Name_____ Date_____

In each section, navigate to the given page or pages by clicking on each of the provided links and review the information provided to respond to the questions that follow.

§1 - Program Background

New York State Energy Research and Development Authority (NYSERDA) *www.nyserda.org*

1. (***ABOUT NYSERDA***) NYSERDA is a public benefit corporation that was created in what year? select one
2. (***Programs*** > ***Renewable Portfolio Standard***) *True or False*? A Renewable Portfolio Standard (RPS) is a policy that seeks to *decrease* the proportion of renewable electricity used by retail customers. select one
3. (***Programs*** > ***Renewable Portfolio Standard***) New York State's goal is to reach what percent of renewable energy by the year 2013? select one

§2 -Energy

Energy Information Administration (EIA) - Kid's Page *www.eia.doe.gov/kids/glossary/index.html*

1. Match each of the following terms to the left with the correct definition to the right by writing the term next to letter that corresponds to the correct definition. (*scroll to find terms*)

   Word Bank: *biomass, fossil fuels, geothermal energy, greenhouse emissions, greenhouse gases, nonrenewable, renewable energy sources*

a. select one — **a.** The heat energy that is produced by natural processes inside the earth. It can be taken from hot springs, reservoirs of hot water deep below the ground, or by breaking open the rock itself.

b. select one — **b.** Any organic (plant or animal) material which is available on a renewable basis, including agricultural crops and agricultural wastes and residues, wood and wood wastes and residues, animal wastes, municipal wastes, and aquatic plants.

c. select one — **c.** Gases that trap the heat of the sun in the Earth's atmosphere, producing the greenhouse effect. Water vapor, carbon dioxide, methane, ozone, chlorofluorocarbons, and nitrogen oxides are examples.

d. select one — **d.** Fuels (coal, oil, natural gas, etc.) that result from the compression of ancient plant and animal life formed over millions of years.

e. select one — **e.** The effect of the Earth's atmosphere, due to certain gases. In trapping heat from the sun, the atmosphere acts like a greenhouse.

f. select one — **f.** Fuels that can be easily made or "renewed." Hydropower (water), solar, wind, geothermal, and biomass are examples.

g. select one — **g.** Fuels that cannot be easily made or "renewed." Oil, natural gas, and coal are examples.

NYSERDA New York State Energy Research and Development Authority

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American Wind Energy Association (AWEA) www.awea.org/faq/wwt_environment.html

2. *Fill in the blanks*: Wind energy system operations do not generate air or water select one and do not produce select one .

3. Match each of the following types of emissions to the left with its effect on the environment to the right by writing the term next to the letter that corresponds to the correct description.

   Word Bank: *carbon dioxide, particulate matter, sulfur dioxide and nitrogen sulfides, toxic heavy metals*

a. select one

a. A global warming pollutant that builds up in the atmosphere, contributing to global warming by trapping the sun's rays on the Earth (as in a greenhouse), causing a gradual rise in average temperatures and increasing fluctuations in weather patterns, resulting in more frequent and severe droughts and floods.

b. select one

b. Cause smog, as well as acid rain that harms forests and the wildlife they support, kills lakes, and also corrodes buildings and economic infrastructure such as bridges.

c. select one

c. Accumulate in the environment and up the biological food chain by making it dangerous to consume certain animal-byproducts due to concern of its presence in animal tissue.

d. select one

d. Has contributed to making asthma one of the fastest growing childhood ailments in industrial and developing countries alike, and it has also recently been linked to lung cancer, as well as major health problems in infants.

4. *True or False*? Wind power is the least expensive, most highly developed renewable energy technology, and the fastest to build. select one

Zero Footprint Kid's Calculator www.zerofootprintkids.com/kids_home.aspx

CarbonFootprint.com defines a *carbon footprint* as a measure of the impact of our activities on the environment, and in particular climate change relating to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc.

