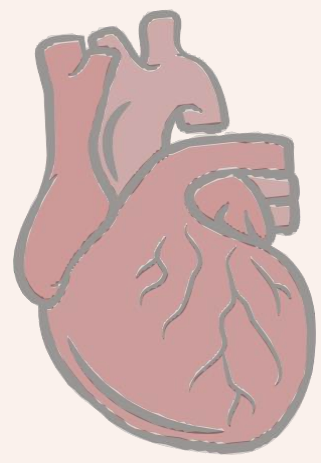
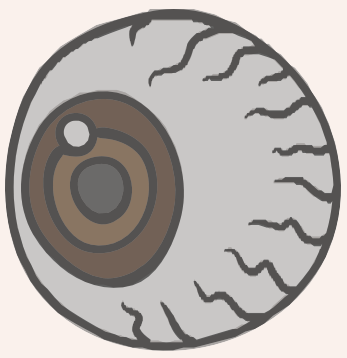


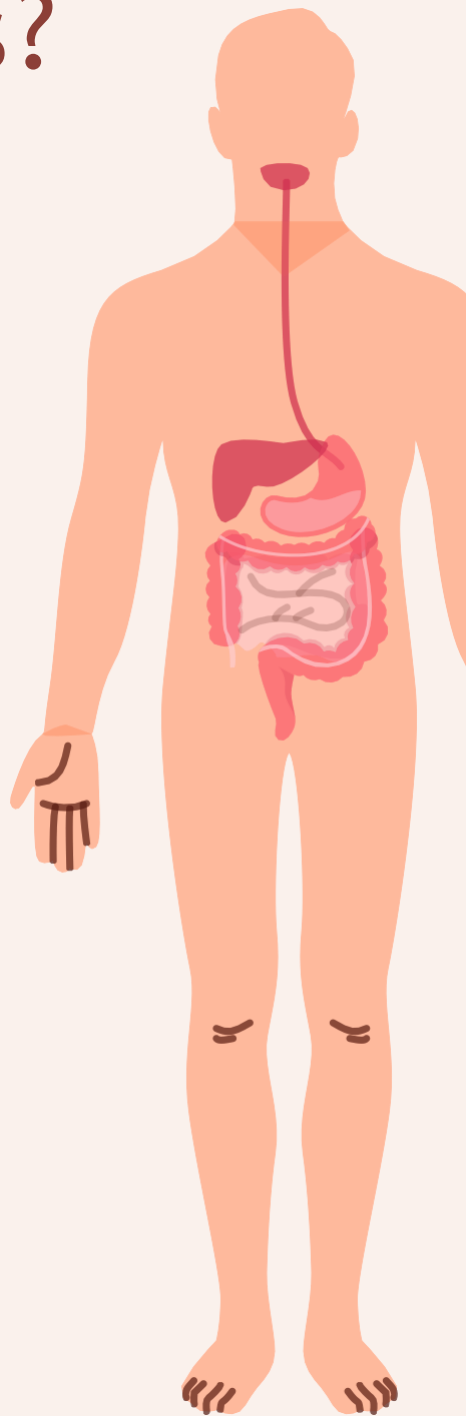
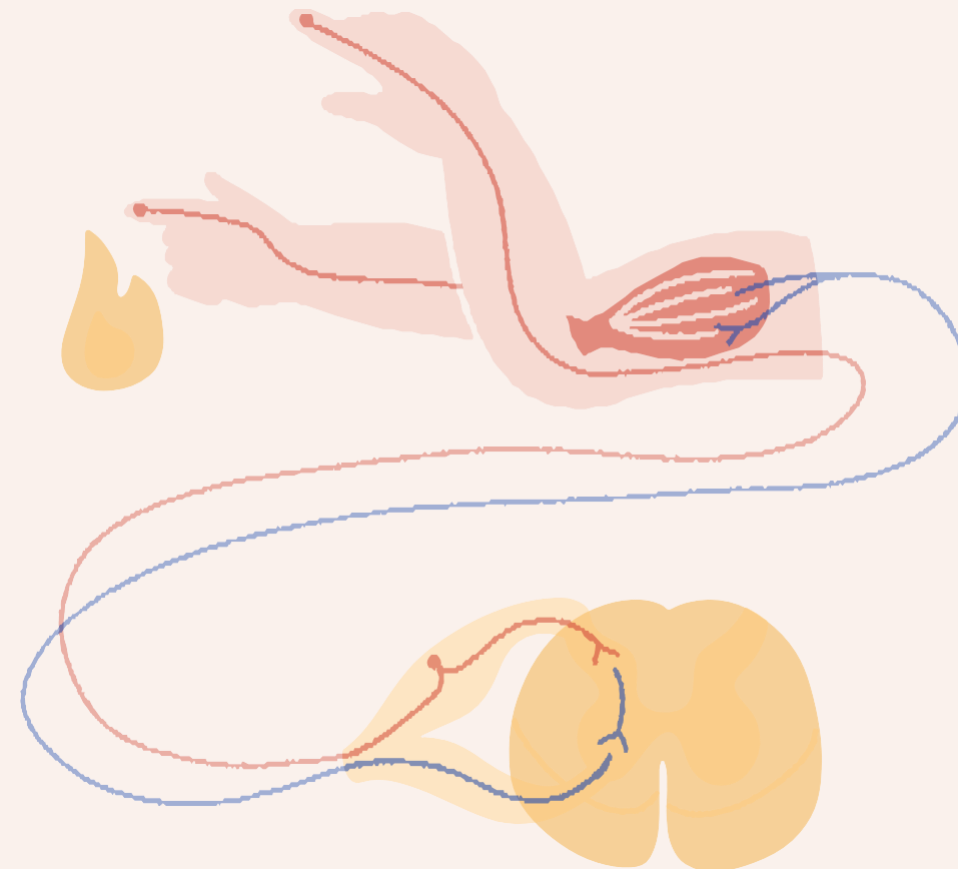
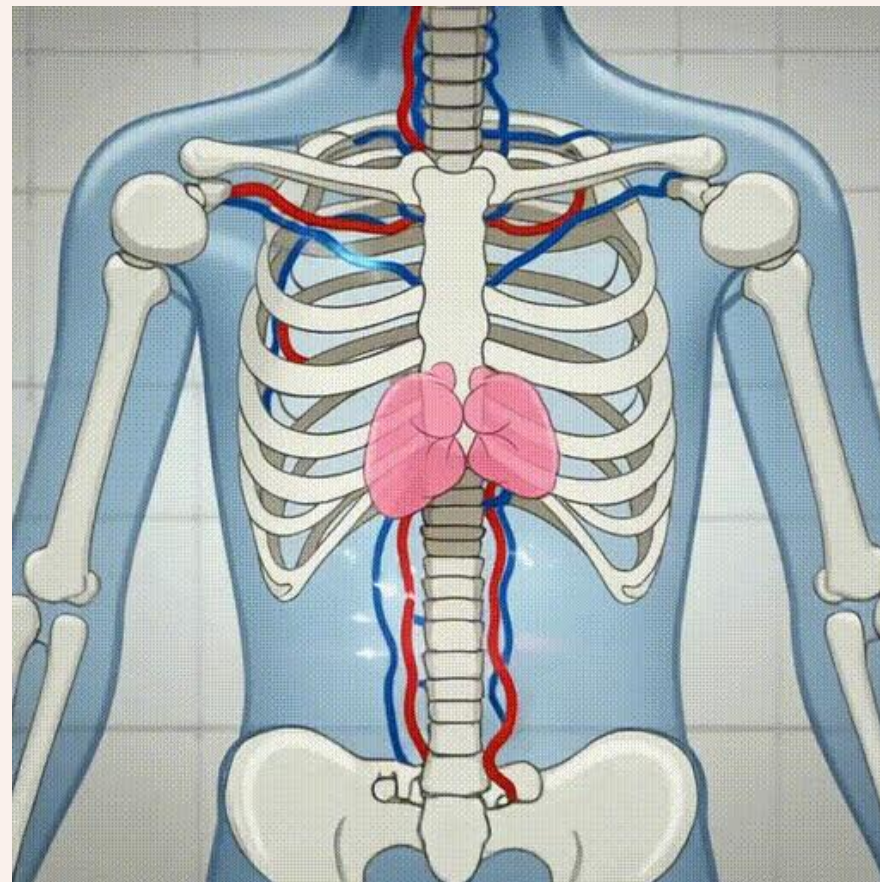
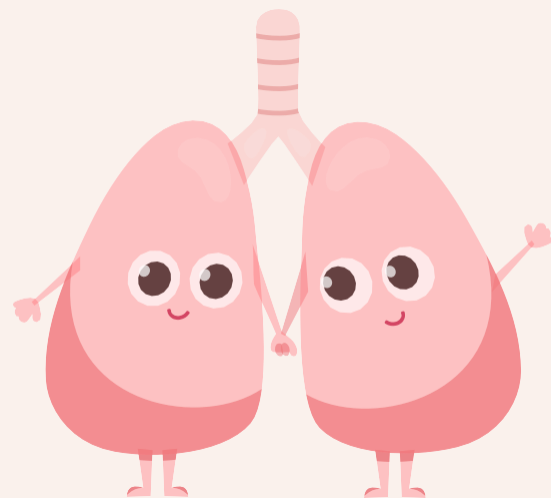
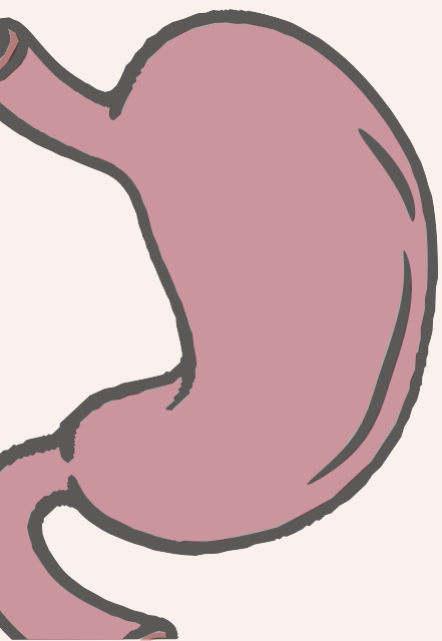
From Brain to Body: The Systems Response Game



Think-Pair-Share



What sense (smell, taste, sight, touch, hearing) do you think warns you the fastest when something is dangerous?
Defend your answer.



