

## Tips for Developing Scientific Thinking with Effective Questions

### To promote problem solving, ask...

- What information do you have? What do you need to find out?
- What strategies are available to you?
- Is any of the information you need missing?
- As you collect data, can you think of ways to apply the results?
- What do you think the answer or result will be?

### To help students learn to reason scientifically, ask...

- What assumption are you making? Is it fact or opinion?
- Why is that true? How did you reach that conclusion?
- Is that true for all cases? Explain.

### To check student progress, ask...

- Can you explain what you have done so far? What is next?
- Have you thought of other strategies?
- Why did you decide to use this method?
- If you were to do this again, what method would you use?
- Do you think this could work with other hypotheses?

### To help when students get stuck, ask...

- Describe the theory or hypothesis in your own words.
- Can you draw a picture or diagram of the theory?
- What facts do you have? What else do you know that will help?
- How did you approach similar problems?

### To help students collectively make sense of science, ask...

- What do you think about what \_\_\_\_ said?
- Do you agree? Why or why not?
- Does anyone have the same answer but a different way to explain it?

### To encourage conjecturing, ask...

- What would happen if...? What if not?
- Do you see a pattern? Can you explain the pattern?
- Is the pattern true for all cases? Can you think of an exception?

### To encourage reflection, ask...

- How did you arrive at your conclusion?
- Does your conclusion seem reasonable? Why or why not?
- What are the key points or big ideas in this lesson?

Do you want to develop additional strategies for developing scientific thinking with effective questions for your teaching practice? Visit [www.pbs.org/teacherline](http://www.pbs.org/teacherline) to view our Science professional development options, including a special collection from WGBH/Teachers' Domain.



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# Tips for Developing Scientific Thinking: The Constructivist Learning Model in Science

PBS TeacherLine offers a special collection of science courses from WGBH/Teachers' Domain designed to demonstrate the constructivist learning model, which states that learners acquire knowledge by building upon what they already know and constructing it in their own way. The content of these courses is presented within the framework of constructivist learning. The model outline below will help you design constructivist science lessons.

## Invitation

- Create students' interest in a particular content topic.
- Give students a clear view of the purpose of the lesson.
- Uncover each student's prior knowledge so that you both are aware of existing understanding.

## Exploration

- Provide students with a base of information on particular aspects of the topic through hands-on activities. Use the Teachers' Domain resources at [www.teachersdomain.org](http://www.teachersdomain.org).
- Involve students actively in the learning process.
- Model one or more metacognitive strategies that students will encounter throughout the lesson.

## Explanation

- Encourage students to develop and discuss their own explanations of what they've explored.
- Provide students with feedback on their explanations from you or other students, or through resources or readings that offer a scientifically valid way of explaining the content.
- Enhance vocabulary for effective communication.

## Application

- Encourage students to apply what they've learned earlier in the lesson to a new situation or to their own experiences.

## Putting It into Practice

- Review the science content from the session.
- Provide opportunities for students to apply what they learned in a different content or problem.
- Allow students to connect new knowledge to previously learned content or experiences.

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