5. Use the **Zero Footprint Calculator** to calculate your carbon footprint and compare your score with the average American score by selecting the American flag from the drop-down menu under the **Carbon** tab in your score summary. What is your carbon footprint score?
   What is the carbon footprint score of the average American? select one
   For tips on how to reduce your carbon footprint, visit www.carbonfootprint.com

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§3 - Wind Energy

U.S. Department of Energy (DOE) – Energy Efficiency and Renewable Energy (EERE)
http://www1.eere.energy.gov/windandhydro/wind_basics.html

1. (***How Wind Turbines Work***) Wind is a form of what type of energy? select one
2. (***How Wind Turbines Work***) Wind is caused by: select one
3. (***How Wind Turbines Work***) What are wind flow patterns modified by? *Check all that apply*.

☐ vegetation	☐ the Earth's terrain
☐ radio waves	☐ clouds
☐ bodies of water	☐ airplanes

4. (***How Wind Turbines Work***)The Department of Energy (DOE) defines *kinetic energy* as "energy in action". Therefore, the kinetic energy in the wind is a result of its motion. Into what does a wind turbine convert the wind's kinetic energy? select one
5. (***Advantages and Disadvantages***) *Fill in the blanks*: The major challenge to using wind as a source of power is that the wind is select one and it does not always blow when select one is needed.
6. (***History***) What were some of the earliest uses of wind energy? *Check all that apply*.

☐ powering cars	☐ heating homes
☐ propelling boats	☐ pumping water
☐ cooking	☐ grinding grain

7. (***History***) To what year does using wind energy to generate electricity date back? select one

§4 -Electricity Basics

Kid Wind *www.kidwind.org/lessons/BBelectricitybasics.html*

1. *Fill in the blanks*: Electricity is the flow of select one . Electricity is created when select one from atoms are loosened and begin to move from one atom to another.
2. Is electricity a primary or secondary source of energy? select one
3. A generator, often referred to as a dynamo, operates based on a law that states that when a magnet is moved within a coil of wire, electric current flows in the wire. What is the name of that law? select one
4. In what units is electricity measured? select one
5. It is estimated that one megawatt (1MW) of electricity can power more than approximately how many average homes here in the U.S.? select one

§5 -Turbine Concepts

National Renewable Energy Laboratory (NREL) *www.nrel.gov/learning/re_wind.html*

1. Wind turbines are mounted on towers that are typically more than how many meters (m) in height in order to take advantage of the faster, less turbulent wind? select one

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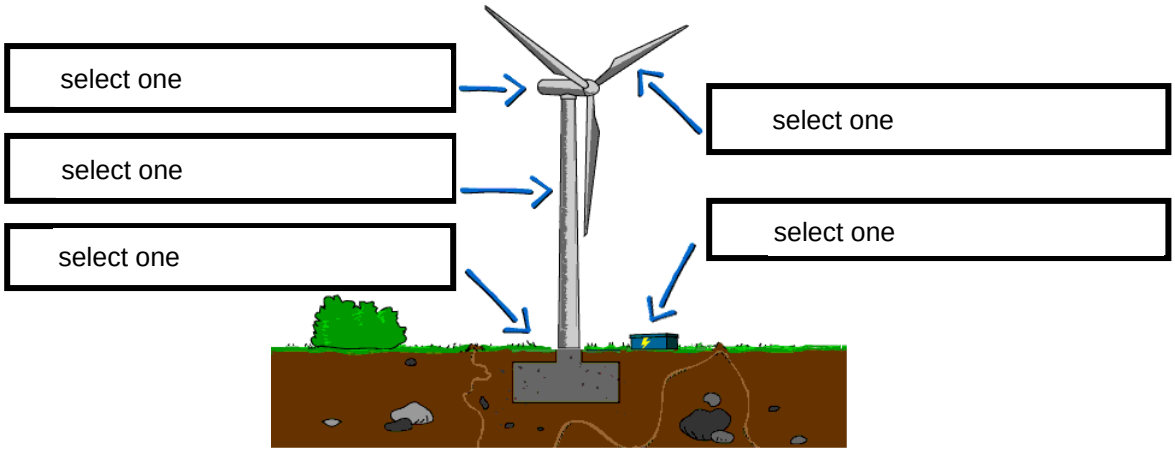
2. What component of a wind turbine usually consists of two or three blades mounted on a shaft? select one
3. *Fill in the blanks*: The combination of select one and select one causes the rotor to spin like a propeller, and the turning shaft spins a select one to make electricity.