Learning Objective

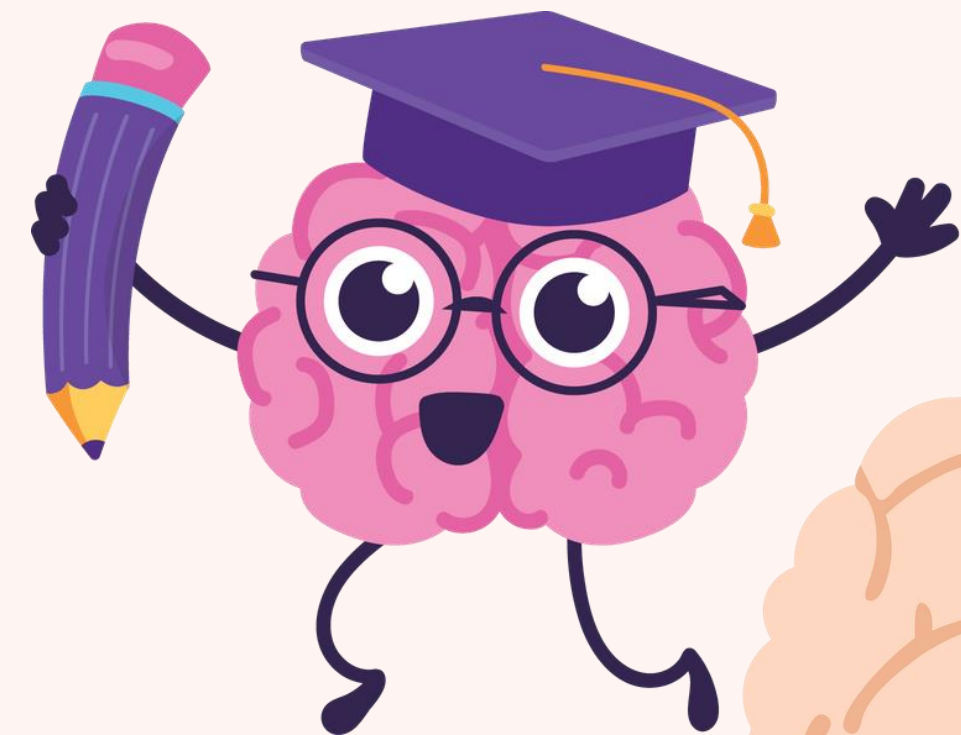
Activity Focus:

Students will model how the brain and body systems work together to detect stimuli and produce a response.



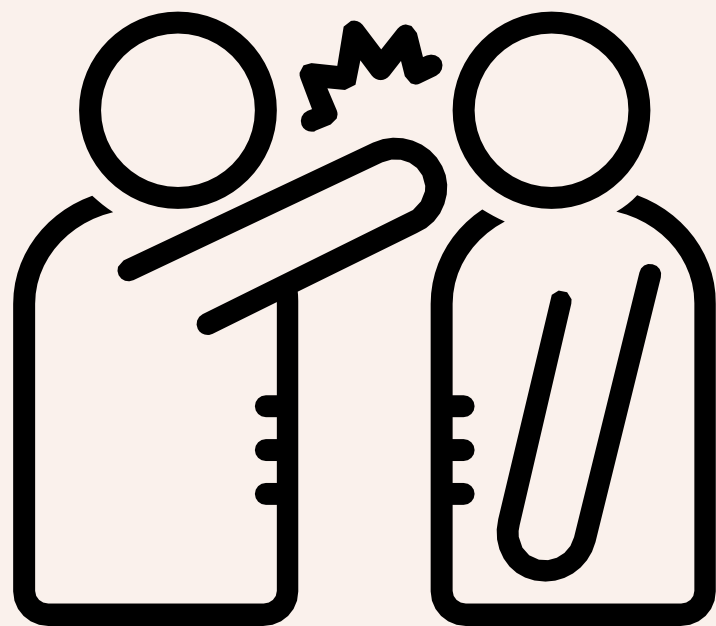
Students will:

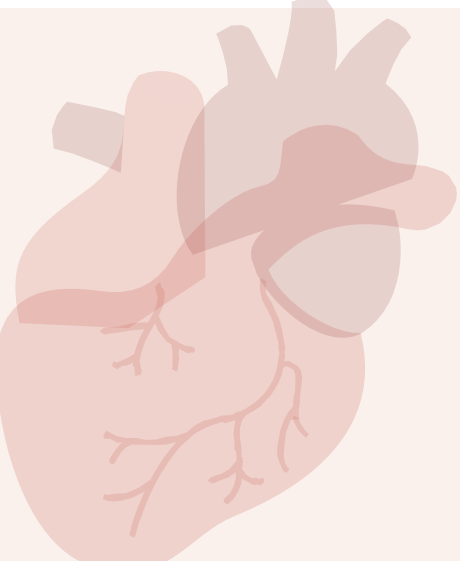
- Explain system interactions.
- Build a signal-flow model.
- Apply the engineering design process.
- Communicate scientific ideas clearly.



Hand Slap Game

- Pair up with someone near you.
- Choose upper or lower hand.
- Crumple the sticky note and place it between you.
- First one to grab it wins.
- Watch the example.





How It Works

Why the curved hand often wins:

1. The brain predicts obstacles.

Your brain quickly plans a path around the other hand before you move.



2. The brain controls speed.

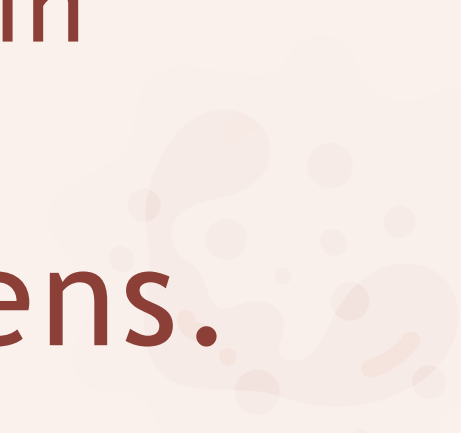
It activates the right muscles at the right time to move fast and smoothly.

3. Reflex + planning work together.

Some of the reaction is automatic, and some is rapid brain planning.

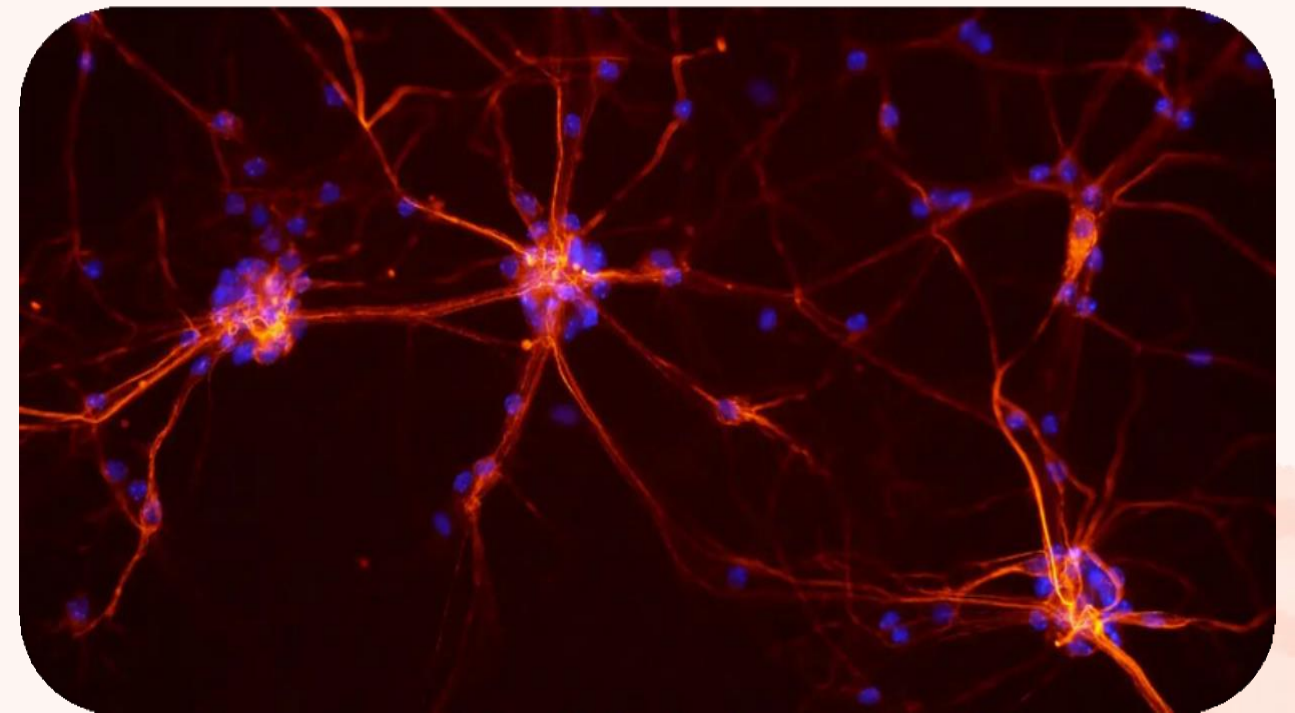
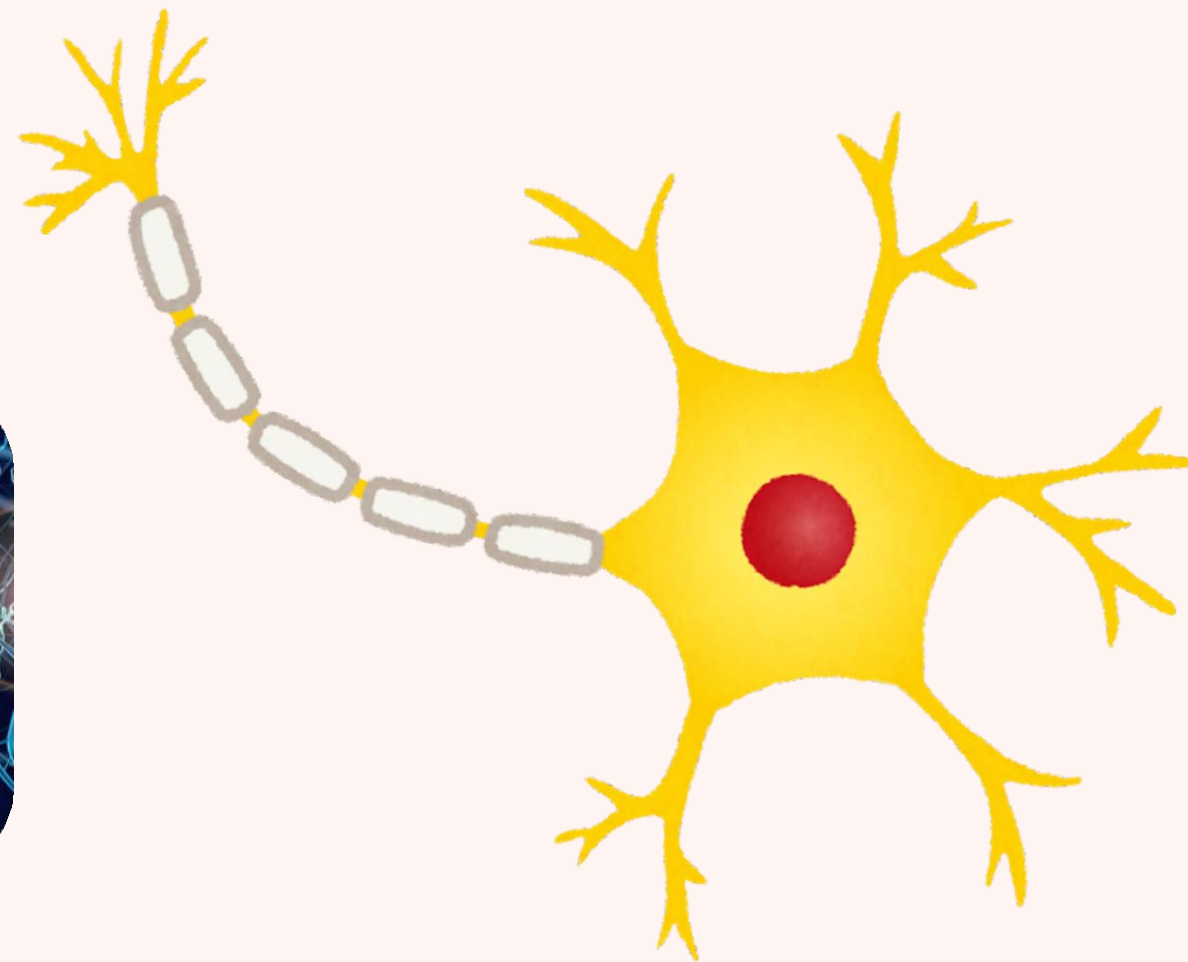


