# Professional Development Workshops

## Science Content and Pedagogy

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**The REAL Process of Science**
Contrary to what is frequently taught in school (and to what most of us were probably taught), there is no "standard" scientific method that real scientists use. Here we dispel common misconceptions about hypotheses, experimentation, observation, and other lock-step scientific method procedures currently in vogue. Teachers will participate in several hands-on lessons for grades 6-12 to discover how real scientists actually conduct their work. Teachers will also learn how to revise science fair procedures/instructions to reflect the real scientific method, and so students can learn the full range of activities possible for undertaking scientific research. Teachers will also be shown how to adapt existing curricula to reflect more accurate examples of the scientific method for their students.

**Teaching Evolutionary Processes to Skeptical Students**
Sooner or later, science teachers encounter a student who disbelieves, or is at least skeptical of, factual information presented about the age of the earth, the age of the universe, astrobiology, or biological evolution. Understanding the evidence and current state of our scientific knowledge about these subjects is important for any science teacher faced with challenges from students, parents, administrators, or other teachers. This workshop provides a summary of different types of pseudoscientific beliefs students have, and suggests ways to approach these subjects so that skeptical learners are more likely to consider the facts presented in the science class. Also included here are some useful approaches for dealing with the more recent creationist ideas and tactics, such as "Irreducible Complexity" and "Intelligent Design." Handouts will describe the different forms of creationism and list questions that their proponents might ask in class (along with suggested answers.)

**Addressing Questions on Intelligent Design**
This workshop is similar to the previous one, but is specifically focused on Intelligent Design. In recent years, the attacks on biological science have frequently focused on "Intelligent Design" as an alternative to biological evolution and other scientific

disciplines. This workshop focuses on strategies for addressing questions about Intelligent Design and its relation to science. More importantly, the workshop will present specific answers to questions intended to challenge the science that appears in the textbook or that the science teacher describes. All participants in this workshop will be actively engaged, both in the role of the questioning student and in the role of the teacher responding to those questions. Participants will have the opportunity to hear alternative approaches and to contribute new ideas for dealing with disbelieving students and with the attacks on science that are a fundamental part of the Intelligent Design movement.

**Making Predictions** illustrates how scientific hypotheses are retained or rejected based on the results of tests. We will examine various types of apparatus, make predictions about what will happen, and then actually perform experiments to verify predictions and test hypotheses (understanding that a hypothesis is different from a prediction). This talk illustrates the process of science and includes plenty of audience participation. Prepare to be surprised!

**The Force is with You!**
How do things (including you) respond to forces? Using a series of demonstrations and illustrations, we will explore various ways that forces can cause accelerations, equal and opposite reactions, and provide explanations for everyday phenomena. See a reenactment of Galileo's famous experiment! Observe the rocket effect with a real rocket! Understand how humans can use Newton's laws to leave earth and explore space.

**Light and Sound** is all about waves. Why does light come in different colors? What causes rainbows? What makes Polaroid sunglasses different from other sunglasses? What does sound have in common with light? What causes sound and the variety of pitches we can hear? Why can't we hear all sounds or see all kinds of light? How can astronomers use light to learn about stars and galaxies millions of light-years away? A variety of eye-catching (or ear-popping) demonstrations will answer these and other questions!

**Learning About the Universe Using Electromagnetic Radiation**
Because astronomers cannot travel to the stars and obtain a sample for analysis, they must learn about the stars by more indirect techniques. One method that has proved exceedingly useful is the analysis of the radiation we receive from the stars. This electromagnetic radiation includes both the light we can see as well as a large range of other types of radiation that are invisible to our eyes. Even though we can't see that radiation, we can detect it and use it to learn an enormous amount about planets, stars, and galaxies. Participants can bring a remote control (e.g., from a TV or video recorder) and construct a device that can detect its invisible beam.

**Solids, Liquids, and Gases**

Is most of the universe a solid, liquid, or gas? See demonstrations that illustrate the differences among these three states of matter, and find out how you can make matter change from one to the other! Learn which of these states of matter can be found in the interior of the earth, in other planets, or in distant stars.

**Using Physics to Understand the Universe**

Thanks to the fact that the laws of physics are the same throughout space and throughout time, we can use the laws of physics to find out about the remotest corners of the universe. See illustrations and demonstrations that show how scientists do this, and hear about some of the amazing things that we have been able to learn about the universe.

**Integrating Science with Non-Science Curricula**

In school, we artificially compartmentalize the different subjects. But, the real world isn't like that. Often, a particular task involves knowledge and experience from a variety of disciplines, and the connections among different content domains are often extremely interesting for students. In this illustrated talk, methods for making interdisciplinary connections are presented, and participants will receive materials that will help them to do the same in their classrooms.

**Ask the Astronomer!** or **Ask the Physicist!**

Flustered about physics? Confused about cosmology? Here's your chance to ask all the questions you (or your students) ever had about astronomy or physics. Find out why the sky is blue, why sunsets are red, why hurricanes rotate counterclockwise in the northern hemisphere, and everything else you've always wanted to know but were afraid to ask.

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