Physical Science Student Learning Outcomes Assessment Questions

1) True or False: A speck containing a thousand atoms would be clearly visible to the naked eye.

2) True or False: All atoms and molecules have mass, even those in air.

3) Which of the following statements best describes light?
   a. Light is a form of energy.
   b. Light is a form of matter.
   c. Light is not part of the physical world.
   d. Light is composed of molecules.

4) True or False: Elements/Atoms are the building blocks of all normal matter.

6) True or False: Chemical reactions such as burning destroy matter.

7) True or False: By carefully positioning fixed magnets along a circular track, one could arrange for a car to continually accelerate.

8) True or False: The distance between earth and distant galaxies is essentially fixed.

9) True or False: Lasers work by focusing sound waves.

10) True or False: All radioactivity is man-made.

11) True or False: The center of the earth is very hot.

12) True or False: Electrons are smaller than atoms.

13) True or False: According to most astronomers, the universe began with a big explosion.

14) Circle the correct answer: Does the Earth go around the Sun or does the Sun go around the Earth?

15) True or False: Science makes generalizations from a limited number of observations.

16) True or False: An important aspect of scientific knowledge is its falsifiability (certain outcomes to experiments could prove it wrong).

17) True or False: The scientific method does not require experimental results to support a theory.
18) True or False: A hypothesis is an initial attempt to explain observations systematically.

19) True or False: An experiment that does not produce the predicted results is flawed and the results always should be discarded.

20) Which of the following statements best describes a scientific theory?

   a. A theory is a highly tentative form of scientific knowledge and has little evidence to support it.
   b. A theory is one of the highest forms of scientific knowledge and an established theory has a great deal of evidence to support it.
   c. A theory is an initial guess that a scientist makes in order to understand a particular phenomenon.
   d. Science is concerned only with facts, and theories have no place in science.

21) Which of the following statements most closely characterizes scientific work?

   a. Science is deductive (it proceeds in a logical manner from initial statements or facts to final conclusions).
   b. Science can address all kinds of questions (including questions concerning ultimate meaning, beauty, and morality).
   c. Science relies primarily on the intuition of scientists.
   d. Science is empirical (it relies on observation and experiment to support ideas).

22) Which of the following best describes a scientific law (such as the law of conservation of matter)?

   e. Scientific laws represent absolute truth and once established have no exceptions.
   f. Scientific laws are generalizations made from observations and have great predictive power.
   g. Scientific laws are models for physical reality.

23) True or False: Many scientific theories clash with the fundamental tenets of the Christian Faith.

24) True or False: The Bible is intended to be a scientifically accurate text.

25) True or False: One view of the relationship between faith and science articulated by leading scientists is that they can co-exist peacefully since they describe completely different realms (spiritual vs. physical).

26) True or False: From the beginning of science, scientists were at odds with the church.
27) In two or three sentences, describe your view of the relationship between faith and science.

Consider the following graph, which shows the levels of carbon dioxide (an important greenhouse gas) in our atmosphere.

28) Which of the following statements best describes the increase in atmospheric carbon dioxide between 1750 and the present?

a) The amount of carbon dioxide has doubled.
b) The amount of carbon dioxide has increased by a factor of five.
c) The amount of carbon dioxide has increased by 5%.
d) The amount of carbon dioxide has increased by 35%.
The (Energy) Future Is Not Now
By ANDREW C. REVKIN

The FutureGen Alliance — a partnership of coal producers and users and government — yesterday announced the Illinois site of what would be America’s first utility-scale zero-emissions coal-powered electrical plant. The plant will also, in theory, produce a stream of pure hydrogen fuel and a stream of carbon dioxide in a form ready to pump into the earth for long-term storage so it doesn’t heat the climate.

But choosing the location was perhaps the least daunting step. The project, announced by President Bush in 2003, seems to be in perpetual creep mode. The budget, as Matt Wald wrote yesterday, has ballooned 50 percent (because of the worldwide price spike in basics like concrete). The timetable has slid. Components are being shed. The portion of the eventual $1.8 billion cost paid by the government is shrinking. The Department of Energy Web site for the project still describes it as “Tomorrow’s Pollution-Free Power Plant,” and that is what has energy and climate experts and some campaigners worried.