The brain finds out after the movement happens.



How Messages Travel

- Neurons (nerve cells) send electrical signals.
- Messages travel brain → spinal cord → nerves → muscles.
- Happens in milliseconds!



Brain to Body

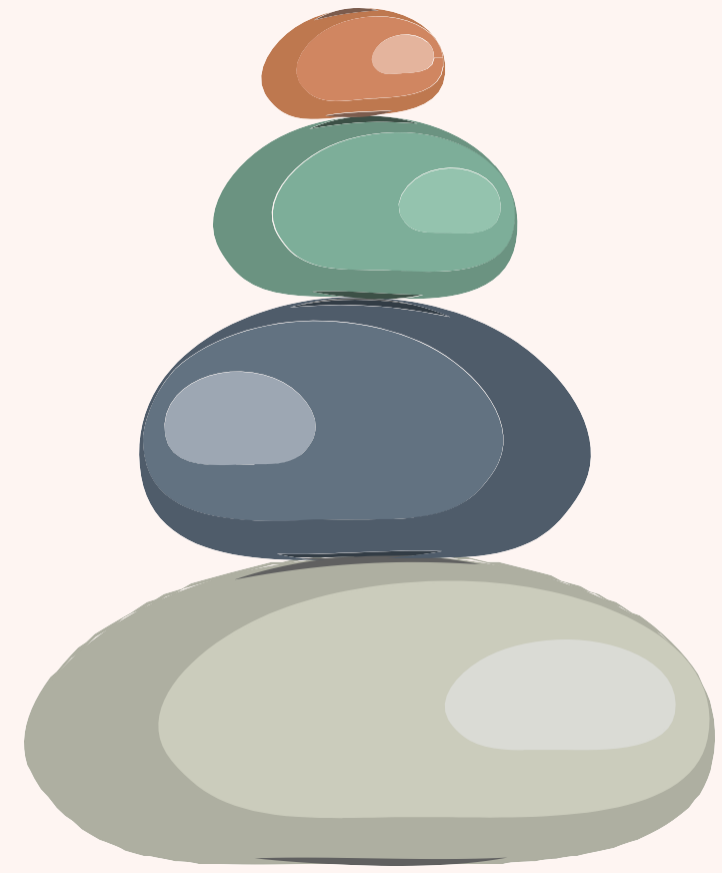
Sense → Signal → Respond

Touch hot stove → nerves send message → body pulls hand away.

- 1. Stimulus** – Something happens.
- 2. Example** – You touch a hot stove.
- 3. Receptor** – Sensors in your skin detect it.
- 4. Sensory neuron** – Carries the signal to the spinal cord.
- 5. Interneuron (spinal cord)** – Makes a quick decision.
- 6. Motor neuron** – Sends a signal to muscles.
- 7. Response** – Muscles contract and you pull your hand away.

Goal: safety & stability (feedback mechanism)

What is Homeostasis?



Homeostasis is keeping the body's internal conditions stable even when the outside changes. Cells need this balance to survive and function; without it, they can be damaged or die.

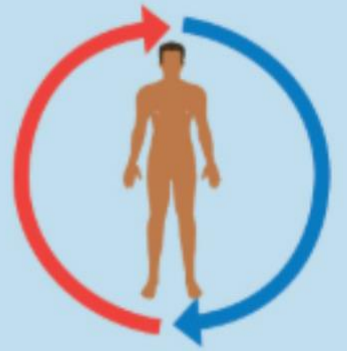
Your body uses **negative feedback** to counteract changes. Examples include:



Blood pressure.



Oxygen levels.



Body temperature.

Your body uses **positive feedback** to strengthen a response until it isn't needed anymore. Examples include:



Blood clotting.



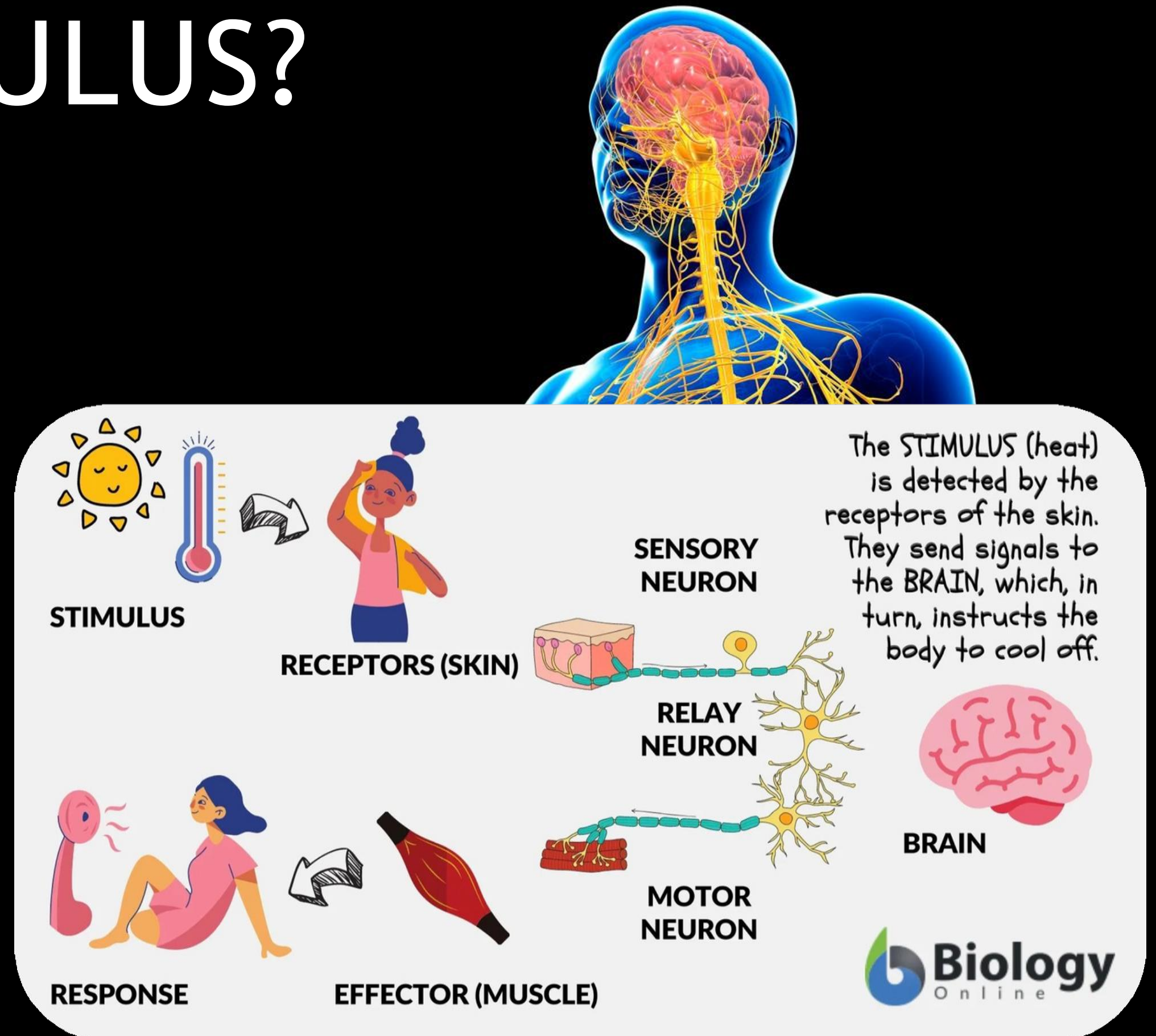
Immune responses and inflammation.

Every disease that affects your body involves a disruption of homeostasis.

WHAT IS A STIMULUS?

A stimulus is a change in the environment that receptors detect and the nervous system responds to.

