1. Use the axes to the right for the following:
   a. Draw and label a line that represents linear growth.
   b. Draw and label a line that represents exponential growth.
2. List the four most populated countries in the world.
   (1) China   (3) United States
   (2) India   (4) Indonesia
3. Define the term ecological footprint

   Amount of biologically productive land and water needed to supply a population with its needed resources, or
   to absorb & disperse its waste.

4. Write an equation for the rule of 70:
   \[ 70 \div r \ \text{(growth rate)} = \text{doubling time (in years)} \]
5. Perform the following calculations: (Show all of your work in a logical progression to the final answer.)
   a. A city has a population of 50,000 in 2012. If the population of the city grows at an annual rate of 2%, the year in which the population will reach 100,000 is \(2047\) and the year it will reach 200,000 is \(2082\).
      Show work:
      \[ \frac{70}{a} \times x = 35 \text{ years} = 2047 \]
      \[ 2047 + 35 = 2082 \]
   b. A country's population was 12 million in 1992 and in 2012 it is 24 million. If the population grew at a constant rate, that percent rate of growth was \(3.5\%\).
      Show work:
      \[ \frac{70}{r} = 20 \text{ years} \]
      \[ r = 3.5\% \]
6. Complete the following table by writing “high” or “low” in each box below.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>More Economically Developed Countries (MEDCs)</th>
<th>Less Economically Developed Countries (LEDsCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>per capita GDP</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>degree of industrialization</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>infant mortality rate</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>per capita fossil fuel use</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>ecological footprint</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>greenhouse gas emissions</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>risk from heart disease</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>risk from infectious diseases</td>
<td>low</td>
<td>low</td>
</tr>
</tbody>
</table>
7. Identify three examples of renewable resources and three examples of nonrenewable resources.
   Renewable: (1) water
   (2) wood
   (3) fishing
   Nonrenewable: (1) coal
   (2) oil
   (3) metals
8. Define the following:
   a. total fertility rate
   b. replacement level fertility
   c. infant mortality rate
   d. crude birth rate
   e. crude death rate
9. Describe the circumstances that will result in a Tragedy of the Commons.

   Depletion or degradation of a potenциально renewable resource to which people have free or
   unmanaged access.
10. Describe an example of a Tragedy of the Commons.
    Depletion of a commercially desirable fish species in the open ocean beyond areas controlled
    by coastal countries.
11. On the axes to the right, draw a line showing a population that exemplifies logistic growth. (s-curve) and label the carrying capacity.

12. Perform the following calculation. Show all of your work. In a particular year a population has the following characteristics: the crude birth rate is 45, the crude death rate is 20, the immigration rate is 1%, and the emigration rate is 0.5%. The percent rate of growth for that year is ___.

Show work:

\[
\frac{(45 + 10) - (20 + 5)}{1000} = 3\%
\]

13. Describe an example of a positive feedback loop.

Global climate change has lots of examples: Polar ice melting exposes more black H2O, causing more water to melt more quickly, exposing more black water, over & over

14. Use the axes below to draw and label lines representing the birth rate, death rate and total population size during the idealized demographic transition of a country. Include, written directly onto the graph, an explanation for each change in the birth rate, death rate and total population size.

15. On the axes below, draw and completely label four age-structure diagrams that represent slow growth, rapid growth, negative growth, and zero population growth (include labels on the x- and y-axes)

16. Describe an example of a negative feedback loop.

Warmer temps cause surface H2O evaporation which creates clouds which decrease surface warming

17. Arrange the following types of electromagnetic radiation in order from lowest to highest energy: Ultraviolet, Microwave, Infrared, Gamma, Radio, X-ray, Visible.

Radio, Microwave, Infrared, Visible, Ultraviolet, X-Ray, Gamma

18. List the following types of visible light in order from shortest to longest wavelength: Green, Orange, Red, Yellow, Blue, Violet.

Red, Orange, Yellow, Green, Blue, Violet

19. Identify three examples organic compounds and three examples of inorganic compounds.

<table>
<thead>
<tr>
<th>Organic:</th>
<th>Inorganic:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Ammonia</td>
<td>(1) Carbon dioxide</td>
</tr>
<tr>
<td>(2) Simple sugars</td>
<td>(2) Nitric acid</td>
</tr>
<tr>
<td>(3) Complex sugars</td>
<td>(3) Prepared elements</td>
</tr>
</tbody>
</table>

20. Using the axes on the right, draw and label three survivorship curves exemplifying early-loss, late loss, and constant-loss species.
   (1)  Higher sea levels rise
   (2)  Species extinction – habitat loss, acid rain, drought, wildfires...
   (3)  Spread of disease, such as remote diseases - ie malaria, encephalitis, leprosy.

