GREEN GENERATION: ANSWER KEY

PART ONE: POTPOURRI

1. What are the similarities and differences between allochoton and autochoton?

Allochoton: : Organic matter entering a stream, lake or ocean but derived from an adjacent terrestrial
system; e.g. falling leaves from a tree located at the banks of the river.
Autochoton: Organic matter produced within a community e.g., fresh-water plants within a river.
Both: forms of Biomass

2. What is the formula for carrying capacity? *Hint: Logistic

$dN/dt = r \cdot N \cdot (K-N)/K$ where r is the intrinsic rate of growth, N is the population density, K is the carrying capacity, and t is time

3. Biologists stocked a lake with 200 fish and estimated the carrying capacity (the maximal population for the fish of that species in that lake) to be 14,000. The number of fish tripled in the first year.

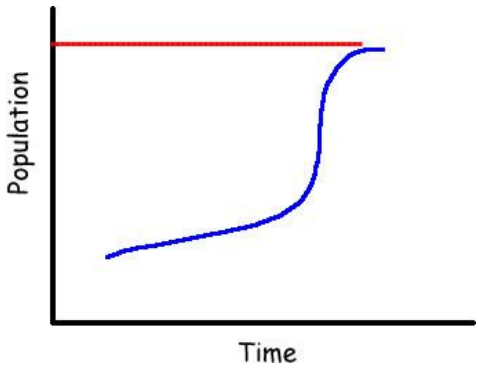
a) Assuming that the size of the fish population satisfies the exponential model, find an expression for the size of the population after t years.

$y = 200*e^{(t*\ln(3))}$

b) How long will it take for the population to increase to 5000?

$5000 = 200*e^{(t*\ln(3))}$
$25 = e^{(t*\ln(3))}$
$\ln(25) = \ln[e^{(t*\ln(3))}]$
$\ln(25) = t*\ln(3)\ln[e]$
$\ln(25) = t*\ln(3)$
$t = \ln(25)/\ln(3) = 2.9299$ years

4.



The curve shown above is an example of:

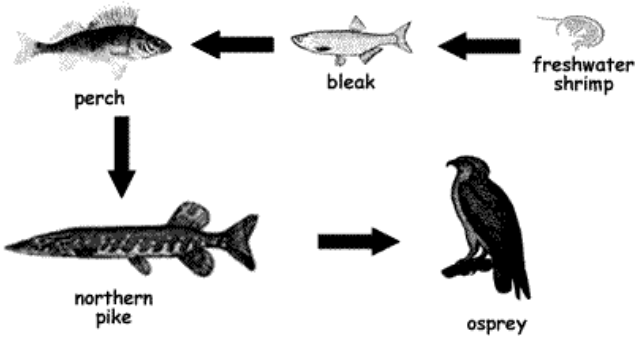
a) Exponential growth

b) Logistic growth

c) Dynamic growth

d) None of the above

5.



The perch has:

a) 100x more energy than the osprey

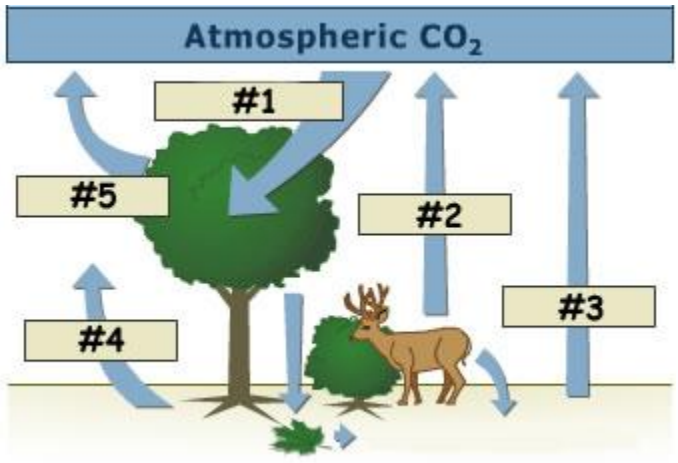
b) 10x more energy than the bleak

c) 1/100x more energy than the shrimp

d) 1/10x more energy than the pike

e) both a and c

6.



