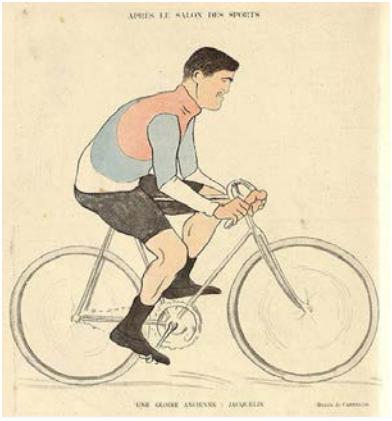
Heat, Energy, and Bicycling in New York City



New York City is one of the densest cities in the world, with millions of people squeezed into a mere 303 square miles. Although it has the world's largest subway system, traffic can still be quite bad, particularly at rush hour. The city decided that it would be a good idea to encourage more people to use bicycles. If more people rode bicycles, the roads would be less clogged with cars. Also, when you ride a bicycle, you are exercising, which makes you healthy. But how can you encourage people to ride more bikes?

The city came up with an innovative solution. In 2013, city workers began installing long racks of bicycles in different neighborhoods. These bicycles were, for a small fee, available for anyone to use. A person could ride the bicycle from one bike rack to another bike rack and park it there. This system was ideal for people who did not own bikes or who wanted to take a bicycle on a short ride without having to return it to the place they took it from. This also made it possible to move quickly between areas that did not connect easily by the subway. The city hoped that people would start using these bicycles instead of taxis or other kinds of cars.

While the city installed the bikes in part because of concerns about traffic, it was also interested in another question: how we use and spend energy. Any time an object is in motion, it is both producing energy and, in many cases, expending energy. For example, a car does not just move because we want it to move. It is powered by a special kind of engine, called an internal combustion engine that burns fuel. When this fuel is burned, it causes a

cylinder to spin in circles. This cylinder is connected to the wheels of the car. As the cylinder spins, so do the wheels. So, one type of energy — fuel — is transformed into another type of energy — forward motion. Energy contained in the motion of an object is called "motion energy."

Just as cars can be considered a kind of energy conversion device, converting fuel to forward motion, so can bicycles. When you step on the pedals of a bicycle, it causes the wheels of the bicycle to spin, pushing the bicycle forward. The energy of your foot pressing down is converted into energy that propels the bicycle. Nearly all transportation — airplanes, trains, pogo sticks — can be thought of as devices that take one form of energy and make it into another form of energy.

When there is a change in one of the forms of energy used to power modes of transportation, then the energy generated by these devices changes as well. Let's say you're pedaling very fast on a bicycle. You are exerting a lot of energy as you do this. You can tell because your heart rate may increase, you may breathe harder, and you may begin to sweat — a sign that your body is trying to cool itself. This is producing a lot of motion energy in the bicycle because you are causing it to move very fast. But if you stop pedaling, then the bicycle will begin to slow down, and the motion energy in the bicycle will decrease. You will also be expending less energy. Your heart rate and your breathing will slow down, too. The decline in your own motion energy — the movement of your feet — is causing the motion energy of another object — the bicycle — to fall at about the same rate.

In the early days of the program, the bike racks were only moderately popular. People were still getting used to the idea of borrowing a bike for a short time at one location, riding it, and then leaving it in another location. Perhaps another reason that people were initially reluctant to use the bike racks is that they were introduced during a very hot week, at the beginning of summer. As discussed above, when you ride a bicycle, you often sweat. This is particularly true when the temperature is high, because your body produces sweat as a way of trying to keep your body cool. If your body gets too hot, you can get sick, so it's in your body's interest to maintain a constant temperature.

How much the temperature of a body increases when it gets warm depends on a number of different factors. While it makes sense that one person in 100-degree heat will get hotter than a person in 75-degree heat, even if two people are exposed to the same temperature, their bodies may react differently. In fact, one person may get much hotter than the other. This is because the amount of heat — which is a form of energy — needed to change the temperature of another object depends on the properties of that object. For example, a person who is wearing a sweatshirt in summer is likely to get much hotter than a person who is wearing a t-shirt. This is because the sweatshirt insulates the person, trapping heat inside. The t-shirt, which is more open, lets the heat escape. So, even if the amount of heat energy directed at the person is the same, the temperatures of different people will react differently.

That raises another question: why does sweat makes people colder? This has to do with a special property of heat. Heat is a kind of energy, and energy moves spontaneously from hotter regions or objects to colder ones. So, consider what happens when your body releases sweat. When it is released, sweat is colder than your body's temperature. When it is on the surface of your skin, it draws the heat from your skin into the water, because heat migrates from warm areas to cold ones. This causes the sweat to warm up. Then the sweat rises into the air and takes some of your body heat with it, cooling the body down.

Your body is constantly monitoring its own temperature. Many of the buildings in New York have air conditioning in the summer. When you walk from the hot street outside to the cool lobby of a tall office building, you can feel the change immediately. After a while, your body temperature will go down. This is because, just as the heat from your body moves to the sweat on your skin, it will also move to the cool air produced by the air conditioning. When your body gets cool enough, it will no longer need to produce sweat to cool you down.

As people continue to ride bicycles, you can expect their collective body temperatures to rise, as their bodies produce energy to power the bicycles and they spend more time outdoors in the hot sun. If the city chooses to install more bikes, then it may also want to install more air conditioning — or pass out more sticks of deodorant.

Name: _____ Date: _____

1. What do cars, bicycles, and many other types of transportation do when they are in motion?

A They take one form of energy and convert it into another form of energy.
B They clog the streets of New York City and create lots of traffic.
C They cause people to sweat because of the energy it takes to use such transportation.
D They make people spend more time outside and increase their body temperatures.

2. What does the author describe in this passage?

A The author describes different types of t-shirts.
B The author describes reasons for moving to New York City.
C The author describes two types of energy.
D The author describes the dangers of riding in taxis.

3. A person on a bicycle is breathing hard, sweating, and pedaling fast.

Based on this evidence, the person is probably

A moving very slowly
B exerting a lot of energy
C exerting a little energy
D exerting no energy

4. When you step from a hot street into an air-conditioned room, you feel cooler. Why does this change occur?

A heat is moving from a cold area (the room) to a hotter area (the street)
B heat leaves your body as it moves from a warm area (your body) to a colder area (the air in the room)
C the motion energy used to walk into the room lowers your body temperature
D the motion energy used to walk into the room raises your body temperature

5. What is this passage mainly about?

A forward motion and backward motion
B cars and air conditioning
C 100-degree heat, t-shirts, and sweatshirts
D motion energy and heat energy

6. Read the following sentences: ". . . a person who is wearing a sweatshirt in summer is likely to get much hotter than a person who is wearing a t-shirt. This is because the sweatshirt **insulates** the person, trapping heat inside."

What does the word **insulates** mean in the sentence above?

A protects the person by keeping the person cool
B protects the person by preventing the loss of heat
C traps the person
D makes the person uncomfortable

7. Choose the answer that best completes the sentence below.

A person's body temperature rises _____ he or she rides a bicycle.

A although
B before
C then
D when

8. According to the passage, how does the human body get rid of heat energy to keep itself cool when the temperature is high?

_____

_____

_____

_____

9. According to the passage, where does the energy that propels a bicycle forward come from?

_____

_____

_____

_____

10. Why can a bicycle be considered a device that can convert energy?

_____

_____

_____

_____