EXTERNAL AND INTERNAL STIMULI

reflect

Think for a moment about activities that require balance. Riding a bicycle and walking across a balance beam require great balance. So do most daily activities like bending over to pick up a book or stepping into the shower. If a person loses balance, he or she can fall off the bicycle or balance beam. The result can be disastrous.

Maintaining balance in order to prevent injuries refers to a specific function of the body that is maintained by the nervous system. But the human body as a whole must maintain internal balance as well. If this balance is not maintained within certain limits, disease or death is possible. How does the body maintain internal balance? What sort of information does the body rely on?

Homeostasis

Homeostasis is the tendency of an organism to maintain a balanced state in order to maintain health and functioning. Many body functions work to maintain homeostasis. For example, the human body is most comfortable around 98.6 °F. When the body becomes too cold, the muscles shake, or “shiver.” Shivering produces warmth that heats the body’s core. When the body is too hot, such as when there is a fever, the body sweats in an effort to cool down.

All organisms have ways of dealing with a changing environment. Anything that provokes a response in an organism is called a stimulus. A stimulus can be internal, or from within the organism itself. A stimulus can also be external, meaning it occurs outside the organism. Both internal and external stimuli can cause a response, or resulting reaction, in an organism. A response can be behavioral or biological. Behavioral responses typically involve physical movements or reactions. Think about what happens when someone touches a hot surface. The stimulus, a hot surface, is external. The typical response is to pull the hand away. This is a behavioral response. Biological responses typically occur inside the body. Now think about what happens when the body is infected with the flu virus. The stimulus is the viral infection, which is internal. The fever that accompanies the flu is the body’s way of trying to kill the invading virus. This is a biological response. You’ll learn more about these responses later in the lesson.

Any response to a stimulus typically moves the organism back to homeostasis in order to maintain a balanced, stable condition that favors survival.
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What happens if homeostasis is not maintained? Imagine the body’s response to strenuous exercise. The body heats up. Sweat is produced in order to cool the body down. The sweating causes the body to lose a lot of water and possibly reach a state of dehydration. Without fresh water to replenish the water lost through sweating, the body may not function properly. In severe cases, dehydration can lead to death. Homeostasis is necessary for survival.

Plant Responses to External Stimuli
Most plants are rooted in place. However, they can still respond to external stimuli in a variety of ways that promote survival. One type of behavioral response in plants is tropism, a directed growth or movement in response to a stimulus. Tropism can be positive tropism towards the stimulus. Tropism can also be negative tropism, a directed growth or movement away from the stimulus.

Plants may respond to the following external stimuli:

- **Light**: Plants rely on photosynthesis to convert light energy into chemical energy. Plants often grow towards a light source. This behavioral response is called positive phototropism. Some plants actually move to follow the Sun as it travels through the sky each day. The turning response to follow the sun is called heliotropism. This allows the plant to maximize its exposure to light energy.

- **Gravity**: Gravitropism is the growth of a plant in a particular direction in response to gravity. Roots grow downward in response to gravity. This is an important behavior that helps plants grow roots into the soil where they can soak up water and nutrients needed for the plant to survive.

- **Touch**: Plants respond to touch through thigmotropism. Plants exhibit thigmotropism when they change their growth to bend around an object or grow up a wall or tree. Many types of vine plants like ivy exhibit thigmotropism.

**look out!**

Plants respond to touch by changing their growth patterns. However, plants do not have a nervous system like animals. Instead, they coordinate their behavioral responses using plant hormones that travel inside the plant.
Look at the images below. Which type of behavioral response is best illustrated in each image?

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Animal Responses to External Stimuli
Unlike plants, animals are usually free to move throughout their environment. Movement gives them access to food. It also exposes them to dangers, such as predators. Animals must react to changes in their external environment in order to survive. If a reaction is immediate and involuntary, the response is called a reflex reaction. Blinking the eyes in response to sunlight is an example of a reflex reaction.

Reaction to an external stimulus requires sensing the stimulus. The five senses (hearing, sight, taste, smell, and touch) are used to detect the stimulus. The nervous system processes the information coming in from the senses and helps drive the responding behavior.
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External stimuli that animals respond to include:

• **Light:** Animals respond to changes in daylight. Some animals are *nocturnal*, meaning they are awake at night and sleep during the day. This is particularly helpful for animals that live in hot deserts. These animals hunt at night when temperatures are cooler. Other animals become active at sunrise, like roosters who crow when the Sun comes up in the morning. Behaviors that follow a daily cycle are called *circadian rhythms*. Circadian rhythms are often triggered by the daily changes in sunlight.

• **Temperature:** Animals require certain temperature ranges in order to survive. Some animals survive best in the hot desert, while others need a cold environment. Some animals *migrate* to warmer areas in the winter in response to changing seasonal temperatures.

• **Danger:** Animal responses often rely on more than one sense at a time. Animals can sense danger, such as a predator, by seeing it, smelling it, or touching something it recognizes as dangerous. If the animal thinks it is in danger, an important behavioral response is the *fight or flight response*. The animal will either run away (flight) or become aggressive towards the danger (fight) in order to survive. The fight or flight response relies on sensory information that is processed by the nervous system, as well as hormones from the endocrine system that drive the behavioral response.

Looking to the Future: Virtual Reality

Animals, including humans, rely on visual information to interact with the world around them. Virtual reality games create fictional visual worlds in which players are immersed in a game or experience. But virtual reality is not just for games. Doctors use virtual reality to create safe, simulated environments. They expose patients to situations or objects that create fear or anxiety in order to teach patients how to manage their fears in the real world. As this technology becomes more available, it may be used more widely to treat patients with memory loss, physical impairments such as limited movement of the limbs caused by brain damage, and even eating disorders.
Plant Responses to Internal Stimuli
All organisms have internal communication pathways to help them maintain homeostasis. Plants need water and nutrients to grow. If water is lacking, the plant may wilt in response. If nutrients are missing from the plant’s environment, its growth might be stunted. These are examples of biological responses.

As with responses to external stimuli, plants rely on hormones to send signals within the plant in order to respond to internal stimuli. For example, some hormones signal a plant to expand its root system in response to lack of water or nutrients.

Animal Responses to Internal Stimuli
Internal stimuli cause responses to protect an animal and maintain homeostasis. Thirst and hunger are biological responses to lack of water and food. Some responses to internal stimuli protect the animal from serious illness. When contaminated food is ingested, an animal will vomit to remove the food from the body. If a pathogen, such as a virus, infects the body, the organism may raise its core body temperature through fever. The fever helps the body inactivate the invading virus. A fever is a biological response to chemicals released inside the body triggered by the invading pathogen.

what do you think?
The human body’s temperature fluctuates throughout the day. These fluctuations are typically within the normal range and do not upset homeostasis. What activities do you think change body temperature within the normal range? Other than infections, what factors or activities might change body temperature outside of the normal range?