Natural Inquirer Scientist Videos: Designing Your Own Study Lesson Map

Topic:	**Guiding Questions:**	**Grade Level:**
Introduce the process of designing a scientific study; Examine how different scientists apply the scientific process to their own work	What steps do I need to take in planning my own science fair project or scientific study? How do scientists take similar steps in their own scientific inquiry?	Middle and high school

Standards Alignment: Next Generation Science Standards

Materials:

- *Natural Inquirer* scientist video series (4 videos per scientist)
- Scientist Videos Graphic Organizer
- *Optional*: large paper and markers for creating a science fair anchor chart or presenting mini-lessons that can be displayed in the classroom

Time Needed: 2 class periods or approximately 2 hours; additional time needed to complete extensions

Background Information:

This lesson plan is designed to introduce your students to the science fair and scientific inquiry in general. Each scientist has a series of four short videos that explain their scientific process:

- developing a testable question,
- planning to test that question,
- analyzing and understanding the data, and
- explaining it all.

Attached to this lesson map, you'll find a brief overview of each scientist, their area of study, and some key topics from their videos.

This lesson plan is designed to be modular; you can organize the sections to best fit your class. Have students watch all four of the videos and complete the graphic organizer at one time, or divide the videos and graphic organizer into the bullets listed above, completing each section separately.

Scientific Process Anchor Chart: This chart can be displayed on a smartboard, whiteboard, or on large paper in the classroom. Use the bullets above as column headings; as a class, add steps, important advice, things to remember, etc. under each heading. As students share what they've learned from the videos and start thinking about their own scientific studies, use the anchor chart to remind them of important steps/considerations.

Scientist Video Series: The Steps of Scientific Inquiry

Activity Steps	Time
Step 1: Divide students into groups and assign each group one of the scientists (*see Scientist Videos Overview*) • Provide the video links for each scientist's series of four videos. • Explain that each scientist will be describing one of their research studies so that the students can see how scientific inquiry happens in the professional world. These studies and scientists will have similarities and differences from one another. The students' job will be to learn about their assigned scientists' work to report back to the class. • *You may also want to provide a small description for each scientist; these can be taken from the Scientist Videos Overview.*	5 min.

Step 2: Introduce the Scientist Video Graphic Organizer • Distribute the Scientist Videos Graphic Organizer to each student. • Explain that they will be watching the videos and taking notes on the items in their graphic organizer. The organizer is separated into sections that match the videos' titles. Students will answer a few questions about each video; then they will reflect on their own possible scientific study. • **IMPORTANT**: Alert students that their assigned scientist may answer some of the questions in a different video than one they're watching. They may not be able to answer that question until the next video. That's okay! Just fill in the answers as they find them.	2 min.
Step 3: Watch the Videos • Students will watch their videos in their small groups and complete their graphic organizers as they go. Each video is around 4-6 minutes in length. • You may want to build in checkpoints to help maintain focus and pacing. For example, give everyone 8-10 minutes to watch the first video ("Developing a Testable Question"), fill out their graphic organizers, and discuss their answers as a group. This checkpoint could also be a time to report initial thoughts to the class, add to your anchor chart about the scientific process, or note any initial similarities and differences among the different scientists. *If you choose to add in checkpoints, the time for discussion may add to the time estimate given.*	30-45 min.
Step 4: Report to the Class and Add to the Anchor Chart • Once students finish watching the four videos and have filled out their graphic organizers, ask them to share their takeaways with the class (e.g. best advice from their scientist, important information they learned about a particular step in the scientific process, similarities and differences among the scientists, etc.). Add these takeaways to the appropriate column on your anchor chart.	10-15 min.