Examples: heat, loud sounds, bright light, cold, hunger, pain, exercise.

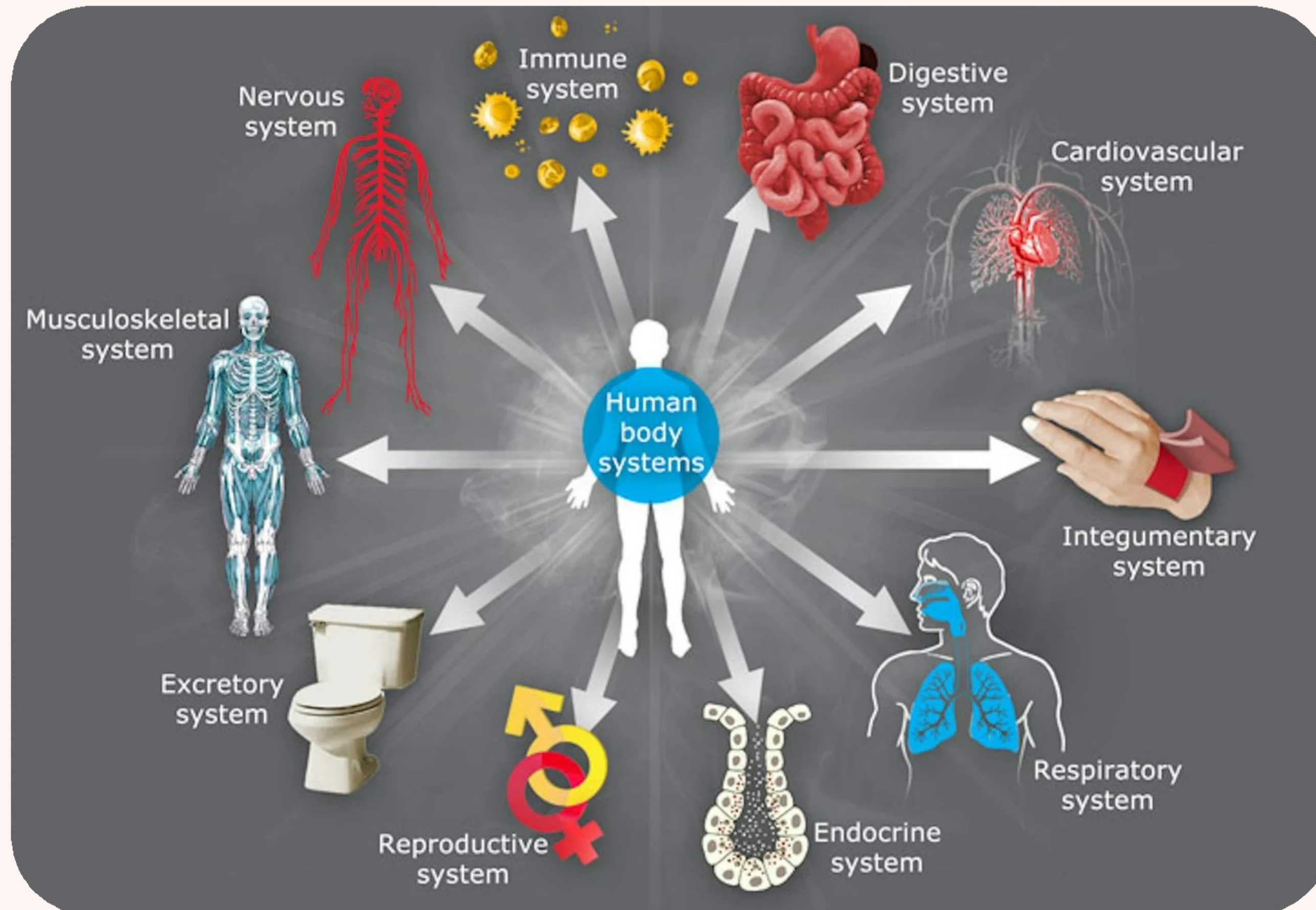


WHAT IS A RESPONSE?

A response is how your body reacts to a stimulus. It may be fast (reflex) or slow (hormonal) and works to maintain homeostasis.



Body Systems Review



Body Systems Review

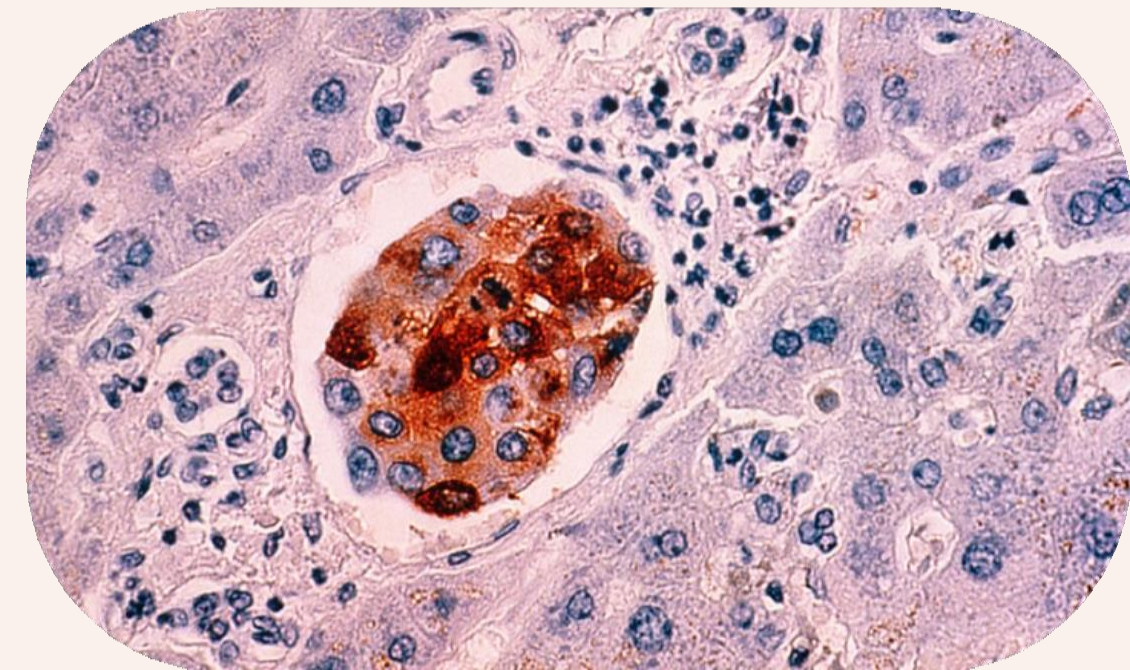
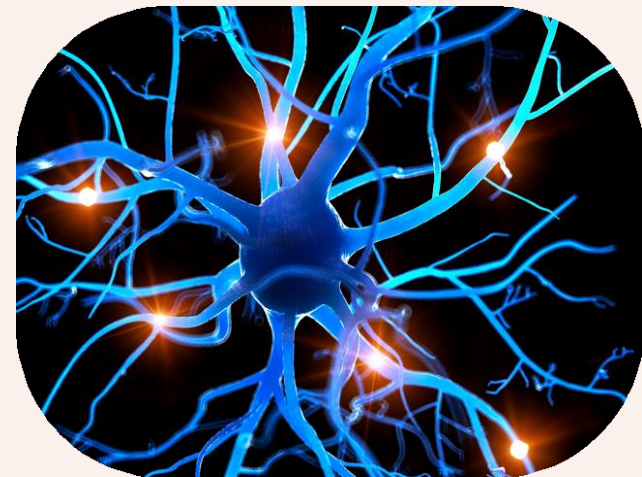
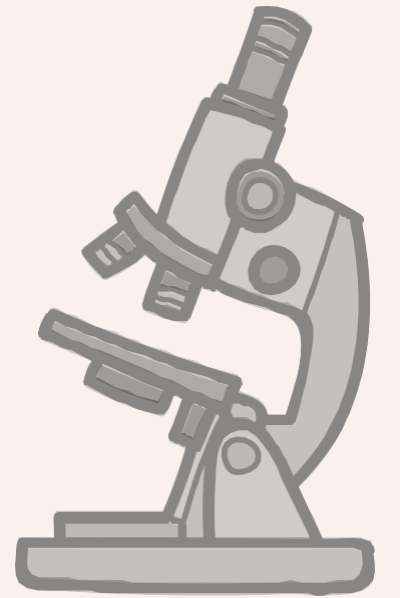
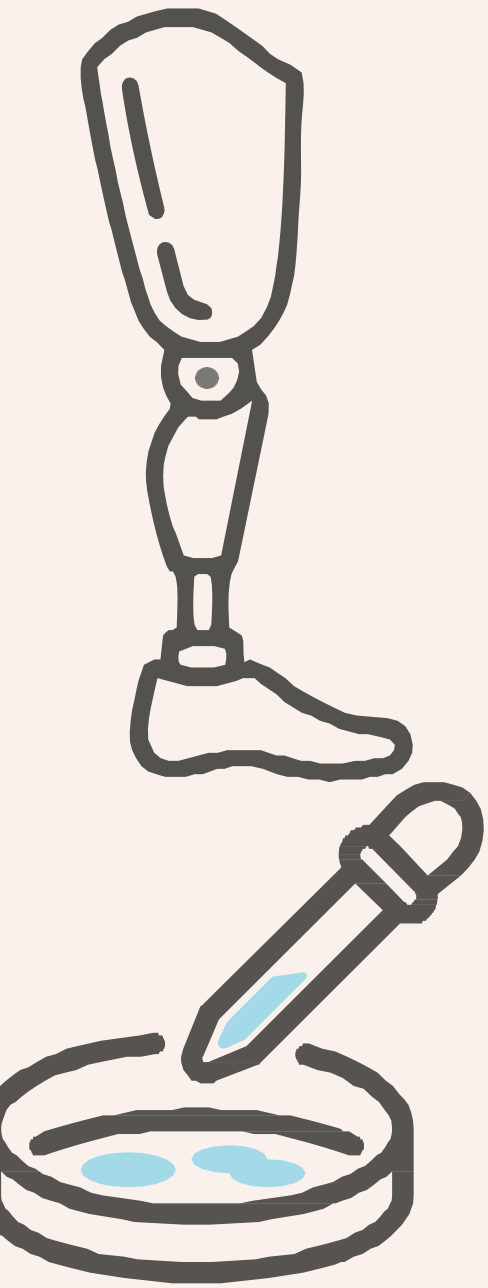
- **Nervous system** – Detects stimulus, sends signals
- **Muscular system** – Carries out movement
- **Circulatory system** – Delivers oxygen/nutrients
- **Respiratory system** – Increases breathing rate
- **Endocrine system** – Hormone-based responses
- **Integumentary system** – Skin senses temperature
- **Immune system** - Fights germs and keeps you healthy
- **Digestive system** - Breaks down food for energy