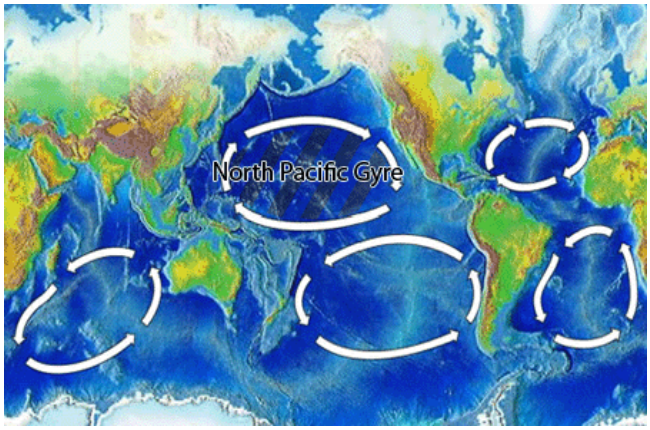
a. In addition to CO2, what chemical compound is released into the atmosphere as a result of processes #2 and #5? _____ **oxygen**

b. Name this process _____ **respiration**

7. According to the Guinness World records, which country has the worst marine pollution and why?

ANS: Japan- A fertilizer factory on Minamata Bay, Kyushu, Japan, deposited mercury waste into the sea between 1953 and 1967. Up to 20,000 people were affected, 4,500 seriously. 43 people died from the poisoning; another 800 deaths were attributed to mercury poisoning by some sources, while 111 others suffered permanent damage.

8.



What is the name for the "structure" resulting from the accumulation of debris that occurs because of the events on this map? **Great Pacific Garbage Patch (or Pacific Trash vortex)**

9.

a) What is the name of this strange occurance? **The blob**

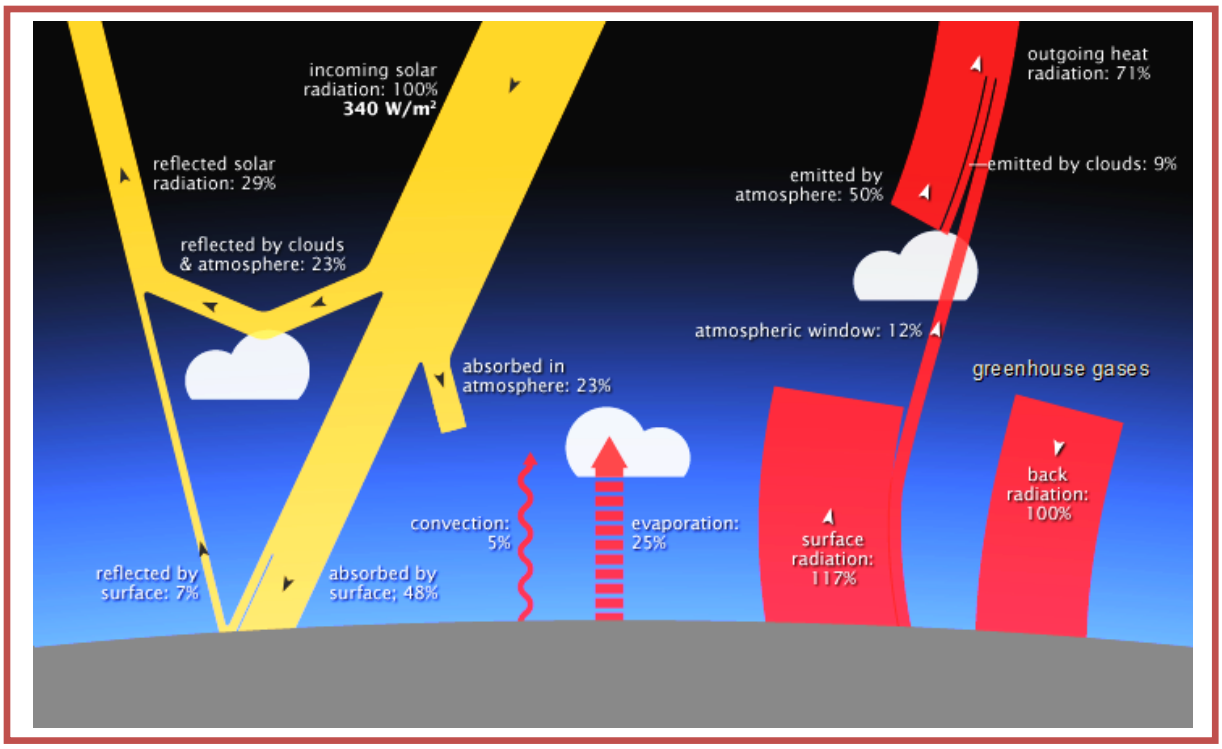
b) Why does this occur? **Phytoplankton bloom beneath the ice in the Arctic due to major changes in Arctic ecosystems as the planet warms.**