22. List three things you could do to decrease your contribution to global warming.
   (1)  Improve energy efficiency - decrease the need for fossil fuel - energy efficient appliances.
   (2)  Walk or bike when possible.
   (3)  Eat less meat - avoid meat from livestock farms - as well as CO2 involved in raising food production.

23. List four greenhouse gases.
   (1)  Methane: $\text{CH}_4$
   (2)  Water: $\text{H}_2\text{O}$
   (3)  Carbon Dioxide: $\text{CO}_2$
   (4)  Nitrous Oxide: $\text{N}_2\text{O}$

24. Use the axes to the right for the following:
   a. Draw a line representing the Earth’s atmosphere.
   b. Label each layer of the Earth’s atmosphere and identify where the ozone layer is situated.

25. Humans began agriculture approximately ______ years ago.

26. A man-made product is also known as anthropogenic.

27. The molecular formula of ozone is $\text{O}_3$.

28. In the box below, write out a series of chemical equations that illustrate the destruction of the ozone in the ozone layer.

   $\text{O}_3 + \text{UV} \rightarrow \text{O}_2$ OR $\text{O}_2 + \text{CFC} \rightarrow \text{cl}$

   $\text{Cl} + \text{O}_3 \rightarrow \text{O}_2 + \text{ClO}$

   $\text{O} + \text{ClO} \rightarrow \text{O}_2 + \text{Cl}$

   **Note:** This sequence of reactions can damage the ozone layer.

29. The acronym HCFC refers to hydrochlorofluorocarbon, which is:

   Any group of organic compounds that contain carbon, chlorine, fluorine, and hydrogen, used as refrigerants and propellants.

30. Identify three examples of biotic components of an ecosystem and three examples of abiotic components of an ecosystem.

   **Biotic:**
   (1)  Plants
   (2)  Animals
   (3)  Bacteria

   **Abiotic:**
   (1)  Soil
   (2)  Water
   (3)  Rocks

31. Complete the following table for these biogeochemical cycles:

<table>
<thead>
<tr>
<th>Trait</th>
<th>Carbon</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance to life</td>
<td>Building block of life</td>
<td>Major component of proteins</td>
<td>Important in nucleic acids</td>
<td>Essential for living organisms and industrial processes</td>
</tr>
<tr>
<td>Largest reservoir</td>
<td>Rock</td>
<td>Atmosphere</td>
<td>Rocks</td>
<td>Saltwater/Ocean</td>
</tr>
<tr>
<td>Methods of transport</td>
<td>Gas, Photosynthesis, Fossil Fuels</td>
<td>FNAAD</td>
<td>No atmosphere</td>
<td>Precipitation/Bioaccumulation/Evaporation/Erosion/Concentration</td>
</tr>
<tr>
<td>Cycle duration (long/short)</td>
<td>Long</td>
<td>Short</td>
<td>Longest</td>
<td>Short</td>
</tr>
</tbody>
</table>

32. Write the balanced chemical equation for photosynthesis in the box on the right:

   $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{sun} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

33. The approximate age of the Earth is 4.56 billion years old.

34. Write the balanced chemical equation for cellular respiration in the box on the right:

   **Cellular Respiration:** $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$

35. Match the following:
   a. generalist species - Zebra mussel
   b. specialist species - Galapagos tortoise
   c. invasive species - American Alligator
   d. keystone species - Tiger salamander
   e. indicator species - Norway rat
   f. endemic species - Giant panda

36. Define the term biodiversity.

   Variety of different species, genes, ecosystems, & functions

37. Define the term biome.

   Transitional regions inhabited by certain types of life, especially vegetation

38. What determines the type of biome an area will have?

   Climate + geography (latitude/longitude/elevation)

---

Review Cycles Cheat Sheet
39. Sketch and/or label the following on the map of the world below:
   a. the equator
   b. the tropic of Cancer and the tropic of Capricorn
   c. the Mid-Atlantic Ridge
   d. the location of suppressed upwelling characteristic of the occurrence of El Niño
   e. the location of China, India, Ethiopia, Brazil, Bangladesh, and Fremont