Danish Wind Industry - Wind with Miller *www.talentfactory.dk/en/kids/index.htm*

4. Complete the **Crash Course** and fill in the blanks on the following image to identify the main components of a wind turbine.



5. Next, go to **Wind Turbine Simulator** and click on **When and How Quickly** to begin. When prompted, click on the **Choose Turbine** button and select the turbine type **Bonus 1000kW, 54m rotor** and answer the following questions as you complete the provided activities.

   *****Be sure to continue using the same turbine type when answering the following questions.*****

   a. What is the minimum wind speed, measured in meters per second (m/s), required to make the wind turbine *start* running? This is known as the *cut-in speed*. select one
   b. What is the maximum wind speed (m/s) at which the wind turbine will run? This is known as the *cut-out speed*. select one
   c. How much power, measured in kilowatts (kW), does the wind turbine generate at a wind speed of 9.7m/s? select one
   d. What is the maximum power output (kW) of the wind turbine? select one
   e. *True or False*? As the height of the wind tower increases, the wind speed at hub height decreases. select one
   f. What environment (roughness class) offers the best conditions for wind? select one

§6 - Wind Potential

American Wind Energy Association (AWEA) – Resources *www.awea.org/faq/basicwr.html*

1. How does the available energy in a wind stream relate to wind speed, and what happens to the amount of available energy if the wind speed doubles? select one
2. What factors cause variation in wind speed? select one

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Wind Energy Resource Atlas of the United States http://rredc.nrel.gov/wind/pubs/atlas/maps.htm

3. (***Map 2-2 Winter season, Map 2-3 Spring season, Map 2-4 Summer season, Map 2-5 Autumn season***) The *Seasonal Average Wind Resource Maps* developed by the Renewable Resource Data Center (RReDC) depict the average wind speeds in the United States for each season by means of a color scale. View and compare Maps 2-2 through 2-5 in order to determine the best season of the year for generating wind energy in New York State: *autumn*, *winter*, *spring*, or *summer*? select one

NYSERDA – New York Wind Resource Explorer http://windexplorer.awstruewind.com/NewYork/NewYork.htm

The Department of Energy (DOE) explains that wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). Class 4 and above are considered good wind resources.

4. (links *for the **Static PDF Wind Maps** are in a blue box on the right side of the screen*) Follow the links to view each of the **Static PDF Wind Maps** at 30, 50, 70, and 100 meters above effective ground level and compare the color schemes on each map to determine whether wind speed increases or decreases as the height above effective ground level is increased. select one
5. Using the same **Static PDF Wind Maps** from the previous question, determine the areas of New York State that provide the overall best wind resources for wind farm installation.
   select one

Kid Wind – Wind Energy Math Calculations www.kidwind.org/PDFs/SUPPORT_Math_Swept%20Area.pdf

6. The *swept area* of a wind turbine rotor refers to the area of the circle that is created by the rotor blades as they "sweep" through the air. Identify the correct expression of the equation used to calculate the rotor *swept area*.
   ◯ $A = \pi r^3$ ◯ $A = \pi \rho^2$ ◯ $A = \pi r^2$ ◯ $A = \rho r^4$
7. Identify the correct expression of the *Power in the Wind* equation.
   ◯ $P = ½ \times \rho \times A \times V^3$ ◯ $P = ¼ \times \pi \times A^4 \times V$ ◯ $P = ½ \times \rho \times A^2 \times V^4$

§7 -Site Selection: Physical Factors

Power Naturally – Wind Guide www.powernaturally.org/programs/wind/WindGuide.pdf

1. Sustained wind speeds are critical to a wind farm's efficiency. What is the minimum annual average wind speed measured in meters per second (m/s) required to operate wind turbines efficiently? select one
2. *True or False*? The proximity of electric turbines to electric transmission lines is *not* an important factor.
   select one
3. What are some physical characteristics of the land that create an ideal site for wind farm installation? *Check all that apply*.

☐ elevated plateaus ☐ onshore locations relatively free of trees and buildings

☐ ridgelines ☐ offshore locations

☐ high hilltops ☐ locations accessible for construction

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4. Approximately what size area of land, measured in acres, is required for large wind projects? select one
   This is equal to approximately .122 square kilometers (.122 km^2).