c) What is the organism related to this? **Chukchi Sea Algae**

10. a. Why does shutdown of thermohaline circulation occur? **Global warming triggers localized cooling in the North Atlantic, leading to cooling in that region.**

b. What countries would this primarily affect? **Countries warmed by the North Atlantic drift, such as the British Isles, France, and the Nordic countries.**

11. Insert the percentages in the green house effect diagram: (Allow a +/-5% error)



12. All of the following gases have been implicated in contributing to the increase in global temperatures via the greenhouse effect, except:

a) O2

b) CH4

c) N2O

d) CO2

e) CFCs

13.

a) What is the name of this highly endangered animal? **Ivory-billed woodpecker**

b) What is the cause of endangerment? **Habitat loss (logging) and over exploitation by humans, who liked its feathers**

14. What is the name of the endangered animal, whose nickname is "The Asian Unicorn"? **Saola**

15. Which of the following is most likely to occur in a forested region that has been recently clear-cut?

a) the concentration of nitrates in streams running through the regions will increase

b) the average depth of topsoil will increase

c) the water temperature in streams running through the region will decrease

d) volume of runoff after rains will decrease

e) the frequency of landslides will decrease

16. Which of the following is the best long-term method of preventing extinctions?

a) breeding endangered species in captivity

b) habitat protection

c) stopping hunting

d) removing invasive species

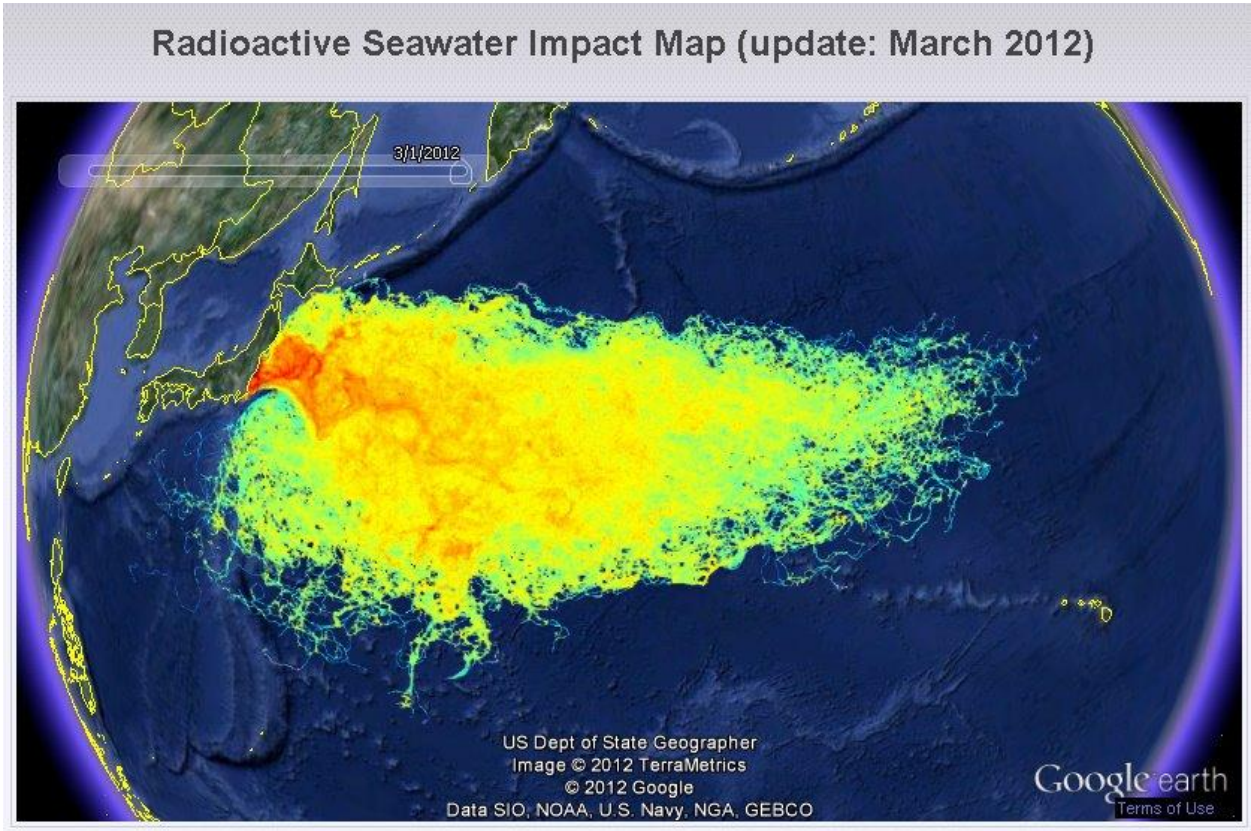
e) there is no way to prevent extinctions because it is an evitable part of the cycle of life