Scientist Video Extensions
• **Science Mini-Lessons**: Some of the scientists mention important science concepts in their videos: statistical significance, bias, randomization, correlation versus causation, qualitative versus quantitative data, the ethical and practical concerns of using live (human or animal) subjects, etc. Assign each group a topic to research and teach the class. Groups can create posters or presentations to share their mini-lessons with the class. Alternatively, you can provide the mini-lessons yourself throughout your scientific inquiry unit.
• **Science Word Bank**: As students watch the videos, have them keep a running list of words they don't know. After watching the video, students can look up the words and add the words and their definitions to a Science Word Wall in the classroom.
• **Scientist Cards/Posters**: Each of the scientists is represented on a *Natural Inquirer* scientist card. Have students find the card for their scientist on designing your own study page and read through the information. Students can report on their scientist by creating a poster for their scientist. Information can include what their scientist studies, how they got interested in their research, their best advice for students, etc.

Next Steps
Use the graphic organizer's sections about students' own scientific studies to lead students through the steps of creating their own science fair project or scientific study. Refer to the anchor chart and the videos as needed as they work through their projects.

<table>
<tr><th colspan="3">Standards: Next Generation Science Standards – Designing Your Own Study Lesson Map</th></tr>
<tr><th colspan="3">Middle School</th></tr>
<tr><th colspan="2">Science and Engineering Practices</th><th>Disciplinary Core Ideas</th></tr>
<tr><td>Asking Questions and Defining Problems</td><td>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</td><td rowspan="4">ETS1.A-M1: The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.
ETS1.B-M1: A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
ETS1.B-M2: There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
ETS1.B-M3: Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.
ETS1.B-M4: Models of all kinds are important for testing solutions.
ETS1.C-M1: Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.
ETS1.C-M2: The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.</td></tr>
<tr><td>Developing and Using Models</td><td>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</td></tr>
<tr><td>Analyzing and Interpreting Data</td><td>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</td></tr>
<tr><td>Engaging in Argument from Evidence</td><td>Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</td></tr>
<tr><th colspan="2">High School</th><th></th></tr>
<tr><th colspan="2">Science and Engineering Practices</th><th>Disciplinary Core Ideas</th></tr>
<tr><td>Asking Questions and Defining Problems</td><td>Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.</td><td rowspan="3">ETS1.A-H1: Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
ETS1.B-H1: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
ETS1.B-H2: Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
ETS1.C-H1: Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.</td></tr>
<tr><td>Using Mathematics and Computational Thinking</td><td>Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</td></tr>
<tr><td>Constructing Explanations and Designing Solutions</td><td>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.</td></tr>
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Scientist Videos Overview: Catalog of Videos		
Scientist	**Specialty**	**Key Topics**
Keith Aubry	Wildlife biologist	• Studies carnivores whose populations are declining; specifically wolverines • Using anecdotal and documented evidence • How to conduct research on animals; highlighting photo traps
Marla Emery	Geographer	• Studies foraging in both urban and rural landscapes • Gathering quantitative and qualitative data • Bias • Statistical significance • Conducting human subjects research
Rebecca Flitcroft	Fish biologist	• Studies salmon and their habitats • Importance of using maps and graphs • Practical impacts of research • Control and variables
Scott Horn	Entomologist	• Studies effects of non-native plants (Chinese privet) on native pollinators • Observations that lead to research questions • Collecting insects for study • Using bar graphs
Rima Lucardi	Ecologist	• Studies invasive plants and what makes a weed a weed by examining the plant's genetics • Anecdotal data versus quantitative data • Statistical significance
Ariel Lugo	Ecologist	• Studies how tropical forests have changed as the result of human impacts • Comparative analysis and researching long-term changes • Control and variables • Scientific debate
Richard MacKenzie	Aquatic ecologist	• Studies stream ecology (how climate and invasive species affect native organisms) in the Pacific islands • Practical impacts of research • Filling knowledge gaps • Using infographics or "cartoons" to present data
Lindsey Rustad	Forest ecologist	• Studies the impacts of extreme events (like ice storms) on forests • Importance of pilot studies • Control and variables • Statistical significance • Using creative methods to communicate your results
Sam Zelinka	Materials research engineer	• Studies how water interacts with wood in order to help wood last forever • Importance of pilot studies • How to gather data on something too small or too large to see • Using infographics or "cartoons" to present data