40. Complete the following table:

<table>
<thead>
<tr>
<th>Type of Biome</th>
<th>Typical Location</th>
<th>Typical Climate</th>
<th>Characteristic adaptations for survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Rain Forest</td>
<td>Tropics</td>
<td>Steady high temps, lots of rain</td>
<td>Plants – Dense canopy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Animals – Chimpanzees, Gorillas, Ants, Cheetahs</td>
</tr>
<tr>
<td>Temperate Deciduous</td>
<td>Outside tropics</td>
<td>Defined seasons, Moderate rainfall</td>
<td>Plants – Deciduous, broad leaved trees</td>
</tr>
<tr>
<td>Forest</td>
<td>but not polar</td>
<td></td>
<td>Animals – Hawks, Deer, Foxes, Owls</td>
</tr>
<tr>
<td>Taiga (Boreal) Forest</td>
<td>Northern S.A. &amp; Eurasia</td>
<td>Cold temps, lower rainfall</td>
<td>Plants – Conifers, cone bearing trees</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Animals – Moose, Fox, Lynx, Bears</td>
</tr>
<tr>
<td>Tropical Grasslands</td>
<td>Tropics</td>
<td>Steady high temps, clear rainy season</td>
<td>Plants – Tall grasses, trees</td>
</tr>
<tr>
<td>(Savanna)</td>
<td>Africa, S.A, Australia</td>
<td></td>
<td>Animals – Lions, Giraffes, Elephants</td>
</tr>
<tr>
<td>Temperate Grassland</td>
<td>Outside tropics</td>
<td>Defined seasons, moderate rainfall</td>
<td>Plants – Short grass prairie</td>
</tr>
<tr>
<td>(Prairie)</td>
<td>but not polar</td>
<td></td>
<td>Animals – Prairie dogs, Wolves, Rabbits</td>
</tr>
<tr>
<td>Tundra (Cold Grassland)</td>
<td>Northern S.A. &amp; Eurasia</td>
<td>Cold, low rainfall</td>
<td>Plants – Grasses, low-growing plants, perennials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Animals – Polar bears, Seal, FOX, Owl</td>
</tr>
<tr>
<td>Desert</td>
<td>Tropical, temperate, arid deserts</td>
<td>Tropical-hot/dry, temp-moderate/day, cold/dry</td>
<td>Plants – Succulents – cacti, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Animals – Lizards, heat tolerant yet</td>
</tr>
</tbody>
</table>

41. Describe the circumstances that will result in cultural eutrophication.

1. Excess nutrients cause algae blooms, 2. Excess nutrients cause algal blooms, 3. As algae decomposes, bacteria produce gas, 4. The bacteria use all of the dissolved O2 during respiration, creating a hypoxic environment, killing fish.

42. Explain the increasing concentration of carbon dioxide in the atmosphere leads to ocean acidification.

O₂ + H₂O → H₂O₂ (hydrogen peroxide) - Can cause coral bleaching, death of marine life, 
Manifes global climate change -kills phytoplankton.
43. Name the following:

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Nitric oxide</td>
</tr>
<tr>
<td>NO₂</td>
<td>Nitrogen dioxide</td>
</tr>
<tr>
<td>NO₃</td>
<td>Nitrate</td>
</tr>
<tr>
<td>NO₁⁺</td>
<td>Nitric acid</td>
</tr>
<tr>
<td>N₂</td>
<td>Ammonia</td>
</tr>
<tr>
<td>NH₃</td>
<td>Ammonium</td>
</tr>
<tr>
<td>NO</td>
<td>Nitrogen oxide</td>
</tr>
</tbody>
</table>

44. In the box to the right, sketch a house and the energy in the northern hemisphere. Include, inside the box, the location of both the winter and summer solstices, and labels to indicate the compass direction that the house faces.

45. Use the information in the diagram on the left, to answer the following:

- The percent change in the per capita global production of protein from poultry between 1980 and 2000 was approximately 48%.
- The percent change in the per capita global production of protein from farmed fish between 1980 and 2000 was approximately 79%.
- The percent change in the per capita global production of protein from beef between 1961 and 2009 was approximately 47%.

46. The founder of the Sierra Club was John Muir.

47. Rachel Carson wrote the book *Silent Spring* to raise people's awareness of the harmful effects of the pesticide DDT.

48. The acronym ENSO refers to El Niño Southern Oscillation, a phenomenon that occurs in the Pacific Ocean.

49. Place the following nine events in chronological order, beginning with the most recent: the oil spill of the Exxon Valdez; the meltdown of the reactor at Chernobyl; the explosion of the Deepwater Horizon; the discovery of contamination at Love Canal; the drafting of the Kyoto Protocol; the ratification of the Montreal Protocol, passage of the US Endangered Species Act; the leak of methyl isocyanate in Bhopal; Earth Day; the leak of methyl isocyanate in India.