17.

a) What infamous event does this image depict? **Dust Bowl**

b) How did this happen? **Severe drought and a failure to apply dryland farming methods to prevent wind erosion**

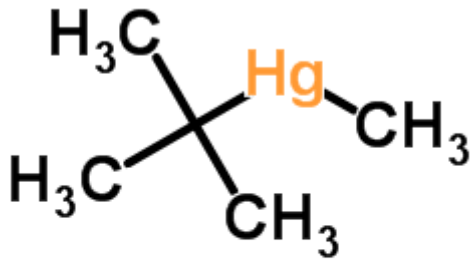
18.

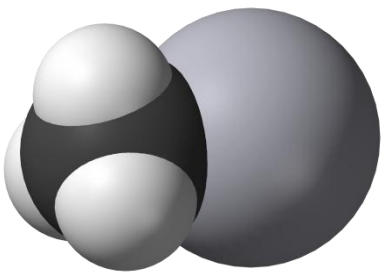


a) What terrible event from 2011 does this picture depict? **Fukushima Daiichi Nuclear disaster**

b) What caused this event to occur? **A meltdown of the three of the plant's six nuclear reactors**

19.





a) What compound do these images represent? **Methylmercury**

b) How is it related to fish and humans? **Inorganic mecury is converted to methylmecury, which enters the food chain when absorbed by plankton. Plankton are eaten by fish. It is known as the primary ciguatoxin.**

20.

a) What infamous event does this picture depict? **Three Mile Island Nuclear Explosion**

b) When and where did this occur? **March 28, 1979 on the three mile island in Dauphin County, Pennsylvania**

21.

a) What is the nickname for this "hole"? **"Door to Hell"**

b) How was this hole created? **In Derweze, Turkmenistan, a drilling rig made by Soviet geologists in 1971 gave way to a large hole measuring 70 meters in diameter, exposing a large methane gas reservoir.**

22. What is the difference between active and passive solar housing?

Passive solar energy systems use the architectural design, the natural materials or absorptive structures of the building, as an energy saving system. The building itself serves as a solar collector and storage device.

Active solar energy systems require a separate collector, a storage device and controls linked to pumps or fans that draw heat from storage when it's available. Active solar systems generally pump a heat-absorbing fluid medium (air, water or an antifreeze solution) through a collector.

