

Earth, the Universe, and Culture

Lesson Procedures

Part 1: Begin by asking the class to tell you what they know about how scientists do their work. Get students thinking about the processes of scientific inquiry and the nature of science by asking them questions. Some examples are listed below:

- What is science?
- How would you describe a scientist?
- What is an experiment?
- Show the class an image of Albert Einstein. Ask the students if they think he is a scientist. Then show the students images of Carolyn Shoemaker and Abd AlRahman Al Sufi. Ask the students if they believe they are scientists as well. Ask the students what they hold as stereotypes of what a scientist should look like.
- Ask the students whether or not they think science is global and whether the entire world contributes to scientific knowledge.

Show Video 1: Universe Origins [Time – 3:28]. Ask students to focus on how our ideas about science differ between our cultures, but also change over time. Have students note what the documentary has to say about what types of individuals scientists are.

Part 2: At this time, ask the students to name some important discoveries in science. List them on the board. Ask the students if they know the names of the scientists associated with these discoveries. Also, ask the students if they know the country of origin of these scientists. If they do know the country, mark the country on the map with a colored pin. Discuss with the students how humans have been studying astronomy for a very long time. Explain, as an example, that the ancient Mayans studied and documented celestial phenomena as early as 300 to 900 AD. Information on how different cultures around the world were involved in important scientific discoveries can be found on the following website.

- <http://ebeltz.net/niftylinks/sci-culture.html>

Other websites that provide examples of how culture and science are rooted together in history are listed below.

- <http://sunearthday.nasa.gov/2005/multimedia/timeline.htm>
- <http://physics.nist.gov/GenInt/Time/time.html>

After looking at some of the examples from the websites above, start a discussion with the students about if they believe science is a collaborative effort between all of the different cultures and countries of the world.

Part 3: Distribute Student Handout. Students will gather information about scientists from the year 300 BC to the present and enter the information onto Explore the Famous Scientists (Student Handout). You can assign this as individual work or divide the work among student groups. Your students should be able to locate the required information easily from the World Wide Web or library reference materials. A set of hyperlinks is provided in the Instructional Materials in case any student (or group) needs assistance.

The next step is to have the students place the scientists on the world map according to the scientist's country of origin. Have the students mark the countries on the map with colored pins. You may wish to use different colors to represent contemporary scientists from pre-1900 scientists or to distinguish between male and female scientists.

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Assessment Strategies

- Discuss with the students how science is rooted in different cultures throughout many periods in history. Have students review the information on Explore the Famous Scientists (Student Handout) and ask them to count how many:
 - scientists had the same country of origin,
 - different countries are represented,
 - centuries (in which they lived) are represented,
 - of each gender represented in the list.
- Ask the students if they see a pattern where scientific discoveries come from and why it is important to have many views from many cultures on scientific theories.
- Ask the students why all women on the list are present after the 19th century and not before
- Ask the students why there is a heavier concentration of scientists from some regions of the world and fewer from others.

Note: This is a sampling of scientists. Patterns may be unintentionally skewed by authors.

Note: The video segments states that the heliocentric is more correct than the geocentric model instead of stating that we now know that the heliocentric model is the correct model.

Extension: Optional Homework Assignment

During the activity, students may have found a scientist that interests them. Encourage them to select a scientist, either from the list or someone more recent, and ask them to complete a report on the scientist. Biographical information and major contributions to science should be the focus of the reports.

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Answers: Explore the Famous Scientists

These are provided as examples only. Students do not have to find each major accomplishment listed. Some interesting facts may also be uncovered by students.

Scientist	Born	Country	Facts and Major Accomplishments
Aristotle	384 BC	Greece	<ul style="list-style-type: none"> Said the universe had no beginning, will have no end Philosopher Studied Earth Science
Pythagoras	530 BC	Greece	<ul style="list-style-type: none"> Developed geometry techniques Pythagorean proposition (theorem) Discovered numerical intervals (used on musical scale)
Nicolas Copernicus	1473	Poland	<ul style="list-style-type: none"> Heliocentric model Founder of Modern Astronomy Wrote "De Revolutionibus"
Galileo Galilei	1564	Italy	<ul style="list-style-type: none"> Used refracting telescope for astronomy Supported heliocentric theory Developed calculus
Sir Isaac Newton	1642	England	<ul style="list-style-type: none"> Law of Gravity Law of Motion Developed calculus
Ptolemy	85	Greece and Egypt	<ul style="list-style-type: none"> Greek astronomer; lived in Egypt Developed the "geocentric model" Was a highly skilled mathematician
Subrahmanyan Chandrasekhar	1910	India/ United States	<ul style="list-style-type: none"> Studied neutron stars Won Nobel Prize in Physics (1983) Advanced our understanding of black holes and supernova
Vera Rubin	1928	United States	<ul style="list-style-type: none"> Studied galaxy rotation rates Found evidence for "dark matter" Discovered the "flat rotation curve" of galaxies

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Scientist	Born	Country	Facts and Major Accomplishments
Edwin Hubble	1889	United States	<ul style="list-style-type: none"> • Showed that the universe is expanding (Hubble's Law) • Father of observational cosmology • Classification system for galaxies
Johannes Kepler	1571	Germany	<ul style="list-style-type: none"> • Discovered laws of planetary motion • Discovered the New Star of 1604 (Kepler's Supernova) • Developed telescope with 2 convex lenses
Abd al-Rahman al-Sufi	903	Persia (Iran)	<ul style="list-style-type: none"> • Corrected Ptolemy's list of stars • Made many observations on stars/ star clusters • Wrote "Book of Fixed Stars" (964)
Caroline Herschel	1750	Germany	<ul style="list-style-type: none"> • Discovered celestial objects including a nebulae and 8 comets • First woman recognized as a scientist in England • Given Gold Medal of Service in Prussia
Carolyn Shoemaker	1929	United States	<ul style="list-style-type: none"> • Holds record for comet discoveries • Found 800 asteroids, 32 comets • Co-discovered Shoemaker-Levy 9 comets
Jocelyn Bell Burnell	1943	Ireland	<ul style="list-style-type: none"> • Studied radio waves that came from stars • Constructed a radio telescope • Co-discovered the first pulsar (1967)
Robert Goddard	1882	United States	<ul style="list-style-type: none"> • Developed rocket fuel • Attempted to send rockets out of the atmosphere • Discoveries led to eventual space program
Albert Einstein	1879	Germany	<ul style="list-style-type: none"> • General Theory of Relativity • Warned about nuclear bombs • Won Nobel Prize, 1921
Benjamin Banneker	1731	United States	<ul style="list-style-type: none"> • Self-taught astronomer and mathematician • Correctly predicted solar/lunar eclipses