HOW THIS SCIENCE IS USED

Engineers and scientists use “sense and respond” to create:

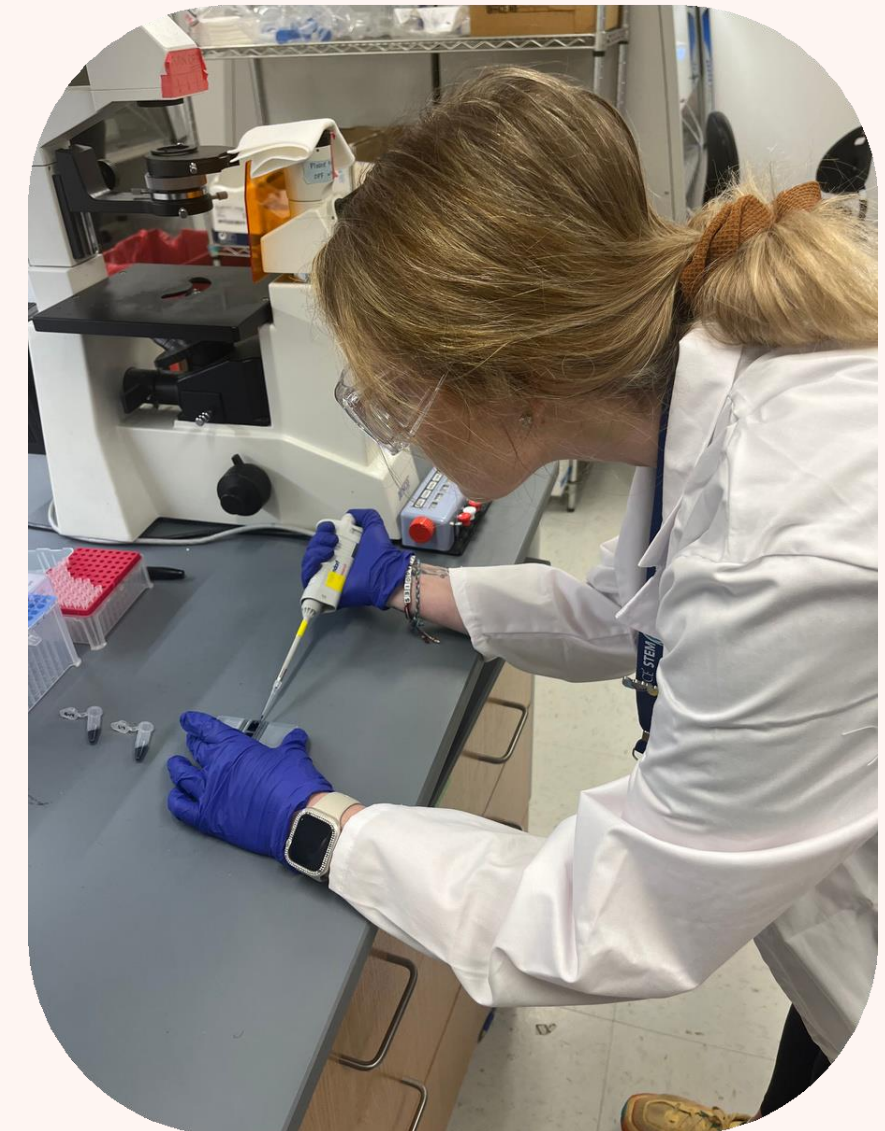
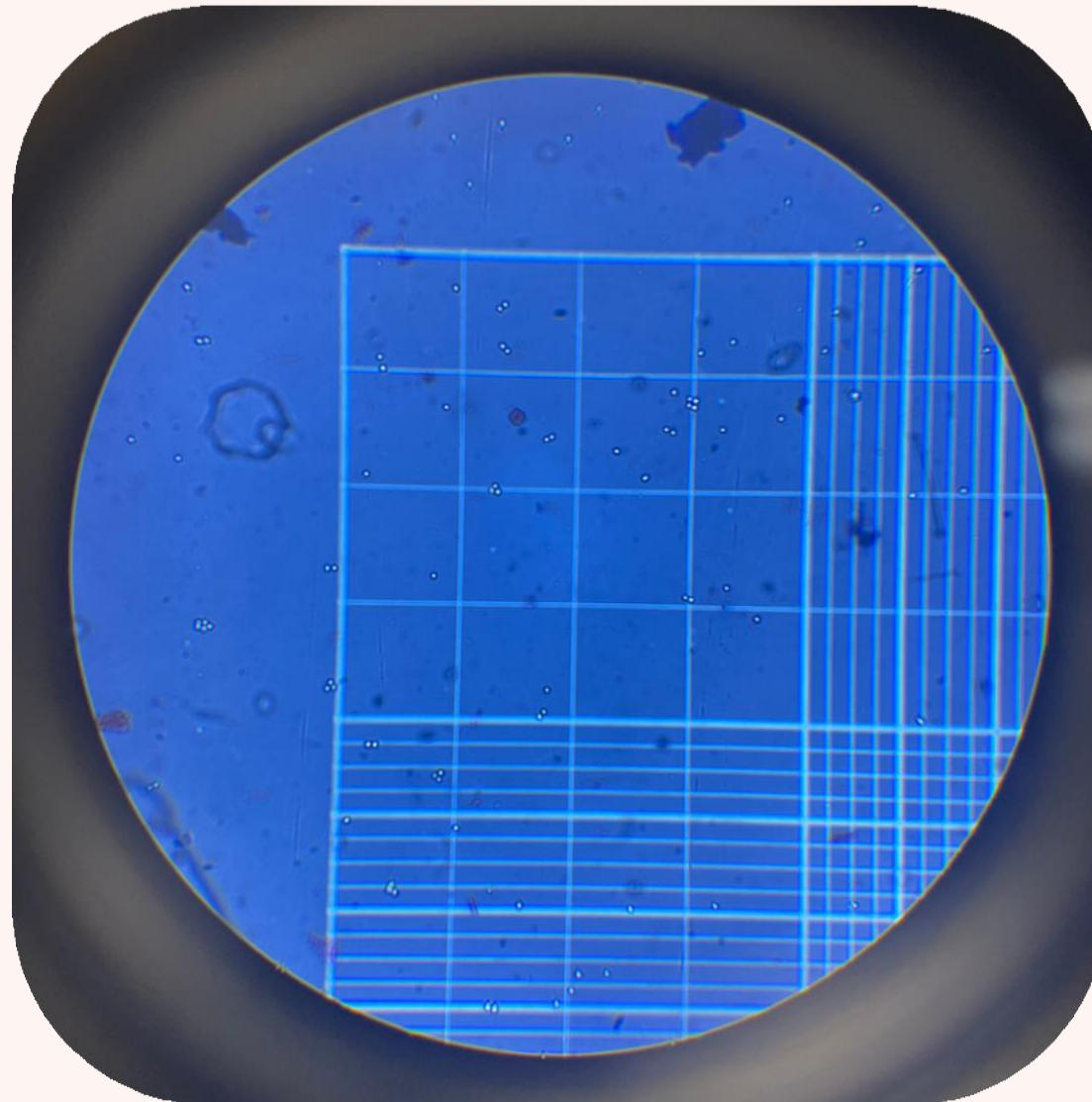
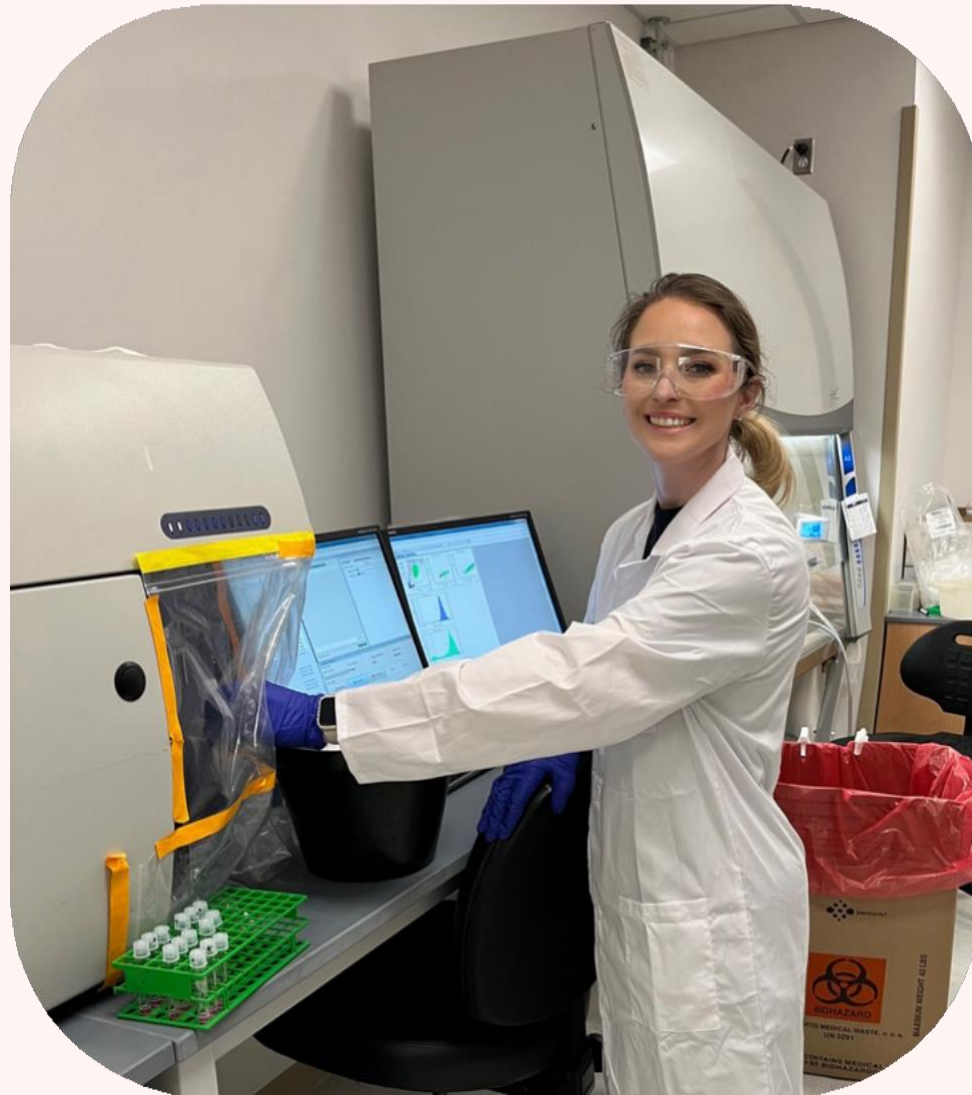
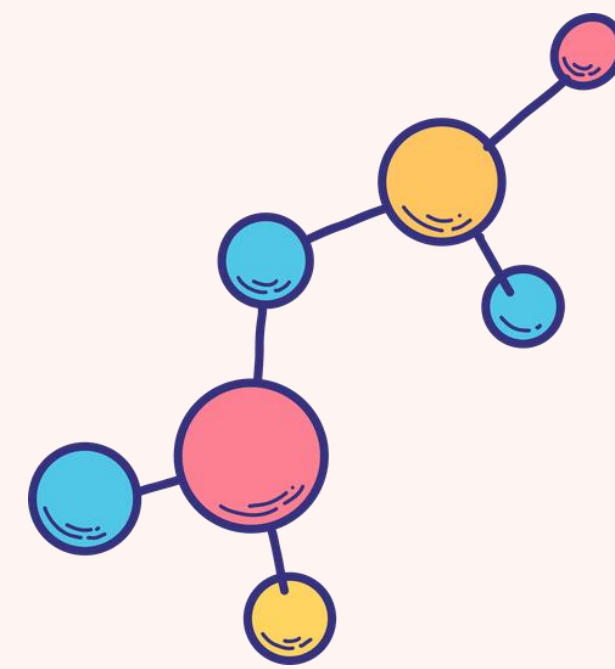
- **Prosthetic limbs** controlled by brain/nerve signals.
- **Cancer-hunting cells** like immune cells that are programmed to sense cancer and respond by attacking only cancer cells.
- **Smart drug cells** that are engineered to sense a problem like inflammation, infection, and low oxygen, and release medicine.
- Cells that detect pollution or pH.
- Robots.
- Automatic systems (doors, alarms, thermostats).
- Medical devices.



