SUNSETS, SOULS AND SENSES

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Overview:

Explores the realm and limits of science. Engages students to give examples of topics that can be studied by science, and those that cannot. This also takes a look at descriptive terms that reflect the true nature of modern science, and those that do not, especially those that do not fit the popular perceptions of science.

Lesson Concepts:

- Science is limited to the study of the natural world.
- Science is limited to natural explanations.
- The natural world refers to that which is perceived directly or indirectly by our senses.

Grade Span: 5-12

Materials:

- Two or three slides or overhead transparencies, e.g. (see "**Other Resources**" below):
  Willy 'n Ethel cartoon with garage mechanics around a steaming car.
  World News headline: "Human Soul Weighs…"
  World cartoon with 2 island natives talking about an erupting volcano…
- Handout sheet with two **check-lists**:
  Group A: What Science Can/Cannot Study…
  Group B: Senses We Can Use to Study…
- Two pages for cut-outs (see **Extension**): "**Science IS…, Science is NOT**"; pair of pages for each team, to be cut up, shuffled and inserted in to envelope (one per team).
- Handout Summary Sheet for Science **IS – is NOT**
- **KEY** for "Science IS…, Science is NOT…"

Advance Preparation:

Prepare slides for showing to class.
Run off copies of student handouts
Make enough copies of the Science IS…, Science is NOT… for every team (plus extras, if needed)
Cut labels apart from both pages, and place in single envelope (one envelope per team) – or ask lab assistant or other willing students from another class to help with this.

Time: One half to full period class period (20-50 minutes)

Grouping: 2-4 students per team

Teacher Background:

Before using any of these **Nature of Science** lessons, be sure to read the **Teaching the Nature of Science**, with a Rationale, Approach, and tips for Presenting the lessons for maximum effect and effectively dispelling some of the popular myths about science.

Other useful NOS resources can be found in our Index to Useful Overviews of the ENSI NOS Lessons.

Teaching Tips:

1. If possible, a day or so before doing this lesson, give your students a short Science Knowledge Survey on the nature of science, to assess their understanding of the realm of science (and designed to reveal common misconceptions).
2. Then (same or following day), introduce "Sunsets, Souls, and Senses"
3. Probably best to use this early in your "Nature of Science" unit, in the first week of school, to set the tone and background for all that is to follow: the science content for this course.
4. Students can work alone, in pairs, or small teams (3-4), as you prefer. Small teams would probably be best.
5. Seriously consider also doing the "**Science IS... Science is NOT**" extension described under **Extensions and Variations** (below). This requires a bit more preparation (as described there, but is very helpful in pointing out common misconceptions about the nature of science. This is probably best done after the Sunsets, Souls and Senses part.

Vocabulary: science, proof, natural, supernatural, testable, belief, observable, authority, predictions, truth, biased, certainty, understanding, facts, objective, fair, uncertainty, absolute, experiment, democratic, repeatable, observable evidence, debatable, measurable, final, change, opinion, perception, inference

Procedure:

1. Show the **Willy 'n Ethel cartoon** (or its equivalent), or display it on the overhead projector, and allow time for students to read and think about it.
2. Ask "What do you think the cartoonist was trying to communicate?"
   STUDENTS: (possible responses:
3. Ask "What do you personally think is the cause of the car's problem?"
   STUDENTS: (possible responses:
4. Teacher: "Let's take a vote as to what is causing the problem."
   STUDENTS: respond by raising hands to be counted and tallied for each of the alternative causes.
5. Teacher: "Why did you choose your answer?"
   STUDENTS: volunteer their reasons for responding as they did.
6. Teacher: "Why wouldn't a mechanic think it is a demon?"
   STUDENTS: volunteer their reasons
7. Teacher realizes that there are other questions possible, but keys in on the last question. "A mechanic can only correct a mechanical flaw. She has no way of seeing a demon, let alone fixing or getting rid of one. To the owner, the demon may be causing the intake flow problem, but that is of no concern to the mechanic. She does not know if demons exist because they are not measurable. She can only deal with material, measurable things --- the engine. This is a natural cause which explains the naturally occurring event."
   STUDENTS: listen to this focal statement:
8. Teacher: "Science has limits, it can only deal with that which is natural... that is, can be either directly of indirectly (using instruments) perceived through the senses. Items that cannot be currently perceived by the senses cannot currently be dealt with by science. This does NOT exclude observations of EVIDENCE of unseen events. Much of science involves INFERENCES based on observed circumstantial evidence, especially if these come from multiple independent fields of study (such as the reconstruction of extinct ecosystems and creatures from fossils collected and the associated geology)."
   STUDENTS: listen to this focal statement:

9. Teacher: "The history of science has been concerned with pushing back the boundaries of the imperceptible, INVENTING NEW INSTRUMENTS allowing the scientist's brains to be able to perceive something that was here-to-fore not measurable. Viruses, onetime thought to be evil spirits now are thought to be protein-wrapped genetic material."
   STUDENTS: listen to this focal statement:
10. Teacher: hand out the **Check Lists** sheet, and have students in teams follow directions for **Group A** only: "Topics Science Can/Cannot Study"
   STUDENTS: accept sheet and complete assignment (Group A only)
11. Teacher: leads class in sharing what items were checked in the **Can** column and what were checked in the **Cannot** column, asking for reasons...
   STUDENTS: respond and justify their answers, contribute to discussion.
12. Teacher: show overhead of "**Human Soul Weighs...**" headline. Ask students: "Is this real science?" Discuss.
   STUDENTS: respond, and discuss. [For article by Massimo Pigliucci that critically discusses the earlier claim - "Study says that the soul weighs 21 grams," go to Rationally Speaking. The "discredited study" linked to from this article is also an excellent example of "Poor Science" that students could analyze.]
13. Teacher: Have students do Group B: "Senses Which Can be Used... " for each item.
   STUDENTS: Students complete the assignment.
14. Teacher: Leads discussion of Group B. Wraps up with closing/summarizing comments.

Assessment:

1. Given a list of topics, students will be able to determine which are suitable subjects for scientific exploration, and which are not.
2. Given a list of descriptive traits, students will be able to say which are characteristic of modern science, and which are not.
3. Prepare quiz in which students are asked to match selection of terms (e.g. those found in the check lists) with "Science Can Study" or "Science Cannot Study"
4. Prepare a second part to the quiz in which students are to match selected terms with whether or not senses can be used to study them.
5. Add questions designed to measure understanding of REASONS why various selected topics can or cannot be studied.
6. How many angels can dance on the head of a pin? Explain.
7. Why can't mechanics fix cars possessed by demons? Explain.

Extensions:

1. Science IS, Science is NOT Cutouts: A useful companion activity to use with the "Sunsets..." lesson (either before or after the lesson).
   PREPARATION:
   First, print out enough copies of the two pages (Click on "Science IS..." above) so that those two pages will go to each team (teams of 3-4 in your largest class) plus a few extras..
   Then, with help of family, friends, or students not in the class where they will be used, cut apart each of the terms or phrases on those two pages. Shuffle them thoroughly, and insert those strips (from those two pages) into an envelope. Give each envelope a number, like "TEAM 1", TEAM 2", etc.
   DAY OF LAB:
   Set up teams of 3-4 students. Give an envelope to each team.
   Ask all teams to remove all the strips and find the two header strips with ""SCIENCE **IS**..." and "SCIENCE IS **NOT**..." and **return all remaining strips into envelope**. Students use the header strips to head two columns they will develop on their desktop.

Then, each person in turn removes a term or phrase (each on strip of paper) from its team envelope, and places it under the appropriate heading, according to team consensus.
When completed, the teacher will solicit a sampling of results to share with entire class, using overhead or chalk board, discussing any differences until class recognizes reasons why each term goes where it does. There is a 2.5 page Key to help you in this discussion of WHY certain terms are more appropriate to one group than to the other, especially since some are not common or intuitive associations. This is a great resource to help students to recognize their misconceptions.
SUMMARY PAGE:
After the two columns are completed and discussed, hand out the Science IS - Science is NOT Summary Worksheet to each student. Then have students record (in pencil) their decisions on that sheet by placing X in the appropriate box - left or right - for each item. [This was created by middle school teacher Christine Evans]. After discussion (and possible changes), students can keep this summary for review.

2. Another approach you might like to try, after your nature of science "survey" quiz, and then pointing out how many in the class are apparently misinformed (with actual statistics from the "survey" item analysis, if you can), is to simply display a list of "What Science is NOT" on the overhead (exposing one at a time, as you briefly explain it). Then go to a description of What Science IS. The Science Knowledge Survey quiz can be used for a post-unit test (and even again at the end of the year, to check long-term understanding and the effect of reinforcement during the course).