50. Strengthen this weak statement: "Fossil fuel use releases carbon dioxide, which causes the greenhouse effect.

51. The acronym BOD refers to Biological Oxygen Demand, which is:

52. The acronym GMO refers to Genetically Modified Organism, which is:

53. Perform the following calculation. Show all of your work. If the grasses on a 100-hectare area of grassland grow at an average rate of 1 cm/day, the average volume of grass that is added to the grassland each day is 10,000 m³. If the density of the grasses that grow in the grassland averages 400 kg/m³, the net primary productivity is approximately 4,000 g/m²/day or 1,460,000 g/m²/year.

54. Strengthen this weak statement: "Protecting endangered species like the Giant Panda costs too much and should be stopped.

Biodiversity offers many benefits: products like food, medicines, fuel, and services; each individual plays a specific role in an ecosystem. More diverse ecosystems are more stable and more productive. The panda likely controls bamboo populations and should be preserved. The benefits above outweigh the monetary cost.
55. Perform the following calculation. Show all of your work. A 40 m² solar array is installed on a house where the average insolation is 6 kWh/m²/day if the average total electricity output of the array is 1.2 kWh/hr; the efficiency of the array is 12%. Show work:

\[
\text{Electricity output} = \frac{6 \text{kWh}}{\text{m}^2 \text{day}} \times 40 \text{m}^2 = \frac{240 \text{kWh}}{\text{day}} \times \frac{1 \text{ day}}{24 \text{ hours}} = \frac{10 \text{kWh}}{\text{h}}
\]

Only 1.2 kWh out of 10 kWh is converted to electricity.

Female Secondary Education and Total Fertility Rates

56. Consider the graph on the right and explain what can be inferred from it.

57. The first National Park was Yellowstone National Park.

58. Match the ten most populous urban areas in the world with their respective continent:

a. Asia
   - a) Seoul, South Korea
   - b) Tokyo, Japan
   - c) Shanghai, China

b. N. America
   - a) Mexico City, Mexico
   - b) New York City, USA

Watershed: Land area that delivers water, sediment, and dissolved substances via small streams to a major stream (river).

Clean Air Act: US federal law designed to control air pollution, requires the EPA to develop emission regulations against airborne pollutants known to be hazardous to human health.

Clean Water Act: The EPA is charged with implementing pollution control programs to ensure water quality standards for surface waters. Does not protect groundwater, wells, and tidal waters.

Clean Drinking Water Act: The EPA sets standards to protect drinking water against contaminants like animal wastes, chemical wastes, etc.


Baghouse filter: Air pollution control device that removes particulates out of air or gas released from commercial processes or combustion for electricity generation.

Electrostatic precipitator: Device that removes suspended dust particles from a gas or exhaust by applying a high voltage electrostatic charge & collecting the particles on charged plates.

Dioxin: Toxic compound produced during combustion processes. It is highly resistant to weathering & can be harmful to living organisms, as well as to people breathing & herbicides manufacturing.

59. Define the following...

Watershed: Land area that delivers water, sediment, and dissolved substances via small streams to a major stream (river).

Clean Air Act: US federal law designed to control air pollution. Requires the EPA to develop emission regulations against airborne pollutants known to be hazardous to human health.

Clean Water Act: The EPA is charged with implementing pollution control programs to ensure water quality standards for surface waters. Does not protect groundwater, wells, and tidal waters.

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Electrostatic precipitator: Device that removes suspended dust particles from a gas or exhaust by applying a high voltage electrostatic charge & collecting the particles on charged plates.

Dioxin: Toxic compound produced during combustion processes. It is highly resistant to weathering & can be harmful to living organisms, as well as to people breathing & herbicides manufacturing.

60. List three sources of methane that are amplified by human activities.

   (1) Forest fires
   (2) Landfills
   (3) Natural gas & oil production

61. The box to the right contains a crude depiction of a mountain, use it to include labels for the direction of the prevailing winds and nearest ocean.

62. NO₂ is converted to N₂ and O₂ in a catalytic converter, which also converts CO₂ to CO₂ and H₂O.

63. Explain the causes of an urban heat island:

   Ozone layer breaks & absorption much higher than air temp. Increased levels of air pollutants (CH₄, CO) trap heat

64. Perform the following calculations: (Show all of your work.)

   a. A rectangular area of forest that measures 10 thousand meters by 300 thousand meters has an area of $3 \times 10^6$ square kilometers and $3 \times 10^8$ hectares.

