Topic 21: The Universe

Source: No chapters in Hewitt's *Conceptual Physics* textbook or Hsu's *Physics: A First Course* cover the universe. However, both Hewitt and Hsu include the universe in their physical science books. Some high school textbooks and obviously astronomy books present studies of the Universe and will need to be referenced. Videos and websites will be a great source for this subject.

Types of Materials: To explore the six topics listed in Topic 21, other textbooks, videos and websites will need to be used.

Building on: This inclusive topic will need the background from most all of the topics studied in Topics 1-20. Some examples would be kinematics, dynamics, energy, optics, electromagnetic waves, heat and thermodynamics, and so on.

Leading to: If humans understand the physical universe, the only thing left is religion, which is a topic for another day. Obviously we are not at the total understanding point by far; for example, dark matter and dark energy account for about 70 percent of the universe, yet we know nothing about. It is theorized that dark matter becomes less dense between measurable matter as the universe rapidly expands. Dark energy appears to give a repulsive force greater than gravity to cause this rapid expansion of the universe. As scientists and astronomers narrow in on this complex issue, we will get a clearer picture of this universe and how it works. Many questions remain unanswered like star production and reasons for the expanding universe.

Links to Physics: What the universe contains and how it works, in my mind, is physics. One example is solar flares from the sun. In September of 2005, large solar flares occurred and were directed toward earth. Large enough flares can penetrate through the magnetic field of the earth and cause changes in our weather patterns, even ocean currents. Another example is the Big Bang Theory and how matter is formed. Dark matter and dark energy are being studied with great interest but with little results. Since DM and DE constitute so much of the universe, we need to find some answers. Radio telescopes provide a unique, high-resolution perspective of the changing, million-degree solar atmosphere, powerful explosions on the sun, and violent activity that characterizes much of the universe. Interferometric radio telescopes have an angular resolution that is better than that obtainable with ground-based optical telescopes. The development of artificial satellites and other spacecraft allowed scientists to study the sun above the earth's atmosphere, permitting a full and continuous view of the sun's ultraviolet and X-ray radiation, and direct sampling of energetic

particles and magnetic fields flowing from it. Satellites are now monitoring key areas in the earth's magnetosphere and the solar winds to understand the entire sun-earth connection.
http://ase.tufts.edu/cosmos/view

Links to Chemistry and Biology:

When it comes to studying the cosmos, an introductory approach is the way of the future. When a scientist wants to know the molecular make-up of some distant body, the telescope working with computer modeling allows scientists to forms answers. The National Science Foundation is exploring fields called biocomplexity, informational technology, nanotechnology, and genomics to understand the complex interactions in biological systems, including human systems and their interaction with their physical environment. Early observation of the sun, using optical telescopes at visible wavelengths, allowed scientific study of the sun to begin, showing that our star is a dynamic changing body. The development of optical spectroscopy permitted investigation of magnetic fields, atmospheric motions, and composition of the sun, as well as a new understanding of the internal structure of the atom and the chemistry of the cosmos. http://www.johnkharms.com/cosmic The National Research Council reported that there are "deep connections between quarks and the cosmos." This challenge connects physics and astronomy requiring both accelerators and telescopes.

Materials (Labs/Activities):

Hewitt*
Hsu*
My Labs/Activities*

Worksheet – The Atom

Demonstration*

Websites and Videos

1. Powers of Ten Sim – in reference book
2. *Black Holes: The Ultimate Abyss* Video Guide – in reference book
3. Videos
   (a) Nova: The Elegant Universe: PBS (3 hours in five- to 10-minute segments, 24 topics)
   (b) The Mechanical Universe and Beyond
   (c) Stephen Hawking's Universe 03

Good Stories

1. Carl Sagan*
2. Edwin Hubble (1989-1953)

Edwin Hubble (1989-1953)

Edwin Hubble helped to change our perception of the universe in two very important ways. In an era when the Milky Way was perceived as the extent of the entire universe, Hubble confirmed the existence of other galaxies through his observations at the Mount Wilson Observatory in Pasadena, California. Furthermore, Hubble showed that this newly discovered universe was expanding and developed a mathematical concept to quantify this expansion now known as Hubble's law.

In 1917 Albert Einstein had found that his newly discovered General Theory of Relativity indicated that the universe must be either expanding or contracting. Unable to believe what his own equations were telling him, Einstein introduced a cosmological constant (a fudge factor) to avoid this "problem." When Einstein heard of Hubble's discovery, he said that changing his equations was "the biggest blunder of my life."

Hubble spent much of the later part of his career attempting to have astronomy considered an area of physics, instead of being its own science. He did this so that the Nobel Prize Committee could recognize astronomers for their contributions. Unfortunately, Hubble did not live long enough to see his dream realized. Edwin Hubble died in 1953, just months before the committee recognized astronomy. He died of cerebral thrombosis. His wife did not have a funeral for him and never revealed what was done with his body. Apparently, it was Hubble's wish to have no funeral service and to be buried in an unmarked grave. As of 2006, the whereabouts of his remains are unknown.