23. If an incandescent lightbulb used for lighting has an efficiency rating of 5 percent, then for every 1.00 joule of electrical energy consumed by the bulb, which of the following is produced?

a) 1.05 J of light energy

b) 1.05 J of heat energy

c) 0.95 J of light energy

d) 0.05 J of light energy

e) 0.05 J of heat energy

24. Why are fossil fuels called what they are called? **They were formed from the organic remains of prehistoric plants and animals.**

25. All of the following substances are derived from petroleum, except:

a) asphalt

b) DDT

c) cellulose

d) polystyrene

e) nylon

26. Which of the following metals is considered an energy resource?

a) uranium

b) cobalt

c) mercury

d) copper

e) palladium

27.

a) Draw the universal symbol for recycling below:

Ans:

b) What do each of the arrows represent? **Each arrow represents one step in a three-step process that forms the recycling loop. Collection of materials to be recycled --> Manufacturing process --> Purchase and use of products made from recycled materials.**

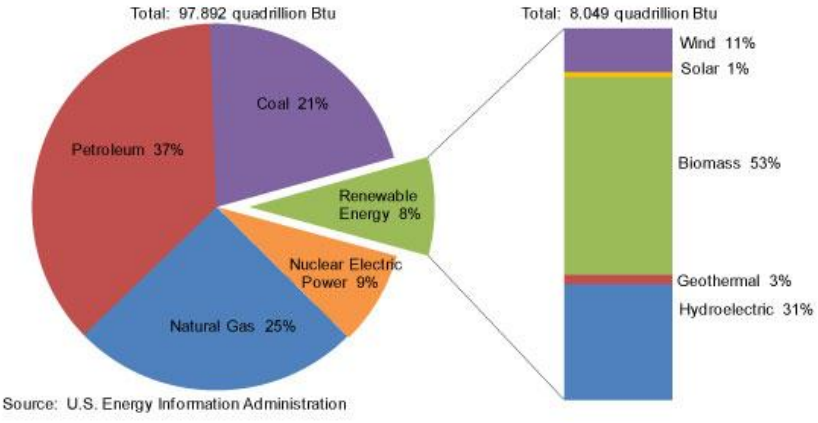
28. What is vermicomposting? **Composting with worms in an enclosed worm bin**

29. What is the *net capacity factor* of a power plant? **Ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full capcity indefinitely**

30. What is the largest hydroelectric dam in the world and where is it located? **Three Gorges Dam in China**

31. Fill in the renewable energy source pie chart using the following word bank:
BIOMASS, COAL, GEOTHERMAL, HYDROELECTRIC, NATURAL GAS, NUCLEAR ELECTRIC POWER, PETROLEUM, SOLAR, WIND

Figure 1. Renewable energy consumption in the nation's energy supply, 2010



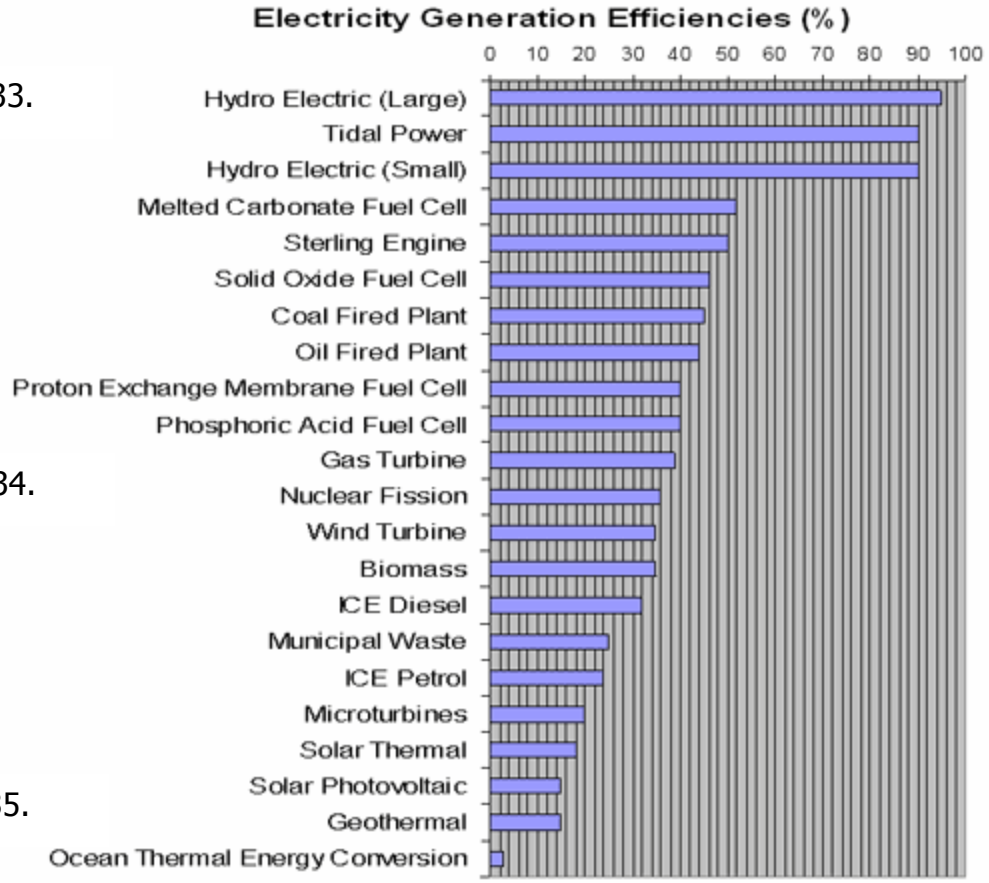
32. Biomass used for electricity generation varies depending on where you are. For the following locations, please list the most common biomass used.

