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Activity 1

Just Like Clockwork

I Spy Science

Have you ever woken up panicky, your heart pounding in your chest, your stomach clenching at the thought that you might have overslept and missed an important event—only to find that you are actually awake right on time or even earlier than you need to be?

Simple Science

Do you find that you wake up at just about the same time every day? Your clock radio might not be beeping or singing at you, but that doesn't mean your alarm system has failed you. We all have an internal clock that keeps us ticking, maintaining regular patterns of involuntary behavior—breathing, blinking, swallowing, sleeping, etc. The sleep/wake cycle is programmed according to one of these biological or body clocks.

Science at Work

Try this simple experiment to test your biological sleep/wake clock. Don't set the alarm before you go to bed and ask your family members to let you sleep until your body tells you that it's time to wake up. (You'll have to set a maximum sleep limit or try this while you're on holiday to make sure you're not late for school!) Repeat this several days in a row. Do you wake up at roughly the same time every day? Does your body reset its sleep/wake clock for the weekend?

Sentimental Science

- Describe your normal wake-up routine.

Science Stunner

- Scientists have found that in mice, the sleep/wake clock is genetically programmed. Because every living creature inherits its gene set from its parents, that means that the sleep/wake program is passed down from one generation of mice to the next.

Activity 2

Breathe in; Breathe Out

I Spy Science

Are you breathing right now? Of course you are. You breathe all the time as air passes in and out of your nose. Like your sleep/wake cycle, your breathing is also controlled by a biological clock. Unless something goes terribly wrong with your body or brain, respiration (breathing) occurs regularly and continuously 24/7.

Science at Work

To simulate the inhale/exhale action of your lungs during breathing, you will need a plastic bottle, a drinking straw, modeling clay, two rubber bands, two balloons, scissors and tape.

Ask an adult to cut the bottom off the plastic bottle. Snip the narrow neck off one balloon. Stretch the balloon over the bottom of the bottle, secure with a rubber band and tape in place. Put the end of the straw into the second balloon and hold it in place with the other rubber band. Again, use tape to hold the straw in place. Wrap some clay around the middle of the straw. Push the clay into the opening of the bottle so that the balloon hangs down inside. (Make sure the clay fits snugly in the opening so that air cannot pass in or out.) Holding the neck of the bottle, pull down on the bottom balloon and then release. What happens to the balloon inside the bottle?

Simple Science

Pulling on the bottom balloon causes the balloon inside the bottle to inflate. The inner balloon deflates when you release the bottom balloon. It is changes in volume (an increase, then a decrease) and pressure (a decrease, then an increase) that cause the air to move in and out of the inner balloon. Your lungs work in a similar fashion.

At rest, your two lungs hold about one-half gallon (2.5 liters) of air (they can hold more than one gallon [5 liters] when the body is very active). To collect oxygen for the body, your diaphragm
(a muscular partition that separates the chest from the abdomen) contracts, becoming shorter and flatter, and your lungs expand, stretching downwards. Your intercostals (the short muscles between each pair of ribs) contract, pulling up your ribs and stretching the lungs forward. All of this increases the volume of your chest cavity and decreases the pressure inside it. Because the air pressure outside of your body is greater than the pressure inside your chest cavity, air rushes in through your nose. When your diaphragm and intercostal muscles relax–pushing up and in–your spongy lungs scrunch together, decreasing the volume of your chest cavity and increasing the pressure inside it. This forces the old, stale air (which has been collected by the blood) out of your lungs and back out through your nose.

Science Stunner

- When you breathe you inhale (along with traces of other gases): nitrogen (78%), oxygen (21%) and carbon dioxide (0.04%) and exhale: nitrogen (79%), oxygen (16%) and carbon dioxide (4%).

Activity 3

Hold That Breath!

I Spy Science

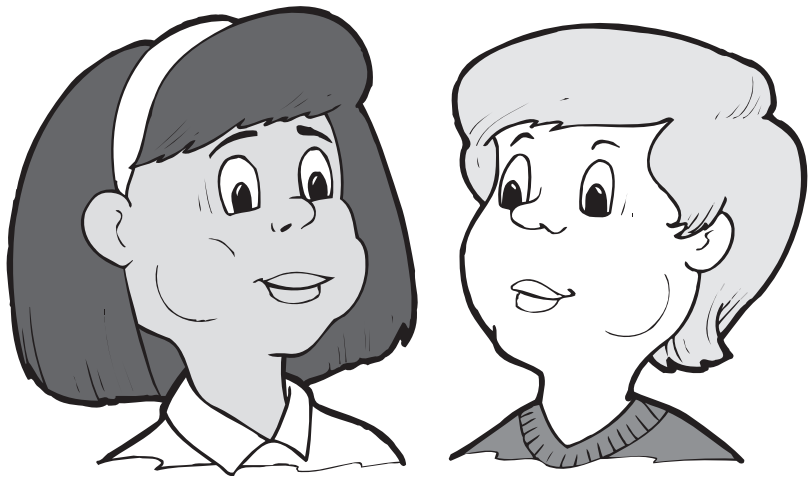
There's a bad smell in your bedroom. Can you put your breathing on hold until it's gone?

Science at Work

Try holding your breath. How many seconds tick by before your body forces you to inhale? Is there any way you can increase the amount of time you can hold your breath?

Simple Science

Although you can prevent yourself from breathing for short periods of time—you do it all the time when you swim underwater—your breathing clock cannot be stopped. The human body has no way of storing oxygen, so it needs a constant, fresh supply to stay healthy. Two sensors situated near the large blood vessels that supply blood to your neck check the amount of oxygen in the blood that is going to your brain. If the oxygen level in your blood drops below a certain critical point and your brain is not getting the oxygen it needs—like when you are holding your breath—the sensors send out a distress signal. Your brain receives the alarm and forces you to breathe (or speed up your breathing if, for example, you are exercising strenuously). Although you can't stop the clock altogether, it is possible to increase your breath-holding capacity slightly. If you breathe in and out several times before you hold your breath, you put extra oxygen into your blood. Your cells can hang on a little longer with that additional extra oxygen, so you don't have to breathe as soon as you otherwise would.



Science Stuff

When you pull air in through your nose (which also has the job of warming and moistening the air and filtering out bits of dust with hairs and mucus), it goes down your throat and into your windpipe. The windpipe branches into two air tubes, the bronchi, which lead to the left and right lungs. In the lung, each bronchus divides into lots of smaller tubes, called bronchioles. Each bronchiole ends in 250 million microscopic bubbles, called alveoli. The alveoli are surrounded by superhighways of microscopic blood vessels called capillaries. Oxygen passes from the alveoli into the blood in the capillaries and is pumped around your body by the heart muscle.

Science Stunners

- Most people breathe 14-16 times each minute.
- Your brain is hungry for oxygen. It takes just under 3 cubic inches (46 cubic cm) of oxygen from the 166 pints (750 ml) of blood that flow through it each minute. That accounts for roughly 20 percent of the body's total at-rest oxygen consumption. Without oxygen, cells begin to die within minutes.