or using different senses. Listen to what your partner says, and see if that helps you notice different things.*
5. Have them partner up with someone standing next to them.
6. Give students ~1 minute to make observations about their object out loud.
7. Pairs share observations with a neighboring pair, then a few share with whole group.
8. Monitor student energy and keep things moving.

Asking Questions (I wonder…)

1. Introduce asking questions with the second prompt: "I wonder…".
2. Students ask questions out loud to themselves for ~1 minute.
3. Pairs share questions with a neighboring pair, then a few share with whole group.

Making Connections (It reminds me of…)

1. Introduce making connections and the last prompt: "It reminds me of…," What it looks like, an experience, or information.
   - ▶ *The veins on this leaf remind me of the lines on my palm.*
   - ▶ *This leaf reminds me of the time I collected leaves at my grandmother's house.*
   - ▶ *My leaf reminds me of a TV show about uses for native plants.*
2. Tell them it can be helpful to focus on one part of the object.
3. Students say "It reminds me of" statements out loud for ~1 minute.
4. Pairs share connections with a neighboring pair, then a few share with whole group.

Applying the Strategy & Inquiry Fever

1. Help students think about how much they can discover in nature.
2. Explain they will be looking for anything they find interesting in nature, then making observations, asking questions & making connections out loud.
3. *Optional Crosscutting concept:* Tell students to pay attention to **patterns**.
   - ▶ *When scientists observe and investigate nature they look for patterns. This leads to more observations and interesting questions about why the pattern occurs.*
   - ▶ *Try to find interesting things to practice observation/investigation skills and look for patterns.*
4. *Optional Crosscutting concept:* Provide some examples of patterns from the field.
   - ▶ *Is there a pattern to he height of woodpecker holes on trees?*
5. Explain boundaries for inquiry fever; students practice strategies in pairs or small groups.
6. Give students 5–10 minutes to explore and offer materials.
7. Circulate, model the strategies, and help students engage with each other's discoveries.
8. Lead the whole group practicing the strategies together.

Wrapping Up

1. *Optional Crosscutting concept:* Ask students what kinds of patterns they noticed and how this impacted their investigations.
2. *Optional Crosscutting concept:* Explain that looking for patterns can help us get more out of science investigations.
3. Ask, "Did you learn anything that surprised you?"
4. Ask students to reflect on how they've learned to be better observers, what kinds of things they noticed, and how there are interesting things everywhere.
5. Let students know they can use these strategies with anything they are curious about in nature or anywhere.

ABOUT BEETLES™

BEETLES™ (Better Environmental Education Teaching, Learning, and Expertise Sharing) is a program of The Lawrence Hall of Science at the University of California, Berkeley, that provides professional learning sessions, student activities, and supporting resources for outdoor science program leaders and their staff. The goal is to infuse outdoor science programs everywhere with research-based approaches and tools to science teaching and learning that help them continually improve their programs.

www.beetlesproject.org

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