## *Tips for Facilitating Science Lessons*

We are so excited that you are joining us for Project Crystal! Facilitating science learning can be a really fun experience for the facilitator as well as the learners (hence why we here on Crystal Cove Conservancy's education team do it as a career!).

Since this may be your first time helping others learn science, we wanted to share our top five tips for facilitating science learning, as well as a few of our favorite resources drawing from educational research.

***Tip #1*** We learn science best by doing science.
***Tip #2*** Before starting, set up norms for science conversations.
***Tip #3*** Ask questions to help learners clarify and refine their thinking.
***Tip #4*** Avoid close-ended questions with only one correct answer.
***Tip #5*** Start a science notebook as a tool to reflect on your own learning.

### *Tip #1 We learn science best by doing science.*

We often learn to drive by trying it in a parking lot alongside an experienced driver. Many people learn trades by apprenticing with someone more experienced. Similarly, the best way to learn science is to engage in the same sort of work that professional scientists do, with a few supports to help along the way.

That is the "why" behind the design of Crystal Cove Conservancy's STEM (Science, Technology, Engineering, Mathematics) education programs. We work with UC Irvine researchers and State Park managers to set up real research projects that address real-world questions. Then, as educators, we plan out what kind of supports and scaffolds that our learners might need to step into the role of scientists during our programs. These supports can take the form of videos to explain certain topics; instructional tools, such as worksheets to walk learners through the process of creating hypotheses, designing models, or analyzing data; and even the questions that we ask, to assist learners in thinking the same way that scientists do.

As you participate in Project Crystal, keep in mind that you and your family are modeling the same way of thinking, talking, and behaving that professional scientists use. The design of the various tasks and suggested questions are tools that you can use along the way in order to think and act as scientists.

## *Tip #2 Before starting, set up norms for science conservations.*

Scientists and other science practitioners have specific ways of talking and expressing their ideas that might be different from our normal everyday habits of speaking. When we're supporting science learning at Crystal Cove Conservancy, we try to model our conversations on the same sort of norms that scientists use. Because of this, it can be helpful to clarify expectations for your "science conversations" before beginning Project Crystal so that everyone understands how to interact and speak.

The Tools for Ambitious Science Teaching (AST) website from the University of Washington has some great suggestions on setting up expectations for science conversations in the classroom, which are easy to adapt for science conversations at home. We encourage you to read these norms out loud to your family before starting Project Crystal. If possible, consider printing them and putting them up on the refrigerator or wall so that they're easy to remember and refer to during your science learning.

***Some suggested norms for science conversations include:***

- Everyone should contribute to the conversation and share their ideas.
- Anyone can ask questions if they don't understand an idea that is being talked about.
- You can critique or question other people's ideas, but personal attacks are out of bounds.
- Don't talk over anyone else – wait your turn to speak.
- Give "think time" before asking anyone to share their ideas.

## *Tip #3 Ask questions to help learners clarify and refine their thinking.*

So much of learning happens when we explain our ideas out loud and engage in conversations with other people. Scientists use questions to help each other explain their ideas, clarify what they're thinking, and justify their claims based on evidence.

As a science learning facilitator, you and your learners will find yourselves using questions similarly: to help each other clarify your thinking, to probe for deeper thought, to press for evidence, and to encourage everyone to build on each other's ideas. We recommend reading through these questions ahead of time, and then printing a copy so that they're easy to refer to during learning activities. If your learners are old enough, feel free to share them with the whole group. (Asking thinking questions can be the job of everyone!)

***Clarifying Questions***, which help us explain what we're thinking:

- What do you mean by that?
- Can you say more about...?
- Can you explain what you mean by....?

***Probing Questions***, which help us think more deeply about ideas:

- Why do you think [something] happens?
- How do you explain...?
- What do you predict would happen if...?

***Pressing Questions***, which encourage us to use evidence to support our ideas:

- Why do you think that?
- What evidence (or data) supports your claim?
- Have you seen something that supports your idea?

***Think Together Questions***, which help us build on each other's ideas:

- [Person A], what do you think about [Person B]'s idea?
- Do you agree or disagree with what s/he just said?
- Can you build on what s/he just said?

### *Tip #4 Avoid close-ended questions with only one correct answer.*

Practicing scientists build knowledge by testing hypotheses and analyzing evidence to see if their initial ideas were true. But this is not how we have traditionally learned science in the United States. When adults think about their science classes at school, we often remember memorizing facts, drawing and labeling diagrams, or participating in science labs that had one predetermined correct answer.

When you and your family participate in Project Crystal, you are taking part in real science. This

means that no one – not our staff, not Dr. Kimball or anyone else at UC Irvine -- knows the final answer to our research question. That's part of what makes this project so exciting! It also means that the focus of our science learning is on testing ideas and generating knowledge, not memorizing facts.

When you are facilitating science learning, you want to make sure the focus is on having conversations, not simply recalling old facts or information. As a result, you should try to avoid asking closed-ended questions that require a "yes" or "no" response or only have one right answer. Asking closed-ended questions often results in what educational researchers call the I-R-E response pattern, where facilitators ask a question, wait for learners to reply with a predetermined correct response, and then move on to the next question in their sequence, thus closing conversational pathways and ending any exploration.

When you're facilitating Project Crystal, focus on asking questions and encouraging discussion. In each activity, we'll provide some suggested questions for your family to ask each other, as well as some resources that can help you learn more about particular topics as you go.

## *Tip #5 Start a science notebook as a tool to reflect on your own learning!*

Education research has shown that metacognition – thinking about our own thinking – is an important part of how we learn. It allows us to take the knowledge and skills that we might learn in one part of our lives (such as Project Crystal) and transfer them somewhere else (such as solving a problem in our home garden). Professional scientists often keep science journals as a form of metacognition, where they can record their ideas and track how they change over time.

At the end of each Project Crystal session, we'll include a section that has some suggested questions to help you think broadly about the topic you've just explored and reflect on what you've learned. In addition to this, we encourage you to have each member of your science learning community set up their own personal science notebook. This could be a physical notebook, some blank paper that has been folded and stapled together, or even a Word document or personal blog. In this notebook, you can keep track of how your thinking and skills change over time.

***As you're reflecting on your learning at the end of each session, some good questions to ask yourself include:***

- What did I do today?
- What did I learn today? What information was new to me?
- What science skills did I use today? Did I practice any new skills that I could use to solve problems in other parts of my life?
- What questions do I still have?