   \[
   10,000 \text{ m} \times 300,000 \text{ m} = 3,000,000,000 \text{ m}^2 = 3 \times 10^9 \text{ m}^2 \times \frac{1 \text{ km}^2}{1000 \text{ m}^2} = 3,000,000 \text{ km}^2
   \]

   \[
   3\times10^9 \text{ m}^2 \times \frac{1 \text{ hectare}}{10,000 \text{ m}^2} = 300,000 \text{ hectares}
   \]
b. A 60-Watt light bulb that is used for an average of 4 hours each day uses \[ 87.6 \text{ kilowatt-hours of electricity per year}. \]

\[ \frac{60 \text{ W}}{1000} \times \frac{1 \text{ kW}}{1 \text{ W}} \times \frac{4 \text{ hours}}{1 \text{ hour}} \times \frac{365 \text{ days}}{1 \text{ year}} = \frac{87.6 \text{ kWh/year}}{1} \]

65. List two characteristics of an r-selected species.
(1) Many offspring
(2) Generalist/broad niche
66. List two characteristics of a K-selected species.
(1) Few offspring
(2) Specialist/narrow niche
67. A Pacific Yew is a/an __________ and it is endangered because of the following:
It is used to make a drug to treat lung cancer. Over harvesting for this drug threatened it.
68. A Piping Plover is a/an __________ and it is endangered because of the following:
Urban development along coastal areas is destroying its nesting areas. Noise/disturbance causes them to abandon their nests.
69. An Orangutan is a/an __________ and it is endangered because of the following:
Their habitat (rainforests of Indonesia and Malaysia) have some of the highest rates of deforestation.
70. A Dodo was a/an __________ and it is extinct because of the following:
It was endemic to the island of Mauritius; Plague caused a downfall in the bird.

71. Complete the following table:

<table>
<thead>
<tr>
<th>Ecosystem Component</th>
<th>An economically valuable ecosystem services it provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>honey bee</td>
<td>Pollination - orchards</td>
</tr>
<tr>
<td>water cycle</td>
<td>Purification, transports nutrients</td>
</tr>
<tr>
<td>forest</td>
<td>Purification of air &amp; soil, Erosion prevention</td>
</tr>
<tr>
<td>bat</td>
<td>Keep mosquitoes at bay, pollinate plants, dispose seeds</td>
</tr>
<tr>
<td>bacteria</td>
<td>Break down waste (landfill) &amp; potentially other toxins</td>
</tr>
<tr>
<td>coral reef</td>
<td>Storm protection/habitat for fish</td>
</tr>
<tr>
<td>wetland</td>
<td>Filtration/Storm protection</td>
</tr>
</tbody>
</table>

72. A company is importing rare tropical hardwood to manufacture furniture, list three laws, regulations, treaties, or acts that the company may have violated.
(1) CITES - Treaty on the International Trade of Endangered Species
(2) Louis Act - prohibits the interstate transport of wild animals without federal permit
(3) Kyoto Protocol - to reduce GHG emissions - during the harvesting of this lumber

73. Whaling is justified in the name of __________ research, by the countries of __________ and __________.
74. Two islands, different distances from the mainland have different rates of extinction, this is explained by the theory of island

75. __________ is a technique typically used to harvest scallops, crabs, and shrimp from the sea floor.

76. A fishing practice that is commonly used to catch large solitary species of fish and was featured in __________ is long-line fishing.

77. 71% of the Earth is covered with water. Of all the water on Earth 97.5% of it is saltwater, 69% is frozen, and 1% is available and relatively accessible.

78. Arrange the following particles in order of smallest to largest: clay, sand, silt
(1) Clay
(2) Silt
(3) Sand

79. To live a healthy, active life most adults need to consume approximately __________ calories of food each day.

80. Arrange the following foods in order of highest to lowest in terms of global production: corn (maize); rice; wheat.
(1) Corn
(2) Wheat
(3) Rice

81. List four innovations that led to the Green revolution.
(1) Artificial selection or GMO
(2) Irrigation
(3) Synthetic pesticides
(4) Synthetic fertilizers
82. Match the following:
   a. anemia                           a. iron deficiency
   b. goiter                          b. vitamin A deficiency
   c. scurvy                          c. vitamin D deficiency
   d. rickets                         d. iodine deficiency
   e. blindness                       e. vitamin C deficiency

83. Use the axes below to draw and label an illustration of the pesticide treadmill.

84. Explain how the biomagnification of DDT led to the (near) demise of the Bald Eagle population in the US.

DDT alters the calcium metabolism in female birds, causing thinning egg shells, poorer hatching of eggs. Small prey animals to the bald eagle are plants sprayed with DDT. This biomagnification up the food chain, with bald eagles having high levels in their fatty tissues (may also cause infertility).

85. List three things you could do to conserve water.
   1. Set timer on the food timer (water is less intensive)
   2. Use grey water to flush toilet or landscape
   3. Low-flow appliances (toilet, showers, etc.)