a. United States **Forest byproducts, i.e. wood residues**

b. Southeast Asia **Agricultural waste, i.e. rice husks**

c. United Kingdom **Animal husbandry residues, i.e. poultry litter**

33.



34.

35.

36. What is the freshwater habitat where you would find organisms that break down organic matter? **Benthic Zone**

37-41 Biomes are often characterized by the amount of rain they receive. Identify the following Biomes:

37. <25 cm of rain per year (warm) **Desert**

38. 25 - 75 cm of rain per year **Grassland**

39. <25 cm of rain per year (cold) **Tundra**

40. 70 - 150 cm of rain per year **Deciduous Forest**

41. >500 cm of rain per year **Tropical Rain Forest**

42. Your Science Olympiad team is attending the national competition in Lincoln, Nebraska for the 2015 term! Congratulations! What is the main biome you are now in?

Temperate Grassland

43. What is characteristic of an ecotone region? **An ecotone region is the area of transition between two biomes. It has characteristics of both biomes and organisms tend to compete with one another for food and shelter.**

44. What is the permanent frozen subsoil on arctic tundra called? **permafrost**

45.

a. Identify this biome. **Chaparral, or Mediterranean Biome**
b. Where is it found? **Mediterranean Basin, California, parts of Australia, middle Chile, Cape Province of South America**
c. c. Describe the winters and summers here in terms of water presence. (Dry/Wet Winters, Dry/Wet Summers... Elaborate if possible.) **Wet winters, Dry summers with frequent droughts.**

46. List three classification schemes for biomes. (No need to explain in detail.)
Possible answers: Holdridge scheme, Walter system, Bailey system, WWF system, Koppen system, MUC (Modified UNESCO) system, Aridity index

PART TWO:

FREE RESPONSE:

Read the following scenarios:

47. Harvard Scientists are working on a new renewable energy system that can harvest the power from the earth's infrared energy. Our planet is constantly releasing hundreds of millions of gigawatts of infrared radiation into space, and now physicists at the Harvard School of Engineering and Applied Sciences (SEAS) envision two devices that could capture it. The research team proposed a pair of devices similar to photovoltaic power systems – but instead of capturing incoming visible light, the devices would generate direct current electrical power by emitting infrared light.

Which step(s) of the 12 principles of green chemisry were followed in this scenario?