Glow-in-the-Dark Reporter Cells

Scientists engineer cells to:

- Glow when something goes wrong.
- Detect toxins, disease, or changes inside the body.
- Cells glow when exposed to cancer signals or pollution.



Cells that light up to warn doctors something is wrong.

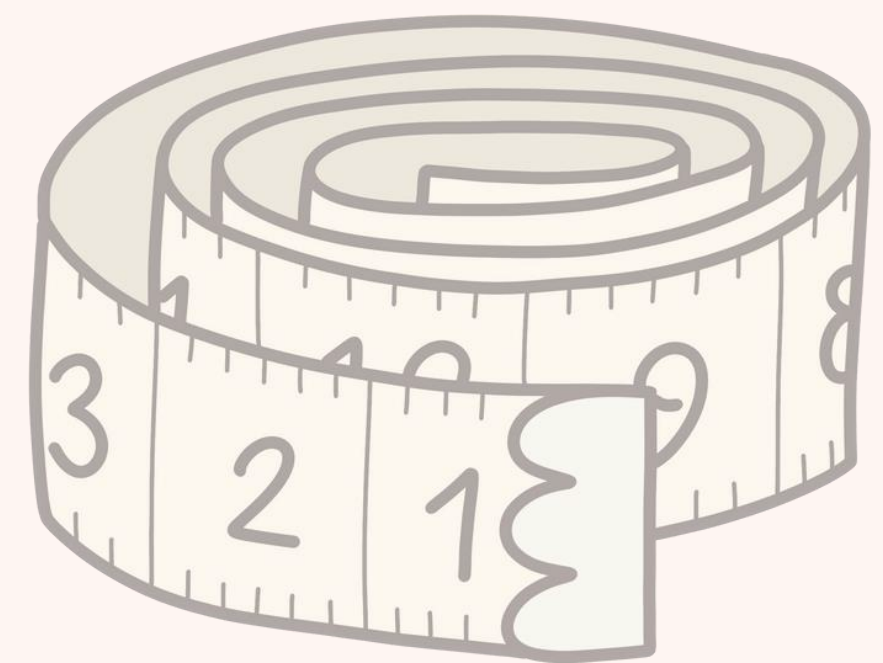
Today's Task



Build a model showing:

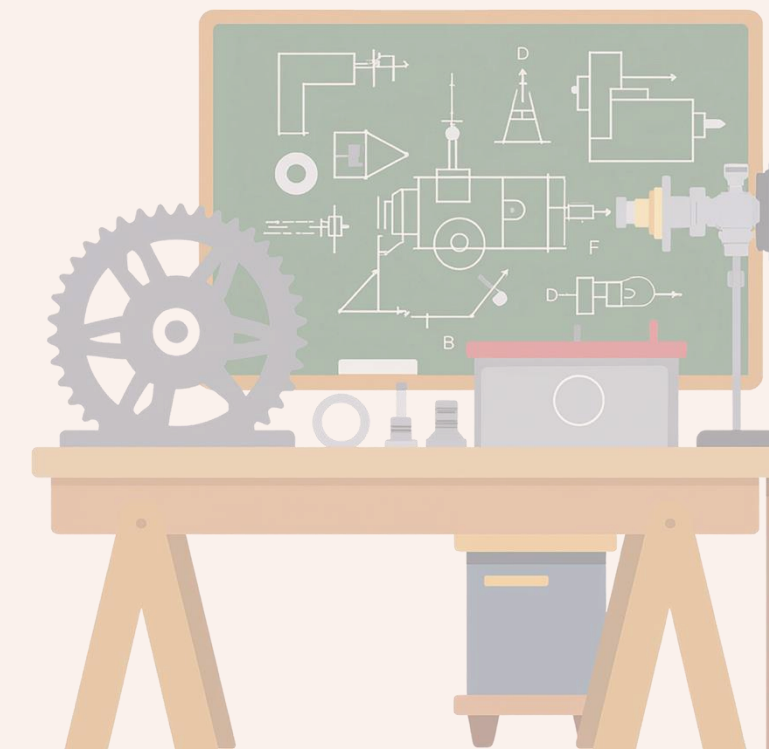
- A stimulus.
- At least 2 body systems interacting.
- How signals travel from detection to response.

Use simple materials: paper, string, markers, etc.



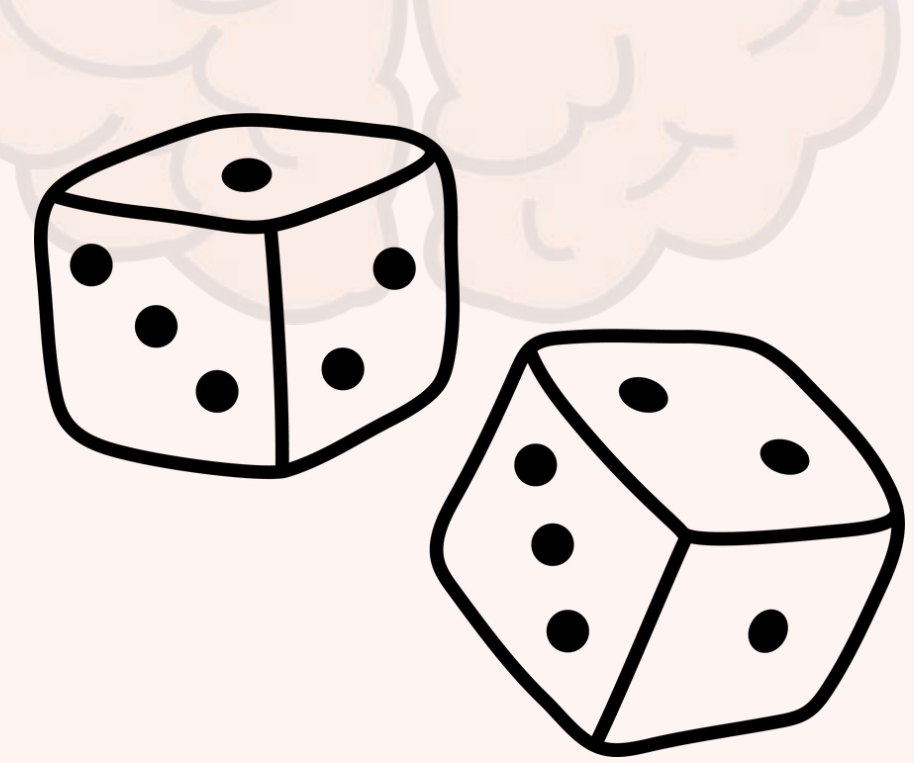
Let's Build!

1. Form groups & assign roles (designer, builder, labeler, presenter).
2. Roll dice to get body systems.
3. Brainstorm a triggering reaction.
4. Sketch a plan.
5. Build a 2D or 3D model.
6. Complete handout.
7. Label systems & pathways.
8. Prepare a 30-second explanation.