86. Perform the following calculations: (Show all of your work.)
   a. A family of 5 replaces a 6-gallon/minute showerhead with a new 2-gallon/minute low-flow showerhead. If every member of the family takes one 10-minute shower per day, the family will save 73,000 gallons of water in one year.
      Show work:
      \[ \text{Gallons saved/year} = \frac{6 - 2}{4} \text{ gallon/minute} \times 10 \text{ minutes} \times 40 \text{ gallons/shower} \times 5 \text{ people} \times 200 \text{ gallons/day} \times 365 \text{ days} = 73,000 \text{ gallons/year} \]

   b. A family has a rectangular swimming pool that measures 15 feet by 20 feet. If water evaporates from the pool at a rate of 50 gallons per square foot per year and a pool cover will reduce evaporation by 90 percent, the family can save 13,500 gallons of water per year by using a pool cover.
      Show work:
      \[ \text{Gallons saved/year} = 15 \times 20 \times 50 \times \frac{1}{90} = 13,500 \text{ gallons saved/year} \]

87. Define the following:
   pH: A measure of the acidity or alkalinity of a solution (pH acid < 7, neutral = 7, base > 7)
   Turbidity: A measure of water clarity (suspended particles like soil, algae, pollen, microbes, etc.)
   Water hardness: The measure of the amount of calcium and magnesium in the water, which arises from the weathering of rocks
   Biological oxygen demand: The amount of dissolved oxygen needed by aerobic biological organisms (such as bacteria) in a body of water to break down organic material present
   Organic waste: All biodegradable wastes that can be broken down in a reasonable amount of time into its basic compounds by microorganisms and other living things
   Cholera: A bacterial disease caused by severe diarrhea and dehydration usually spread by oral water in water supplies in developing countries or areas of poor sanitation
   Schistosomiasis: A blood fluke that causes human disease in parts of Africa and South America
   Giardia: A type of intestinal infection caused by the protozoan flagellate, found in areas with poor sanitation, urinary tract infections

88. Completely label the following diagram of a sewage treatment plant and list the items removed at each step.
89. In the box to the right, list the ranks of coal in order from highest to lowest:

   (1) Anthracite (2) Bituminous (3) Sub-bituminous (4) Lignite

90. List three air pollutants that are emitted during the burning of coal:

   (1) Carbon dioxide (2) Sulfur dioxide (3) Nitrogen dioxide

91. List seven products that are derived primarily from crude oil:

   Asphalt, Gasolene, Napth, Diesel Oil, Heavy Oil, Aviator Fuel, Gasoline

92. The acronym OPEC refers to Organization of Petroleum Exporting Countries, which is important because:

   It is made up of 13 countries that have about 60% of the world's proven crude oil reserves and are thus likely to control the world's oil supply for many decades. Its official mission is to coordinate and unify the petroleum policies of its member countries and ensure the stabilization of worldwide oil prices.

93. Fracking is a common name for Hydraulic Fracturing and it is a concern because:

   It is the linear opening of fissures in subterranean rocks by introducing liquid at high pressure, to extract oil or gas. Concerns about groundwater contamination and its impact on wildlife.

94. Explain what the Deepwater Horizon was, where it went, and why it is significant:

   The Deepwater Horizon was an oil platform in the Gulf of Mexico. It was the largest designated wilderness area in the US.

95. The acronym ANWR refers to Arctic National Wildlife Refuge, which is important because:

   It was established in 1980 to preserve diversity, ensure a place for hunting and gathering, protect water quality, and allow international wildlife treaties. It is the largest designated wilderness area in the US.

96. Perform the following calculations: (Show all of your work in a logical progression to the final answer.)

   a. A family has a total of 1500 Watts of light bulbs throughout their house, if they replace them all with LED light bulbs, which use 90% less energy, the family will now use __225__ Watts of electricity.

   **Show work:**

   $$1500 \text{ Watts} \times 0.1 = 225 \text{W}$$

   b. A space heater operates at 1500 Watts, if it is used for 10 hours each day for one week and the cost of electricity is 20 cents per kilowatt-hour, it will cost __$21.00__ to operate the heater for the week.

   **Show work:**

   $$1500 \text{ Watts} \times \frac{1 \text{ hour}}{1000 \text{ Watts}} \times \frac{7 \text{ days}}{1 \text{ week}} \times \frac{0.20 \text{ dollars}}{1 \text{ kWh}} = 21 \text{ dollars}$$

97. The acronym CAFE refers to Corporate Average Fuel Economy, which is important because:

   They are regulations in the United States which are intended to improve the average fuel economy of cars and light trucks produced for sale in the US.

