External and Internal Stimuli

Background

All organisms maintain a balance of internal conditions such as body temperature, moisture level, and energy level as a requirement for survival. This process, called homeostasis, is the tendency of an organism or cell to maintain stable body conditions to stay healthy and functioning. A change in external or internal conditions of the organism is a stimulus. An organism responds to external or internal stimuli to maintain balanced stable conditions and survive.

An external stimulus is something that happens in the environment or area around an organism that causes the organism to respond or react. For animals, a stimulus can be caused by many different events such as a change in the weather, the approach of a predator, the call of a mate, the taking in of pathogens or toxic substances. Toxic substances can be things such as when an animal breathes in smoke, its response is to cough to clear the toxic substances from its lungs. In all cases, the animal will respond in a way to increase the likelihood of the survival of the animal or its species.

The fight or flight response enables animals to respond to potentially dangerous situations. The endocrine system sends messages to the nervous system and other body systems to prepare for danger. These responses are intended to help an animal survive a dangerous situation by allowing it to either run for its life or fight for its life. This response is an instinctive reaction and is one that every animal possesses.

Not all external stimuli are life threatening, for example: cooling temperatures stimulate a bear to prepare for hibernation or a bird to fly to a warmer climate to find food. The red flash from the throat of a male anole stimulates the female anole to approach the male to mate. The setting of the sun stimulates some birds to find a place to roost for the night, while other birds, like owls, are stimulated to begin their nightly search for food.

Plants respond to external stimuli for orientation in growth and movement. This response is called tropism and may be toward (positive) or away (negative) from the external stimulus or stimuli. Phototropism is a plant’s (positive) response towards light. The ability to grow towards sunlight gives a plant an evolutionary advantage. More energy from sunlight results in an increase in photosynthesis resulting in more glucose production. Gravitropism is a plants’ response towards or away from the force of gravity. This form of tropism causes roots to grow toward the source of gravity (positive tropism) and the stalk, stems, and leaves to grow in the opposite direction (negative tropism).

Continue to the next page.
Background Information, continued

Organisms also respond to internal stimuli, coming from inside an organism. Some examples of internal stimuli for animals include thirst, hunger, blood-sugar levels and oxygen levels. So, when an animal feels hunger, it is stimulated to hunt for food.

Fever is an increase in an organism’s regulatory body temperature usually in response to an infection or inflammation. Fever occurs when fever-producing substances, such as viruses or bacteria, trigger the body’s immune system. These substances are external stimuli from a source outside the body, stimulating the production of fever-producing substances inside the body.

Vomiting is a response to an internal stimulus in which the contents of the stomach are forcibly emptied either voluntarily or involuntarily through the mouth. Factors that can cause vomiting include viral infections, food poisoning, motion sickness, ulcers, and other infections or illnesses. These stimuli trigger the body’s response to vomit as a mechanism for maintaining balance.

In plants, wilting is an example of a response to the internal stimulus of a decrease of water in the cells. This stimulates the plant to take in water. Once the roots are able to resupply the plant cells with enough water, the plant responds by regaining its healthy shape. The need for water and nutrients stimulates root growth such as shallow roots for areas with wet climates and deep roots for dry climates.

Answer the Background questions in your Student Journal.
Part I: External Stimuli in Animals

Protection of the organism is one of the reasons animals respond to stimuli. The ability to see is very important for many animals including humans. In order to protect the eyes, humans have an automatic response to the stimuli of something moving rapidly towards the face. In this investigation you will observe a human response to an external stimulus.

Procedure:
1. Choose one person to be the responder, one person to be the external stimulus, and one or more persons to be the observers.
2. The responder holds a clear plastic sheet protector with two hands as a shield to cover his or her face. The sheet should be held at a distance of about 3 cm from the end of the responder’s nose.
3. The external stimulus stands 0.5 to 1 meter away from the responder and throws 5 cotton balls, one at a time, at the eyes of the responder. The responder should relax and not fight the natural response.
4. The observers stand on either side of the responder to watch and record the response.
5. Rotate roles until all have had an opportunity to serve in each role for a total of 4 trials.

Complete Part I in your Student Journal.
Part II: Internal Stimuli in Animals

Homeostasis is the tendency of an organism or cell to maintain a balanced state so as to maintain health and functioning. Maintaining a livable body temperature is an important part of homeostasis. Animals have various methods of keeping a constant body temperature. In humans, the integumentary system works with other body systems to help us keep our “cool”. The human body needs to maintain a stable temperature in order to stay alive and function properly. The body sweats to keep cool and shivers to stay warm. In this activity you will observe how an internal stimulus of rising body temperature results in a response to cool the system down.

Procedure:
1. Choose one person to be the jogger, one person to be the sitter, one person to be the timekeeper and one to be the observer.
2. Place a plastic bag over one hand of the jogger. Place a second plastic bag over one hand of the sitter. Tape the bags around their wrists to form a seal. Keep the tape on the plastic – do not tape the skin. Do not make the seal so tight it cuts off the blood circulation.
3. The timekeeper uses a stopwatch to mark the time as the jogger jogs in place while the sitter sits still for 3 minutes. The observer records any physical changes that occur to the jogger and the sitter during this time.
4. At the end of 3 minutes the jogger stops jogging and the observer continues making observations which includes asking questions about the plastic wrapped hands.
5. Remove the bags and observe what has collected inside the bags and on the hands.
6. Feel the fingers of the jogger and the sitter.
7. Record your observations in your Student Journal.

Complete Part II in your Student Journal.
Part III: Plan Your Investigation

Background
You are a medical student about to graduate and become a doctor! However, as part of your graduation requirements, you must correctly diagnose the illnesses of four patients based on the body’s attempts to maintain homeostasis; in other words, the symptoms caused by internal or external stimuli.

You will have access to each patient’s case description. Remember that the body responds internally to maintain homeostasis as a result of internal or external stimuli. Pathogens are infectious microbes that cause diseases when they enter the host body and are as such external stimuli. An internal stimulus is a stimulus that comes from inside an organism. You may have experienced an internal stimulus of hunger after a long day at school. This stimulus prompts the response of eating some food in order to regain needed energy. When reading the patient’s case descriptions you will consider the symptoms of each as a result of body response to internal or external stimuli. You will also have access to a Description of Symptoms and Causes Reference Sheet.

You will write to each patient to provide an explanation about how you concluded your diagnosis and how the body is behaving internally in response to an external stimulus such as a pathogen or other causative stimulus. You will conduct an investigation to identify the internal or external stimulus that results in typical body responses.

Question of Inquiry:
With your class and teacher, discuss the Question of Inquiry and list the materials that you will need to conduct your investigation.

Technology Connection
Use a computer with internet access for additional research regarding patient symptoms.

Safety Precautions
This is a scenario so additional safety precautions are not required.

Procedure: You will follow a set of instructions to implement your investigation in Part IV.

Answer the questions for Part III in your Student Journal.
Part IV: Implement Your Investigation

Procedure:

1. Read each patient’s case description in the Meet the Patients Reference Sheet.
2. Apply prior knowledge about the symptoms and use the Description of Symptoms and Causes Reference Sheet to diagnosis each patient.
3. Write to each patient, explaining how you concluded your diagnosis and how the body is behaving internally in response to the causative internal or external stimulus.

Complete the Reflections and Conclusions questions in your Student Journal.