Danish Wind Industry *www.talentfactory.dk/en/tour/wres/shear.htm*

5. (***Roughness and Shear***) *Fill in the blanks*: In the wind industry one distinguishes between the select one of the terrain, the influence from select one , and the influence from select one .
6. (***Roughness and Shear***) What roughness class do sea surfaces fall into? select one
   What roughness class does a landscape with many trees and buildings fall into? select one
7. (***Park Effect***) Though land use and the cost of connection to the local power grid indicate that wind turbines should be spaced closer together, the *wake effect* tells us to space turbines as far apart as possible. The *wake effect* states that each wind turbine will slow down the wind behind it as it pulls energy out of the wind and converts it to electricity. How many rotor diameters are required between wind turbines in the prevailing wind direction? select one How many rotor diameters are required between wind turbines in the direction perpendicular to the prevailing winds? select one
8. (***Tunnel Effect***) Placing a wind turbine in a "tunnel" that is formed naturally by the landscape is a clever way of obtaining higher wind speeds than in the surrounding areas. This occurs when the air becomes compressed on the windy side of the "tunnel", and its speed increases considerably as it travels between the obstacles to the wind to the low-pressure side. What would happen if the "tunnel" were to be formed by hillsides that are very rough and uneven?
   select one
9. (***Hill Effect***) *True or False*? It is always an advantage to have as wide a view as possible in the prevailing wind direction at a wind turbine site. select one

§8 -Site Selection: Environmental Factors

American Wind Energy Association (AWEA) – Wind Energy and Wildlife Fact Sheet
www.awea.org/pubs/factsheets/Wind_Energy_and_Wildlife_Mar09.pdf

1. According to the National Academy of Sciences, what percent of bird deaths caused by human (and feline) activities can be attributed to wind energy generation? select one
2. *Fill in the blanks*: Wind businesses have implemented many strategies to attempt to reduce bird impacts at Altamont Pass. Over the years, wind companies have select one wind turbine select one , reduced select one , and added " select one " to prevent perching on turbine towers.
3. What do the letters in the acronym *BWEC* stand for? select one

   Nonrenewable sources of energy (such as coal, oil, and fossil fuels) can have far-reaching effects on the environment due to the drilling, mining, and compressing of fuels, as well as other manufacturing processes that cause flooding of land, stream flow changes and waste water disposal.

4. *True or False*? The use of wind energy largely avoids these far-reaching effects. select one

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American Wind Energy Association (AWEA) *www.awea.org/faq/wwt_offshore.html*

5. *True or False*? It is likely that offshore wind farm installations will disturb the sea bed and cause coastal erosion. select one
6. It has been suggested that the noise from wind turbines will travel underwater and could disturb sea life. What have studies indicated regarding the impact of noise from existing offshore turbines on marine life? select one

§9 -Site Selection: Social Factors

Power Naturally – Wind Guide *www.powernaturally.org/programs/wind/WindGuide.pdf*

1. To meet Federal Aviation Administration requirements, turbines must be illuminated at night with what? select one
2. *Fill in the blanks*: A select one and select one of potential project layouts provide communities with realistic examples of how a project will look from different perspectives.
3. *True or False*? Noise issues regarding wind turbines have been reduced through advances in system designs and the appropriate use of setbacks from residences. select one
4. *Fill in the blanks*: At the base of a tower, typical noise levels from turbines are select one decibels (dB). Noise levels drop to about select one dB at one-quarter of a mile from the turbine, or the same level of noise you would routinely hear inside a select one .

American Wind Energy Association (AWEA) – Myths vs. Facts
www.awea.org/pubs/factsheets/050629_Myths_vs_Facts_Fact_Sheet.pdf

5. *Fill in the blanks*: Shadow flicker is the term used to describe what happens when select one come between the select one and the select one , causing a moving shadow. The effect can be precisely calculated to determine whether a flickering shadow will fall on a given location near a wind farm, and how many hours in a year it will do so. Solutions range from providing an appropriate select one from the turbines to select one to disrupt the effect.

   The American Wind Energy Association (AWEA) explains that ice throw occurs when the weather conditions are such that the blades of a wind turbine become covered in ice. This may result in ice fragments being thrown by moving turbine blades or falling down from static blades.

6. *True or False*? Ice throw is considered to be of great danger. select one

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