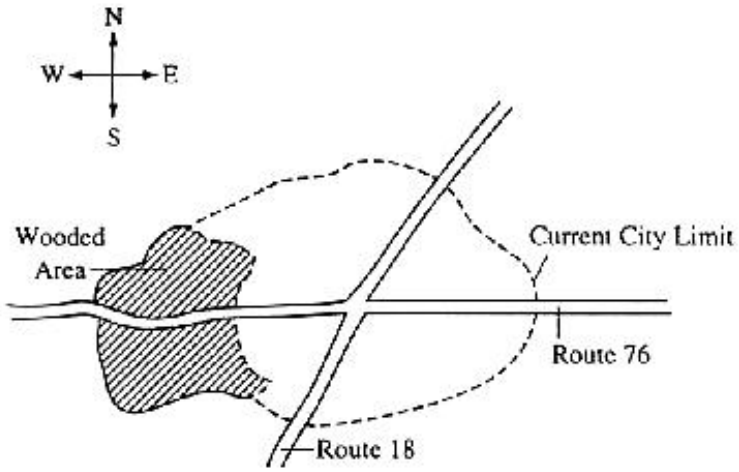
Design for Energy Efficiency

48. Demolition is a messy business—not only does the process require heavy machinery and produce clouds of dust, but it also results in giant piles of rubble that often head straight for the landfill. Omer Haciomeroglu, a student at Sweden's Umeå Institute of Design has designed Ero – a robot that recycles concrete in an energy-efficient manner and separates it from rebar and other debris on the spot.

Which step(s) of the 12 principles of green chemisry were followed in this scenario?

Design for Energy Efficiency, Reduce Derivatives, Inherently Safer Chemistry for Accident Prevention

49.



Fremont

The map above shows the town of Fremont, where biologists have noted that the population of a certain species of bird has been declining over the past several years. This bird species is now found only in the wooded area on the western edge of the city. Developers view this wooded area as prime real estate and have recommended to the Fremont City Council that the area be zoned for single-family housing. A group of citizens concerned about the bird species and its habitat recommended to the council that future urban expansion be directed toward the eastern portion of the city and that the wooded area be preserved

(a) Identify and briefly describe two federal laws or regulations that might apply to this situation.

(b) Assume that the Fremont City Council votes to preserve the wooded area. Explain the positive and negative consequences of this action. Include long- and short- term effects on the environmental, economic, and recreational needs of the citizens of Fremont.

(c) Assume that the Fremont City Council votes against preserving the wooded area. Propose and defend an alternative plan that both protects the bird species and provides for urban expansion.

ANS:

a. Two federal laws or regulations that apply to this situation are the Wilderness Act and the Endangered Species Act. The Wilderness Act established a national wilderness preservation system and it officially defined "wilderness". The Endangered Species Act identifies endangered, threatened, and vulnerable species. It regulates commercial and recreational activities involving these species.

b. There are positive and negative consequences if the Fremont City council votes to preserve the wooded area. The primary positive consequence is that the birds' habitat would not be destroyed by construction of the single-family housing. The primary negative consequence is that the Fremont City Council would need to make a choice on where to place the new housing. They would end up moving the new housing to the eastern portion of the city.

b. The long term effects on the environment would be that the birds are protected. However, due to the location of Route 76, the area would still become polluted because the road goes straight through the wooded area. The long term effects on the economy would be that more families are moving into the Fremont town and using more resources. The long term recreational effects would be that there would be more land available to camp on provided that the campers ensure to abide by environmental park laws.

b. The short term effects on the environment are that the area would receive publicity and would become more respected as a community that cares for the and animals. A short term effect on the economy is a lack of new housing for families. A short term effect on recreation is that the citizens would be temporarily blocked off from using the land.

c. A compromise could be set so that the plan protects the land and the birds, plus provide a place for urban expansion. The Fremont City Council could declare the land as protected and set up funding to watch the birds' health. The new housing should be placed in the eastern section of the city; it is already cleared off and will not harm the birds while still providing homes for the human citizens of Fremont.