98. List two species that may be threatened by the construction of a solar power tower in the California Desert:

   (1) Thousand desert tortoise (2) Endangered peninsular bighorn sheep

99. Sulfur ___ is the active element in most photovoltaic cells.

100. List four things you could do to conserve energy:

   (1) Energy efficient appliances (2) Switch to LED light bulbs
101. State where Chernoby is located and explain what happened there.

Chernoby is in Pripyat, Ukraine. An explosion and fire released large quantities of radioactive particles into the atmosphere, which spread across the western USSR & Europe. Worst nuclear power plant accident in history.

102. Complete the following chart.

<table>
<thead>
<tr>
<th>Mining Technique</th>
<th>Description</th>
<th>Environmental consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-Pit mining</td>
<td>Removing minerals such as gold, silver or iron by digging an open cut of the Earth's surface and leaving all waste behind.</td>
<td>Land above cleared, forest destruction. Contamination of ground water &amp; surface water. Acid rain damage.</td>
</tr>
<tr>
<td>Subsurface mining</td>
<td>Extracting of a metal or mineral resource such as coal from deep underground deposits.</td>
<td>Coal mining, explosions, landslides, water pollution. Acid rain.</td>
</tr>
<tr>
<td>Strip mining</td>
<td>Extraction of surface mining in which the overburden is strip-mined.</td>
<td>Leaves a surface scar with protrusions erosion. Acid rain damage.</td>
</tr>
<tr>
<td>Mountaintop removal</td>
<td>Mining of minerals found usually in massive veins or placer deposits.</td>
<td>Waste rock &amp; dust destroys forests, rivers, streams. Acid rain.</td>
</tr>
<tr>
<td>Drilling</td>
<td>Subsurface mining using a large drill, such as a diamond drill.</td>
<td>Causes ground water pollution, instability, contamination of water.</td>
</tr>
</tbody>
</table>

103. Strengthen this weak statement: “Mining causes pollution that may disrupt the environment.”

Mining causes many environmental issues. The main pollutants from mining include:
- Air pollution (SO2, NOx, particulate, flue gas)
- Soil/land pollution from waste, sediments, sulfate acid, mercury, arsenic, cyanide (gold)

104. Match each of the following elements with its ore:
   a. aluminum          d. galena
   b. iron               e. quartz
   c. uranium            f. bauxite
   d. lead               g. hematite
   e. silicon

105. Explain what happened at Three Mile Island, and why it is significant.

Three Mile Island occurred in Middletown, PA in 1979. A cooling malfunction caused part of the core to melt down. Some radioactive gas was released, but not enough to cause harm to local residents.

106. Explain how thermal pollution is produced by power plants.

In most power plants, heat is produced when coal/oil/sugar is burned to release large amounts of energy. This heat heats water in a giant generator to steam, which turns a turbine, which produces electricity. This steam must then be cooled & condensed back to water. Cooling water is circulated back to the hot stream & is then dumped into nearby lakes, streams, or rivers.

107. Explain what happened at Fukushima Daiichi and why it is significant.

Occurrences March 2011 in Okuma, Fukushima, Japan. An internal failure occurred when the plant was hit by a tsunami triggered by a magnitude 9.0 earthquake. Multiple leaks occurred in 3/6 reactor's fuel rods or short term radiation exposure was reported.

108. Perform the following calculation. Show all of your work. A radioactive cloud may contain Iodine-131, which has a half-life of 8 days. If the waste must decay to a concentration of less than 0.1% to be considered safe, it will take approximately ___ days to reach safe levels.

Show work:

100 \times 0.1 = 10

109. Perform the following calculation. (Show all of your work in a logical progression to the final answer.) A family has a 75 m² solar array on their house, which has an efficiency of 10%. If the average insolation on their array is 6 kWh/m²/day and their average cost of electricity is 20 cents per kilowatt-hour, the family has the capacity to produce $84 worth of electricity daily, and $3,360 annually, from the sun.

Show work:

\[
\frac{75m^2 \times 6kWh}{1m^2} \times 0.1 \times \frac{0.20}{1kWh} = \frac{360}{365} = \$360.60
\]

110. For each of the following substances, draw an arrow that points to an unambiguous location along the line, below, representing pH: orange juice, normal rain, ammonia, lime (calcium carbonate), sulfuric acid, acid rain, human blood.
111. Explain what evapotranspiration is and why it is significant.

   The process by which water is transferred from the soil to the atmosphere by evaporation from the soil and other surfaces by transpiration from plants. Responsible for 15-20% of atmospheric water vapor.

112. What is different about growing plants hydroponically?

   Hydroponics is the process of growing plants in soil, gravel, or liquid, with added nutrients, but without soil.