Various experts, including a nonpartisan panel at M.I.T., have said the world needs something like 10 FutureGen-style projects to be developed in the next decade or so if there is to be any hope that gas-trapping technology will play a meaningful role in stanching the tens of billions of tons of carbon dioxide that will be coming from coal burning in the next few decades.

David Hawkins of the Natural Resources Defense Council put it in simple terms in an e-mail last night: “Too much future, too little gen.”

Mr. Hawkins said adequate construction of CO2-trapping plants would happen more swiftly if a “performance standard” requiring this technology were added to climate legislation like the Warner-Lieberman bill being considered in the Senate. Such a provision would require new coal-plant construction to incorporate such systems and spread the cost over the economy so utilities aren’t hit too hard. He said that counting on Congress to approve sufficient money for research and development of such systems guaranteed ever more slip-sliding away of yet another someday technology.

Before he flew to Bali for the climate-treaty talks, James L. Connaughton, the chairman of the White House Council on Environmental Quality, acknowledged that FutureGen has problems, saying some aspects may be scaled back. “They’re trying to figure out how to raise more money or to rescale the project so it still can fulfill its purposes but maybe hold off on a couple components,” he said.

He stressed that the plant was just one of a variety of “low-carbon fossil” energy projects the Bush administration was pursuing. During the climate talks, the administration pressed other
countries to do more work on technologies for exploiting coal without venting more carbon dioxide to the atmosphere.

There are more such power plants in the works, with international partnerships preparing to build them in Australia, the Middle East, and China. The Chinese project, called GreenGen, has gained a new partner, Peabody Energy, the world’s largest private coal company (the one battling the governor of Kansas over stalled permits for coal-burning plants).

Having the world’s largest coal company join the world’s largest CO2 emitter in such a project is certainly a significant, if very preliminary, step in testing whether the world can have its coal and its climate too.

You can find Peabody’s announcement of its GreenGen activities on its home page, just to the right of the ticker reeling off 2007 coal sales in tons per second. (It was at 226,861,610 tons around 9:30 this morning; what is it now?)

Even with these initial moves, many scientists I’ve talked to over the years still say there are enormous basic questions that remain unanswered about things like how to handle CO2 in billion-ton quantities and which geological formations can hold the liquefied gas securely. They say only government can build what would amount to industrial-scale prototypes. And they don’t give it a better shot of success than, say, finding ways to make solar power much, much cheaper (yet that arena still gets scant federal funding).

There are plenty of experts who still doubt that capturing carbon dioxide and putting it in cold storage will ever work at a meaningful scale. Vaclav Smil at the University of Manitoba has calculated that capturing, compressing and storing just 10 percent of current CO2 emissions — here and now — would require as much pipeline and plant infrastructure as are now used worldwide to extract oil from the ground. And oil is a pricey commodity while carbon dioxide is a waste gas.

Clearly the future is not yet now.

29) Which of the following statements best summarizes the main point of this article?

a) The article reports that energy can be easily generated from coal without the emission of carbon dioxide, a greenhouse gas.

b) The article reports on a new project that may one day generate energy from the sun without any pollution.

c) The article is about global warming, which is a myth.

d) The article reports on a possible new way to generate energy from coal without emitting carbon dioxide into the atmosphere.
The author states:
The evidence of the last century, particularly the last quarter century, clearly shows a warming climate. In addition, the warming rate has accelerated over the last few decades (Figure 1).

30) According to above, what was the annual mean temperature difference (°C) for the year 2000 with respect to the end of the 19th century?
   a) +0.6  b) -0.6  c) +0.2  d) -0.2

31) True or False: According to Figure 1, after the year 1900, the annual mean temperature (°C) was consistently above the annual mean temperature of the year 1900.

32) In two or three sentences, describe one important scientific issue that affects our society, and state your opinion on this issue.