Title of Lesson: Mystery Tube Activity Middle School Science **Grades6,7,8**

Big Idea: **The Nature of Science**

RED * Indicates Optional Extensions in the Unit of Instruction

Benchmarks:

SC.8.N.1.6	**Understand that scientific investigations involve the collection of evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations, and models to make sense of the collected evidence.**
SC.8.N.1.3	**Use of phrases such as "results support" or "fail to support" in science, understanding that science does not offer conclusive proof of knowledge claim.**
SC.7.N.1.3	**Distinguish between an experiment and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation.**
SC.7.N.1.7	**Explain that scientific knowledge is the result of a great deal of debate and confirmation within the scientific community.**
SC.6.N.1.4	**Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.**
SC.6.N.1.5	**Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.**
SC.8.N.2.1	**Distinguish between scientific and pseudoscientific ideas.**
SC.7.N.2.1	**Identify an instance from history in which scientific knowledge has changed when new evidence or new interpretations are encountered.**
SC.6.N.2.1	**Distinguish science from other activities involving thought.**
SC.6.N.2.2	**Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.**
SC.6.N.3.4*	**Identify the role of models in the context of the science benchmarks.***
SC.7.N.3.2*	**Identify the benefits and limitations of the use of scientific models. ***
CCR.RST.6-8.1	**Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.**
CCR.RST.6-8.10	**Read and comprehend complex literary and informational texts independently and proficiently.**
CCR.RST.6-8.7	**Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.**
CCR.WHST.6-8.2	**Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.**
CCR.WHST.6-8.4	**Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.**
CCR.WHST.6-8.9	**Draw evidence from literary or informational texts to support analysis, reflection, and research.**

Students should be able to:

Understand	Know	Do
Scientific process and creativity play a role in scientific thinking. Scientists often develop theories or models to explain things they cannot see with their own eyes. Also, they often change their models to revise their theories based on new experimental evidence.	...how scientists employ imagination and creativity in developing hypotheses, designing experiments and drawing conclusions	Explain the scientific thinking they experienced as they drew a conclusion about the construction of the Mystery Tube.

Advanced Prep /Time 10 minutes/	Materials ?? Poster (or other visual) of the Einstein quote ?? 1or more Mystery Tube(s) ?? "Steps to Inquiry Student Worksheet" 1 per student ?? Copies of the article "How Creativity Powers Science" 1 per student ?? Optional Materials to create Models of the Mystery Tube ?? Poster Paper 1 piece per group ?? Markers 1 set per group Also consider creating posters of the Nature of Science Benchmarks to be referred to throughout the year

Engage (hook, demonstration, free write, brain-storming, analyze a graphic organizer, KWL, etc)	ENGAGE Part 1: Einstein Quote: Einstein once remarked that "…***imagination is more important than knowledge for that is where novelty arises"***. He claimed that his ideas regarding relativity emerged from his imagining what riding on a beam of light would be like. Ask students to consider what that means to them. (Think, Pair, Share) ENGAGE Part 2: Teacher demonstrates pulling the strings. Students create a drawing of their initial thoughts on the construction of (the inside of) the tube based on their observation of how the tube behaves (in Box 1 on the worksheet).
Explore (investigation, solve a problem, collect data, construct model, etc.)	Mystery Tube Guided Inquiry **Activity**: Teacher allows students to examine the Mystery Tube much more closely. **Diagram** of student "modified" idea of what the inside of the tube looks like (in Box 2 on the worksheet) Teacher asks students to consider if, how, and why their initial and modified diagram changed.

Explain (student analysis, structured question-ing, reading and discussion, teacher explanation, compare, classify)	**EXPLAIN Part 1: Discourse**: students will **share** their observations and diagrams and **verbally explain their reasoning** (citing their observations as the evidence for their explanation). **EXPLAIN Part 2: Teacher guided class discussion** Guiding Questions following the Discourse (class discussion): ?? You were not allowed to open your Mystery Tube and do not know for sure what is inside. How is this like a scientist who is investigating the natural world? How is it different? ?? In what ways did other classmates affect the way you investigated your Mystery Tube and the conclusions you reached? What does this imply about the value of collaboration when doing science? ?? Considering that many of you approached the problem (of hypothesizing how the tube is constructed) in different ways, what might we conclude about the existence of one scientific method? ?? How might technology have helped your investigation? ?? Some of you claimed that sound helped you determine how the inside of the tube is constructed. How was sound useful? How might your conclusions have been different had you never heard sound before? What does that imply about how prior knowledge and experience impacts your investigation and data analysis? ?? In what way did you have to make meaning of the data you collected? How is this different than data telling you what to think? ?? How did you use different pieces of evidence to support your conclusions? ?? How might your ideas change if you had more time or made new observations? ?? Several of you asked to make your own model of the mystery tube. How do scientists use this as a strategy when investigating the natural world? Classroom conversation should include the following: ?? To us, what is inside of the tube is not as important as how it behaves. Since we cannot see inside, our conclusions are based on how the tube responds to our manipulations. This could lead to a discussion of observations vs inferences ?? As new evidence is presented (through additional trials or hearing the explanations of others) a student's initial idea of how the tube is constructed could change. This could lead to discussion of an instance from history in which scientific knowledge has changed when new evidence or new interpretations are encountered. ?? Use of phrases such as "results support" or "fail to support" in the explanation of how the Mystery Tube must be constructed based on how it behaves. This should lead to a discussion of the understanding that science does not offer conclusive proof of knowledge claim. ?? If students are probed to present ideas that are fictional (ie: gremlins or fairies inside the Mystery tube) a discussion of the difference between scientific and pseudoscientific ideas could result. **EXPLAIN Part 3: How is the tube related to Einstein's quote?** Students will record their thoughts about how the tube is related to Einstein's quote on their Inquiry Worksheet.

