

DragonflyTV Nano Educator's Guide: Introducing Nanoscale Science and Technology

Welcome to the *DragonflyTV Nano* Educator's Guide. This book is designed for science educators, both formal and informal, and accompanies *DragonflyTV Nano*, a six-show series on the nanoscale world.

Nanoscience is so new even accomplished scientists are constantly debating questions surrounding the field. The teaching of nanoscience and nanotechnology offers a unique opportunity to reinforce core science concepts and discuss some ethical issues that arise with any cutting-edge technology. Don't be afraid! You CAN teach nanoscience and you DON'T have to know all the answers. No one does. Questions asked by your young learners may have never been asked before; so there is no right or wrong answer—only room to explore. We hope you will embrace this chance to expose your students to a new field of science that will most assuredly affect them in the years to come.

About DragonflyTV Nano

Building on the success of DragonflyTV's presentation of science inquiry conducted by children, the nano series contains stories of science inquiry that take place at science centers and university-based nanolabs around the country. Each inquiry story begins at a museum where kids engage in an exhibit or activity that introduces them to a nano-related concept. Then they deepen the experience with a hands-on experiment conducted on their own or with the help of university scientists. The goal of the TV series is to illuminate the nanoworld while introducing the inquiry process and inspiring viewers to question the world around them and conduct their own investigations.

You may be wondering how to create hands-on inquiry activities for a science that can't be seen. This question came up often as we developed the content for our series. At DragonflyTV we had the advantage of partnering with labs where scientists had the tools to manipulate materials at the nanoscale. To help you, whenever possible we have included the actual laboratory images relating to the activities at hand. (See the **Image Gallery** on page 66-67.) On the accompanying DVD, you will also find a feature called "Zoom Cab," which takes viewers on a journey from the macroscale to the nanoscale to view common objects like a leaf and a human hand. You can use this media to help students "see" the nanoworld.



In general, we discovered the challenges facing nanotechnology education are no different than those found in chemistry and microbiology, where the “players”—such as atoms and bacteria—are invisible. In that light, we approached nanotechnology activities with similar educational tactics that did not require high-tech tools. First, we relied on modeling. Modeling is the backbone of scientific research in nanotechnology. It is used as a means to predict the behavior of small-scale objects. Visit the Hockey Sticks (pages 22–25) and Nanosilver (pages 62–65) segment activities to see examples. In other instances, we created activities in which kids could explore nanoscale properties and phenomenon with macroscale objects and macroscale effects. Examples of this approach can be found in Nasturtium Leaves (pages 44–47) and Self-Assembly (pages 48–51).

How to use this guide

This guide contains 12 sets of activities that comprise a minicurriculum on the big ideas of nanoscale science and technology and are also useful for teaching children how to engage in science inquiry. Each set begins with an Icebreaker, a simple activity that introduces a skill that is part of the full inquiry process and sparks interest in the topic at hand. The Icebreaker activities are intentionally short discrepant events that take minutes, not hours.

The second component of each set is a main Investigation, a more rigorous activity that includes a full science inquiry. This activity is often a representation of the inquiry seen on *DragonflyTV Nano*. Allow several hours to complete an Investigation, perhaps even letting it spill across several days.



Nano Ethics

Be sure to visit the “Hey, Wait a Nanosecond” feature in each show. It provides kids’ views on various ethical questions surrounding nanotechnology. These segments could act as jumping off points for deeper discussions on the pros and cons of advancing technologies.

How to use *DragonflyTV Nano* video

If you ask a dozen educators how they use video in their program or classroom, you'll get a dozen different answers! DragonflyTV realizes the importance of providing flexible content for integration into any number of educational environments.

Each story in the *DragonflyTV Nano* video collection models an inquiry investigation. As such, we encourage you to use one video story at a time as a catalyst or motivator to get students enthused about conducting a science investigation. For example, perhaps you have a group of students for a day-long summer camp. Use a corresponding video as a discussion starter at the beginning of the day and then lead your students through the rest of your planned activities. The energy and enthusiasm of the young scientists in the DFTV video will certainly rub off on your students!

DragonflyTV Nano also provides an opportunity to present a "minicurriculum" on nanoscale science and technology. As such, you might consider introducing a new video each week, with related activities, for a six-week course on the big ideas of the nanoworld. This approach will be welcomed by educators who want to present nanotechnology to their students with packaged, ready-to-go content.

Using DragonflyTV in the Classroom

In 2006, DragonflyTV commissioned a report on a four-month study of teachers' use of DragonflyTV videos and educator guides. This classroom evaluation recommends that teachers use videos to introduce new content areas at the beginning of a lesson and also to demonstrate or reinforce concepts at later points in instructional units.

Teachers also offered praise for DragonflyTV's ability to teach and reinforce concepts related to the process of scientific inquiry. Several teachers noted long-lasting effects in how students approached inquiry exercises after viewing DragonflyTV. Furthermore, comments made by both teachers and students in this study suggest that students make connections between science and real life and that they grow more interested in science as a result of viewing DragonflyTV.

On a student survey conducted at the end of the study, 77% of students noted that DragonflyTV helped them with their science fair projects or science projects for class assignments. Teachers cited examples of students' answers on tests and assignments improving as a result of viewing DragonflyTV—explaining that students demonstrated a better grasp on the parts of the scientific process and wrote more complete and clear responses to open-ended questions that asked them to describe results of scientific investigations.

To see the full study, *Using Video in the Science Classroom*, please visit <http://tpt.org/dragonflytv/evaluations/>