113. In the box below, write a series of chemical reactions that leads to the formation of tropospheric ozone in photochemical smog.

   \[ \text{NO}_x + \text{VOC} + \text{Sunlight} \rightarrow \text{O}_3 \]

114. The acronym POP refers to Persistent Organic Pollutants which is:

   Organic compounds that are resistant to environmental degradation. POPs' biomagnify. Examples (pesticides), lead, PCBs that deliver water, sediment, & dissolved substances via small streams, to a major stream or river.

115. Explain what a watershed is and why it is significant.

   A land area that delivers water, sediment, & dissolved substances via small streams, to a major stream or river, regulated by Stockholm Convention.

116. List two environmental benefits of wetlands.

   1. Flood control
   2. Natural filter

117. In the box to the right, draw a diagram that illustrates how electricity is produced by a dam.

   Electrical lines deliver energy to the grid

118. List four characteristics that will result in waste being classified as "hazardous"

   1. Poisoneous
   2. Flammable
   3. Corrosive
   4. Chemically reactive

119. Explain what an El Niño event is and why it is significant.

   An irregular recurring complex series of climatic changes affecting the equatorial Pacific region at every 2-7 years. The trade winds weaken or reverse, waters warm 5-10°, & prevent upwelling. Also affects weather substantially in other regions.

120. What is a wet scrubber and how does it work?

   A device that removes pollutants from a gas stream (like sulfur oxides). The gas stream is brought in contact with a scrubbing liquid, coating them in the liquid basin. The final liquid must be treated before being released.

121. What is an electrostatic precipitator and how does it work?

   A device that removes suspended dust particles from a gas or exhaust by applying a high voltage to an electrode charge, collecting the particles on charged plates.

122. In the box below, write a series of chemical reactions that leads to the formation of acid rain.

   \[ \text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_3 \] (sulfuric acid)

   \[ \text{H}_2\text{O} + \text{NO}_2 \rightarrow \text{HNO}_3 \] (nitric acid)

123. Kwashiorkor is a form of malnutrition caused by protein deficiency in the diet, results in "blasted bellies" common in developing countries.

124. Marasmus is severe undernourishment causing an infant's or child's weight to be significantly low for their age.

125. If the cost of gas is $3.50 per gallon and the average gas mileage of a car is 25 mpg, the cost of driving the car per mile is

   \[ \frac{0.14}{\text{gallon}} \times \frac{1\text{ gallon}}{25\text{ mi}} = 0.14 \]

   Show work:

   \[ $3.50 \times \frac{1\text{ gallon}}{25\text{ mi}} = 0.14 \]

126. The acronym NIMBY refers to Not In My Back Yard, which is:

   Opposition by residents to a proposal for a new development because it is close to home, even though it is needed by society (i.e., landfills, power plants, etc.).

127. Identify significant sources of the following air pollutants:

   Formaldehyde: Significant in indoor air pollution. Found in building & insulation materials.
   Radon: A radioactive, odorless gas. Radon originates from rock, soil, & water, vent upwards into homes from basements/ crawlspaces.
   Mercury: Found in many metals, including coal. Coal burning power plants are the largest sources of human-caused.
   Carbon monoxide: Motor vehicle exhaust is the main source. Other sources are fossil fuel burning, mercury emissions, coalpower.
   Nitrous oxide: Automobile engines & coal-burning power plants are the main sources (human activity).

128. List three specific health effects of lead on humans.

   Potent nervous toxin - palsy, paralysis, blindness, mental retardation
129. What was the Green Revolution and why is it important?

130. Label the four major zones of life in the appropriate box.

131. For each of the following biomes, identify a specific country in which each biome occurs in relative abundance:

- Taiga: Russia, Canada
- Desert: Upper Africa, Australia
- Tropical rainforest: Congo, Nigeria, Brazil
- Tropical grassland: Argentina
- Temperate grassland: China, US
- Coral reef: Australia, Indonesia, Philippines
- Tundra: Russia, Canada

132. List three disinfectants that are commonly used to make drinking water safe during the water treatment process.

1) Chlorine
2) Chlorine dioxide
3) Chloramin

133. In the box below, write the chemical equation for the formation of carbonic acid from the reaction of water with carbon dioxide.

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \]

Identify two places in the environment where the above reaction occurs naturally.

1) In the oceans/laugh
2) In the blood

134. Sketch and/or label the following on the map of the world below:

a. the equator
b. the Mediterranean Sea
c. the Ogallala Aquifer
d. the island of Mauritius (where the Dodo once lived)
e. the location of Saudi Arabia, Indonesia, Philippines, Panama, Iceland, California