Dice Roll



Red Dice

1. Nervous
2. Respiratory
3. Muscular
4. Skeletal
5. Endocrine
6. Immune

Green Dice

1. Cardiovascular
2. Nervous
3. Muscular
4. Digestive
5. Circulatory
6. Integumentary

Yellow Dice

1. Immune
2. Digestive
3. Endocrine
4. Digestive
5. Circulatory
6. Cardiovascular

Blue Dice

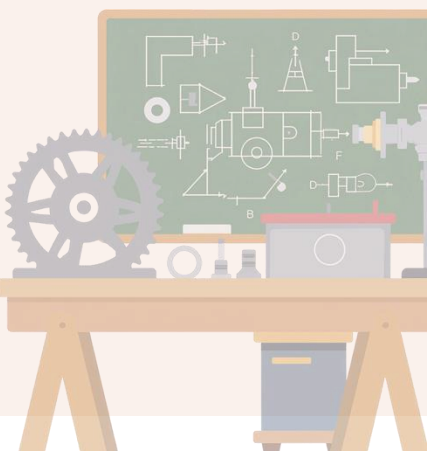
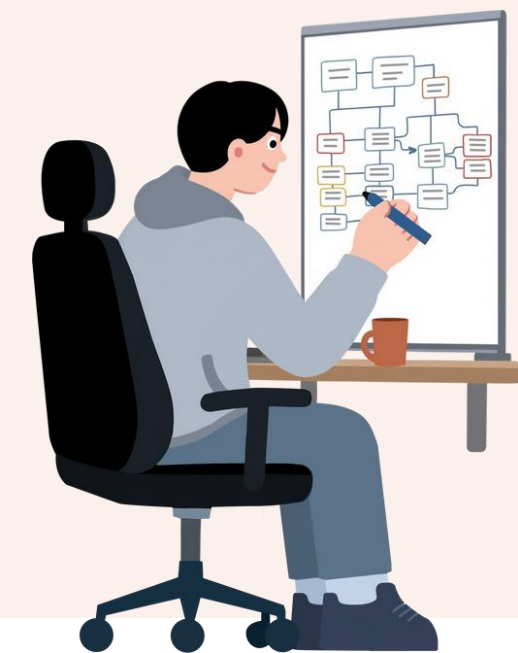
1. Respiratory
2. Integumentary
3. Nervous
4. Immune
5. Muscular
6. Digestive

Brainstorm

With your group, create a stimulus that triggers both of your body systems.

Think about:

- **Purpose:** Avoid danger, get energy/oxygen, control temperature, or support movement.
- **Source:** Inside the body or outside the body.
- **Speed:** Fast (reflex/breathing) or slow (hormones/regulation).
- **Pathway:** What change happens first? What is the final action?
- **Systems check:** Would the response still work if one system was missing? Why?



Presentations

Present Your Model

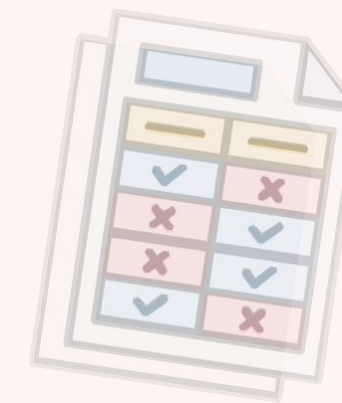
In your quick presentation, explain:

- The stimulus.
- The systems involved.
- How the signal traveled.
- How the response helps the body.

Observe & Rate

- Take notes on each group.
- Score models on your handout.





Rubric

1. Science Accuracy

- 2+ correct systems labeled
- Clear stimulus → signal → response
- Pathway makes sense

2. Model Clarity

- Easy to understand
- Neat, organized, readable
- Clear sequence of steps

3. Materials & Design

- Materials match purpose
- Creative and sturdy

4. Communication

- Explains stimulus and systems
- Uses science vocabulary
- Explains how it supports homeostasis

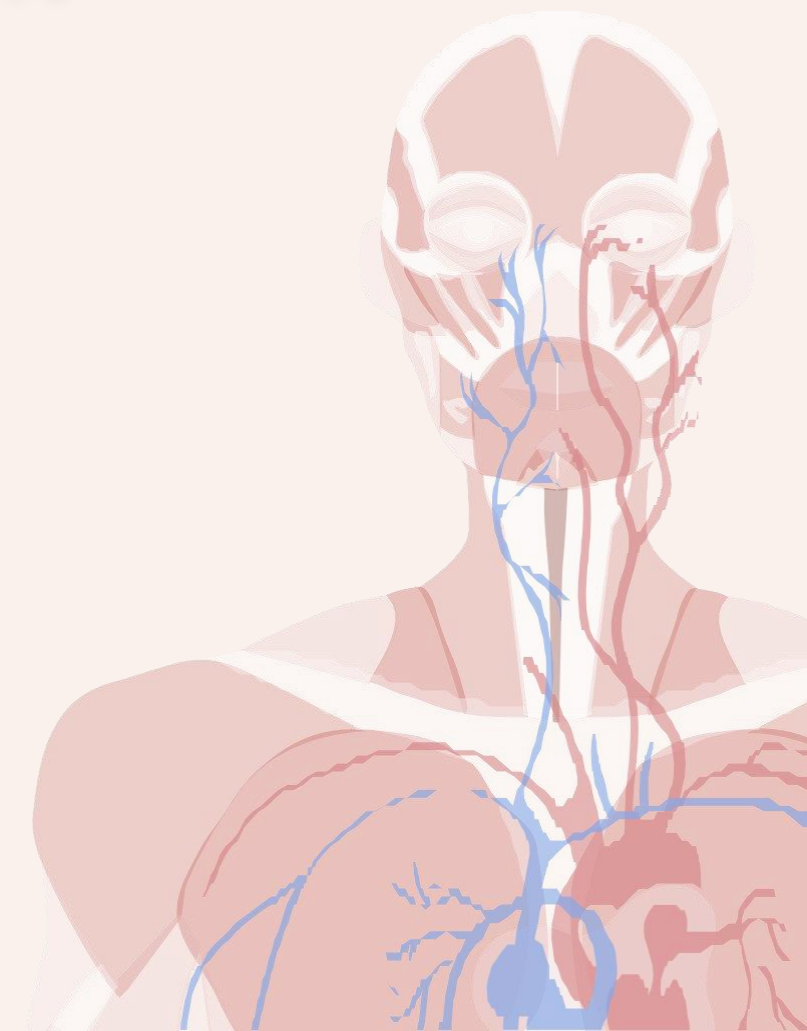
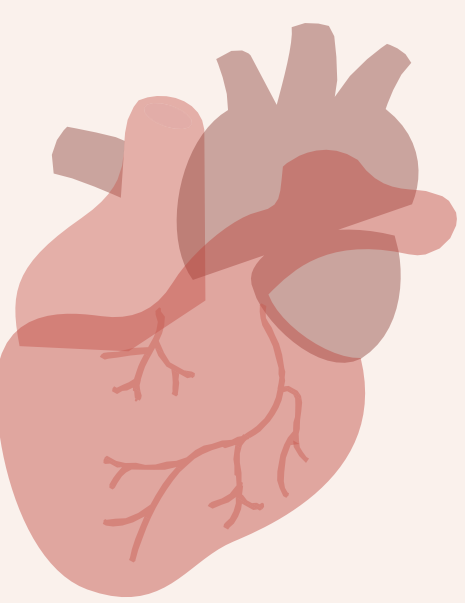
5. Teamwork & Process

- All members contribute
- Planned before building
- Shows effort and improvement

Conclusions

Discussion

- How did the model help your understanding?
- What surprised you?
- How is the body like an engineered system?
- Why are multiple systems needed?