Other Resources:

1. CARTOONS AND HEADLINES:
   Click here to get the Willy 'n Ethel cartoon (permission to use kindly granted to us by cartoonist Joe Martin, 2/27/01).
2. In the second cartoon, two island natives are looking at an erupting volcano on a nearby island, and one says to the other: "It's one of two things, ... either the great god of the inner earth, Timbuktu, is angry with our last virgin sacrifice, or the enormous pressure of a formation of molten rock is breaking through a weak spot in the earth's crust." (*World*, 8-1-72)
3. Headline in *Weekly World News*, Nov. 1, 1988: "HUMAN SOUL WEIGHS 1/3,000TH OF AN OUNCE", "Terminal patients were weighed before and after they died! 'This proves there IS life after death,' say top scientists" [Also, see the article by Massimo Pigliucci that critically discusses the earlier claim - "Study says that the soul weighs 21 grams," go to Rationally Speaking. The "discredited study" linked to from this article is also an excellent example of "Poor Science" that students could analyze.]
4. Until and unless we get copyright permission to make these items available to you directly on this site, you have three options:
   1. We could send **scanned copies** to you, as email attachments if you'll contact us (click on "Talk to us" and request these, specifying which items you want);
   2. Find your own cartoons and headlines which will stimulate dialogue concerning the distinction of what science is and is not, what it does and does not do... A useful online resource for catchy headlines would be The Weekly World News <http://www.weeklyworldnews.com/>. Click on its "Stories Archives" and do a search.
5. Draw (or have a creative student draw) your own cartoons. For example, in place of the "volcano" cartoon, you could have two citizens of ancient Greece (in togas) looking at a lightning storm, paraphrasing what the two islanders were saying, or have two native Americans looking out over a city devastated by a major earthquake (or tornado), then paraphrase the islanders' statement. **If you do this, and wouldn't mind sharing your cartoon with your colleagues via this site, please send it (or them) to us!**

6. Other Resources:
    Portions of the movie: "The Gods Must Be Crazy."
    Portions of the movie: "Christine" (the demonic car).

Acknowledgements:

1. Original Source: "Willie 'n Ethel" lesson prepared by 1989 ENSI group:
    Jane and Nick Digiovanni, John Monsma, and Doug Rosendahl.
    Permission to use Willy 'n Ethel cartoon kindly granted by cartoonist Joe Martin (2/27/01)
2. Modified by: Jeff Gale (and Ginny Lambert?), 1990 ENSI
3. Reviewed / Edited by: Martin Nickels, Craig Nelson, Jean Beard 12/15/97
4. Science IS… Science is NOT Summary Sheet created by teacher Christine Evans (2012)
5. Edited / Revised for website by L. Flammer 2/25/01, 8/6/01

RESOURCES:

General NOS Background: **Teaching the Nature of Science** using ENSI NOS lessons for maximum effect:
    http://www.indiana.edu/~ensiweb/lessons/NoS.Gen.Disc.html

Science Knowledge Survey quiz (with key): http://www.indiana.edu/~ensiweb/lessons/sci.tst.html

Willy 'N Ethel cartoon: http://www.indiana.edu/~ensiweb/images/suns.wil.jpeg
    Permission to use this kindly granted to us by cartoonist Joe Martin, 2/27/01

Sunsets, Souls and Senses Checklist Sheet: http://www.indiana.edu/~ensiweb/lessons/sunsets.pdf

Rationally Speaking: Does the soul weigh 21 grams?
    http://rationallyspeaking.blogspot.com/2007/03/does-soul-weigh-21-grams.html

Discredited Study on Weight of Soul: http://www.snopes.com/religion/soulweight.asp

Science IS… Science is NOT Cutout Sheets (2) http://www.indiana.edu/~ensiweb/lessons/sci.is.o.pdf

KEY to Science IS… Science is NOT Cutouts (2 ½ pages) with explanations
    http://www.indiana.edu/~ensiweb/lessons/sun.key.pdf

Science IS… Science is NOT Summary Sheet with KEY (2 pages)**:**
    http://www.indiana.edu/~ensiweb/Sci%20IS%20-%20is%20NOT%20SummaryWS.pdf

What Science is NOT (for overhead): http://www.indiana.edu/~ensiweb/lessons/unt.not.html

What Science IS (for overhead): http://www.indiana.edu/~ensiweb/lessons/unt.s.is.html

Weekly World News (for outrageous headlines): http://weeklyworldnews.com/