Elaborate/Extend (problem solving, decision making, experimental inquiry, compare, classify, apply)	**OPTIONAL:** Consider allowing students to create a model of Mystery Tube to show their idea of how it is constructed. This may help them to better understand how the mystery tube behaves which may cause them to change their idea of what is inside of the mystery tube. **Begin the LDC Module** **Read** the article: ?? Teacher reads the first section aloud (to re-Engage and model the expectations for students). ?? Model Text Marking: While reading aloud, the teacher reads the section in its entirety. If a statement in the article stands out in support of the prompt, the teacher marks the paragraph with an asterisk. ?? The teacher reads the passage aloud a second time bringing students' attention to the points that were marked and narrows them down to the 2 pieces of evidence from the section that supports how creative thought and/or scientific thinking powers science. (For example: "*On page 1, in paragraph 4, Creativity is a new idea that has value in solving a problem…*" ("because this shows that the new idea has value in solving a problem or answering a question"). **Jig-Saw** Activity (Active Reading): ?? Teacher will assign student groups a section of the text. Students will read their section, identify (mark with an asterisk) evidence that aligns with the prompt; which means that they are marking pieces of evidence from the section that supports how creative thought and/or scientific thinking powers science. ?? Student groups will create a poster identifying the two most powerful pieces of evidence from their section which supports the prompt. Student groups will share their findings with the entire class. ?? While each group presents, individual students will mark the evidence on their text as the evidence is being presented. **Revisit**/Re-read All (Active Reading): ?? To be sure students get "the big picture" of the article, they should read the article in its entirety and mark quotes that they feel <u>best</u> support how creative thought and/or scientific thinking powers science. **Complete** the Reader's Response Journal on the "Steps to Inquiry Student Worksheet". Students revisit the text to identify 3 pieces of evidence they think most supports how creative thought and/or scientific thinking powers science while making connections to the Mystery Tube activity. **Set students up for writing**: (see LDC module) Bridge to Writing Task. The students complete an entrance slip: ?? Using your diagram of the mystery tube and the information in the article, explain how your conclusion of the construction of the mystery tube combined with evidence from the article model the practices of science.

Evaluate (any of above, devel-op a scoring tool or Rubric, performance assessment, produce a product, journal entry, portfolio, etc.)	**Continue the LDC Module** Students **complete** their "Published" **diagram**. Teacher asks students to consider if, how and why their hypothesis changed after the class discussion and creation of their own model (if done). The students **write an article** to show how they acted like a scientist to creatively explain the mystery tube. An evaluation rubric is located within the attached LDC module. What conclusions and implications can be drawn? Since students were able to write the article and state how they acted like a scientist when they made conclusions about the construction of the Mystery Tube, they should imply that creativity is a key component in the scientific processes. Students should be reminded that they will have to rely on all of the scientific processes/habits of mind as they are making sense of science concepts throughout the school year and their lifetime.

References

Text Reference(s):	"How Creativity Powers Science", Cutaro, Jennifer. Science News fo Kids, May 24, 2012. http://www.sciencenewsforkids.org/2012/05/how-creativity-powers-science/
Electronic References (web sites, Gizmo, other, paste hyper-links or URLs here)	The **Mystery Tube** - YouTube www.you**tube**.com/watch?v=LHTpYhAGW0U http://undsci.berkeley.edu/lessons/mystery_tubes.html
Electronic Attachments	See the "Nature of Science" icon on your electronic curriculum guide (Resources page) ?? LDC module ?? Power points ?? Student worksheet (Steps to Inquiry)