50. Refer to the article and diagram below when answering the questions that follow.

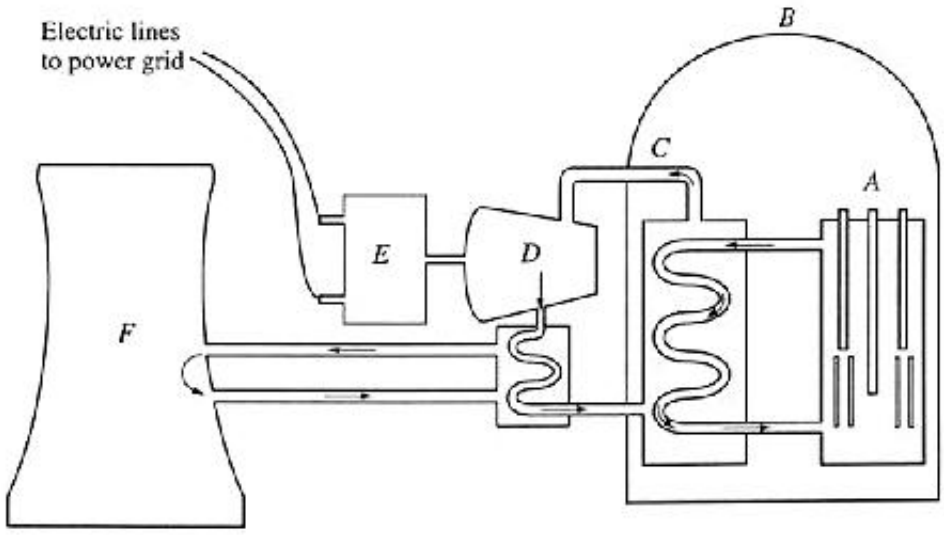
FUTURE OF NUCLEAR POWER IN DOUBT

A long decline for nuclear power in the United States began in the late 1970's when predictions that the price of oil would rise to $100 per barrel did not materialize. In 1979, the near-meltdown at the Three Mile Island nuclear plant in Pennsylvania alarmed the public over the potential hazards of nuclear power. These concerns were further exacerbated by the events at Chernobyl in 1986.

Societal concerns about nuclear power and increased costs associated with the construction and operation of nuclear generating plants have led to a virtual moratorium on new plant construction. In the United States, no new orders for nuclear power plants have been placed since 1979. Even Energy Department officials are now reluctant to predict that another nuclear reactor will ever be built in this country.

Nuclear power plants currently generate 21 percent of United States electricity and the 110 nuclear power plants across the nation are operating more efficiently and safely now than ever before. Some officials believe that if we do not continue research on nuclear energy, then we will not have a viable economy in 30 years.

DIAGRAM OF NUCLEAR POWER PLANT



(a) Identify and describe the function of any three parts labeled on the diagram of a water-cooled nuclear power plant shown above.

(b) Describe and discuss two environmental problems associated with the use of nuclear power for generating electricity.

(c) On the basis of the article and other information, what options do you foresee for the future production and use of electricity in the United States?

(d) Describe briefly the environmental implications of your answer in part (c).

(A) Identify and describe the function of any three parts labeled on the diagram of a water-cooled nuclear power plant shown above.

ANS. A. Control Rods- regulates the rate of fission and amount of power the reactor produces.

B. Containment Shell- keeps radioactive materials from escaping into the environment in case of explosion or core meltdown, and to protect from external threats.

D. Turbine- turns with steam to produce electricity.

F. Cooling Tower- removes heat from water, allowing it to return and cool the steam.

(B) Describe and discuss two environmental problems associated with the use of nuclear power for generating electricity.

ANS. One problem is the production of solid nuclear waste. The half-lives are so high that these wastes do not decay. Everything they are exposed to becomes radioactive. There is also the risk of meltdown and explosions. This releases large amounts of radioactive material into the atmosphere, which causes serious environmental and health problems.

(C) On the basis of the article and other information, what options do you foresee for the future production and use of electricity in the United States?

ANS. The United States will have to increase the use of nuclear energy. With the decline of fossil fuels and increase in costs, it will be more efficient and eventually necessary to use nuclear energy. The government will have to convince the public that this energy is safe and needed.

(D) Describe briefly the environmental implications of your answer in part (C).

ANS. There will be a greater risk for large-scale environmental disasters, even with increased safety. In addition, solid nuclear wastes will continue to build up, without a good way to deal with them. But, emissions from burning fossil fuels would be greatly decreased.