Examples

Example 1: Nervous + Muscular

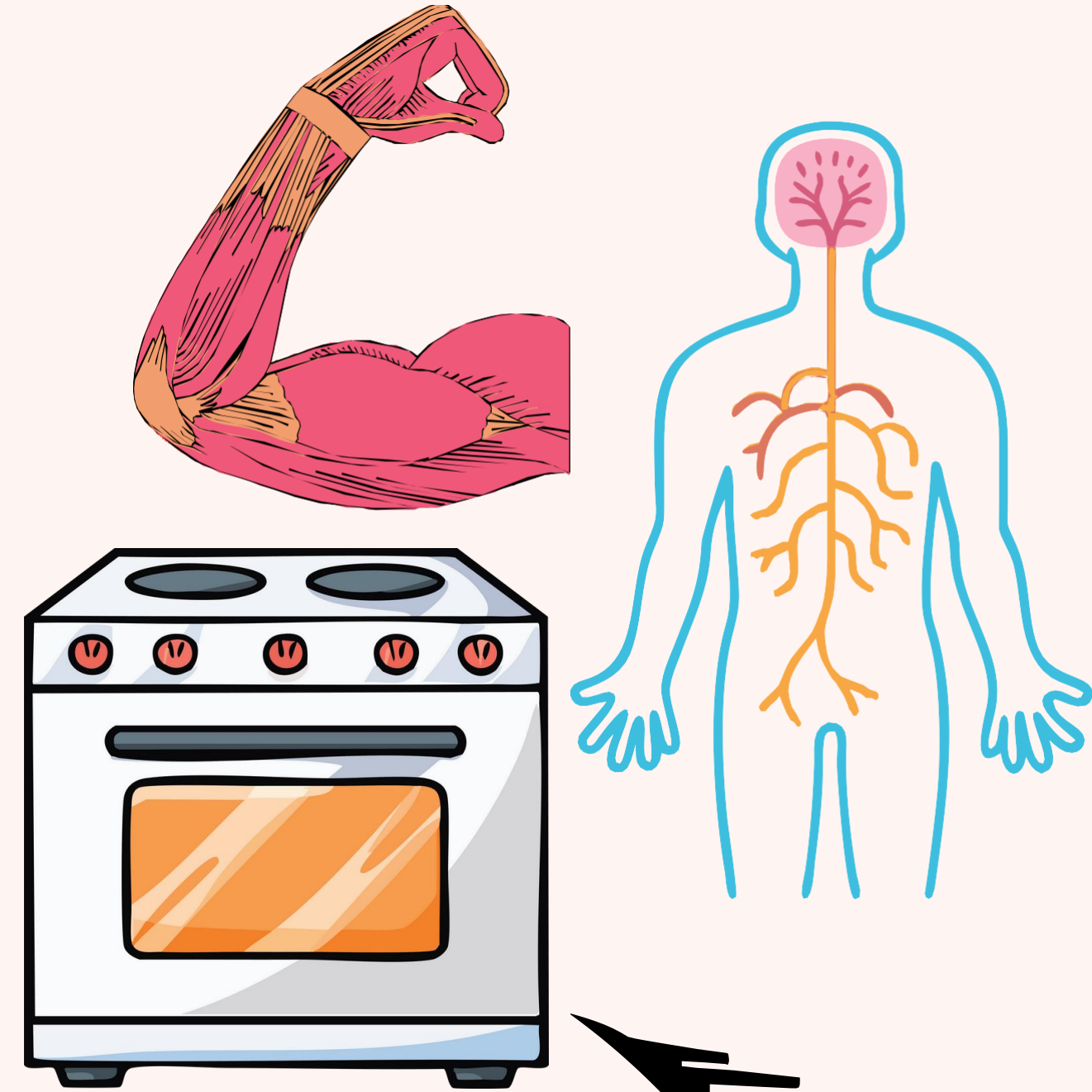
Stimulus: Touching a hot stove

Sense: Skin receptors detect heat

Signal: Nerves send signal to spinal cord

Response: Arm muscles contract → hand pulls away

Why it helps: Prevents burns and tissue damage



Example 2: Respiratory + Muscular

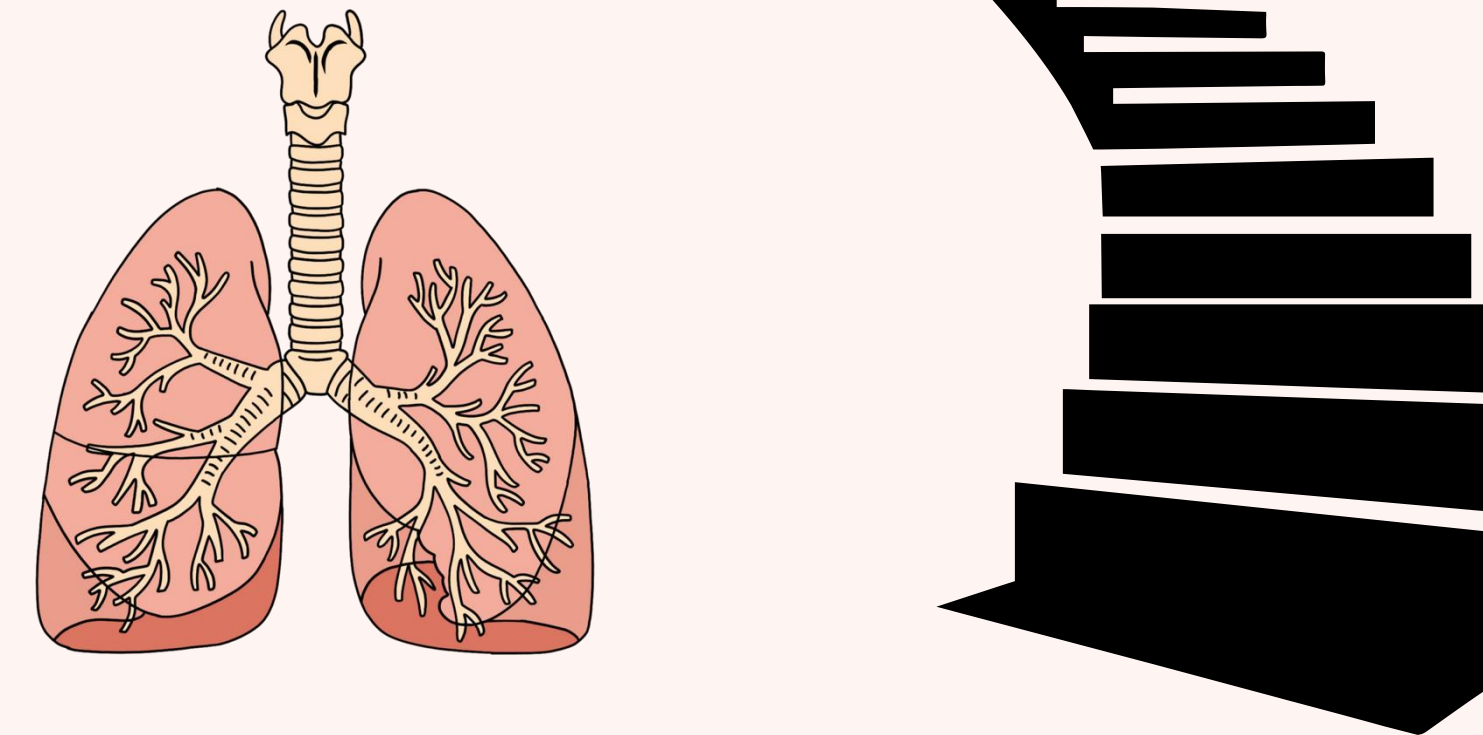
Stimulus: Running up stairs

Sense: Brain detects low oxygen levels

Signal: Brain sends signals to breathing muscles

Response: Breathing rate increases

Why it helps: Gets more oxygen to muscles



Examples

Example 3: Nervous + Integumentary

Stimulus: Cold weather

Sense: Skin receptors detect low temperature

Signal: Nerves send message to brain

Response: Skin muscles cause goosebumps

Why it helps: Traps heat and maintains body temperature



Example 4: Nervous + Digestive

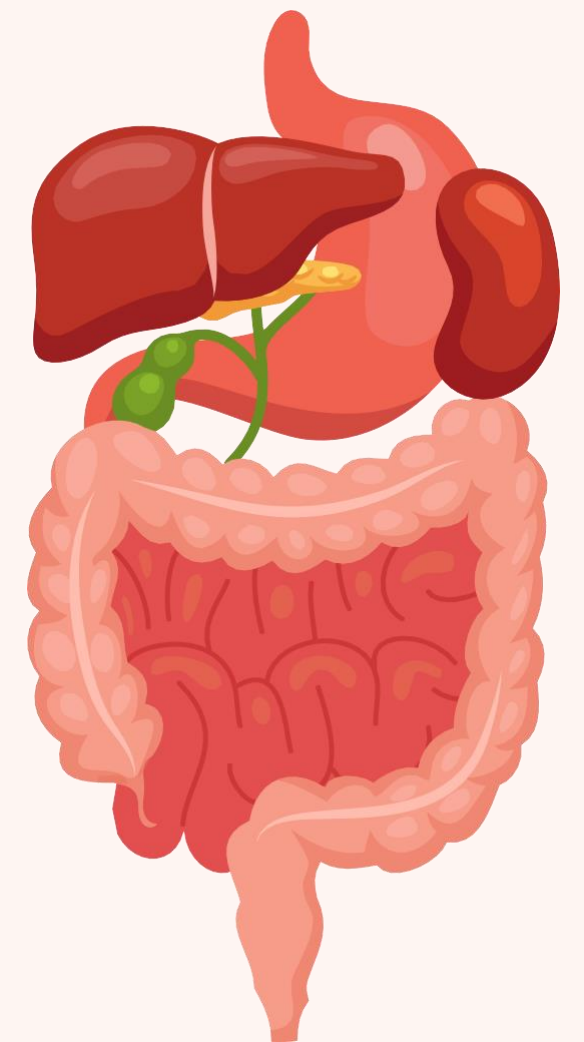
Stimulus: Smelling food

Sense: Smell receptors in nose detect odor

Signal: Nerves send signal to brain

Response: Digestive system releases saliva and stomach acid

Why it helps: Prepares body to digest food



Examples

Example 5: Nervous + Cardiovascular

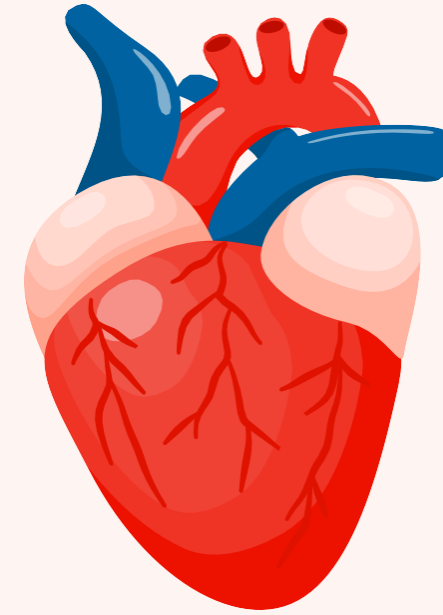
Stimulus: Jump scare (loud noise)

Sense: Hearing receptors detect sound

Signal: Brain activates fight-or-flight response

Response: Heart rate increases

Why it helps: Delivers oxygen quickly for action



Example 6: Muscular + Skeletal

Stimulus: Deciding to pick up a backpack

Sense: Brain plans movement

Signal: Nerves send signals to arm muscles

Response: Muscles pull on bones to lift bag

Why it helps: Allows movement and task completion



Examples

Example 7: Nervous + Endocrine

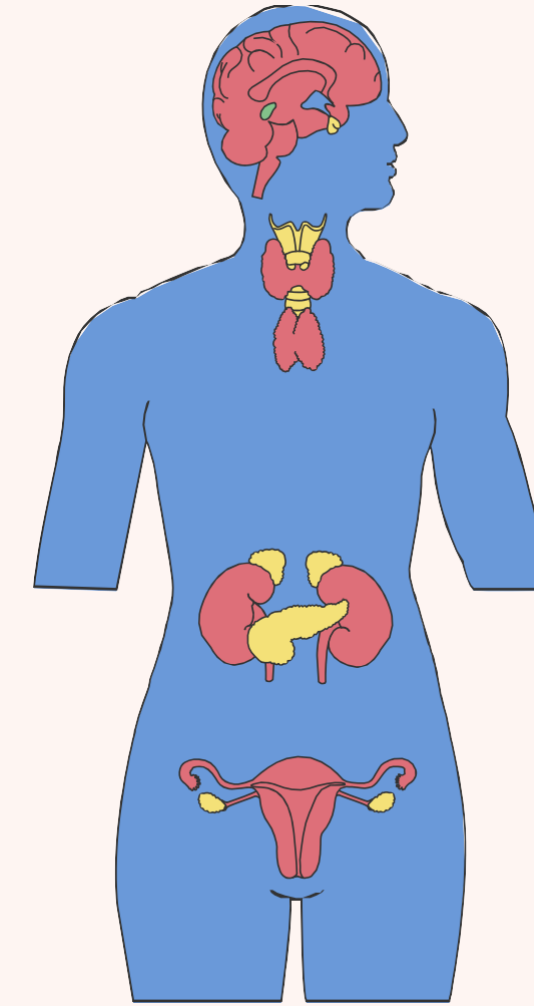
Stimulus: Long-term stress

Sense: Brain detects ongoing stress

Signal: Hypothalamus signals endocrine glands

Response: Adrenal glands release cortisol

Why it helps: Helps body manage stress over time



Example 8: Immune + Circulatory

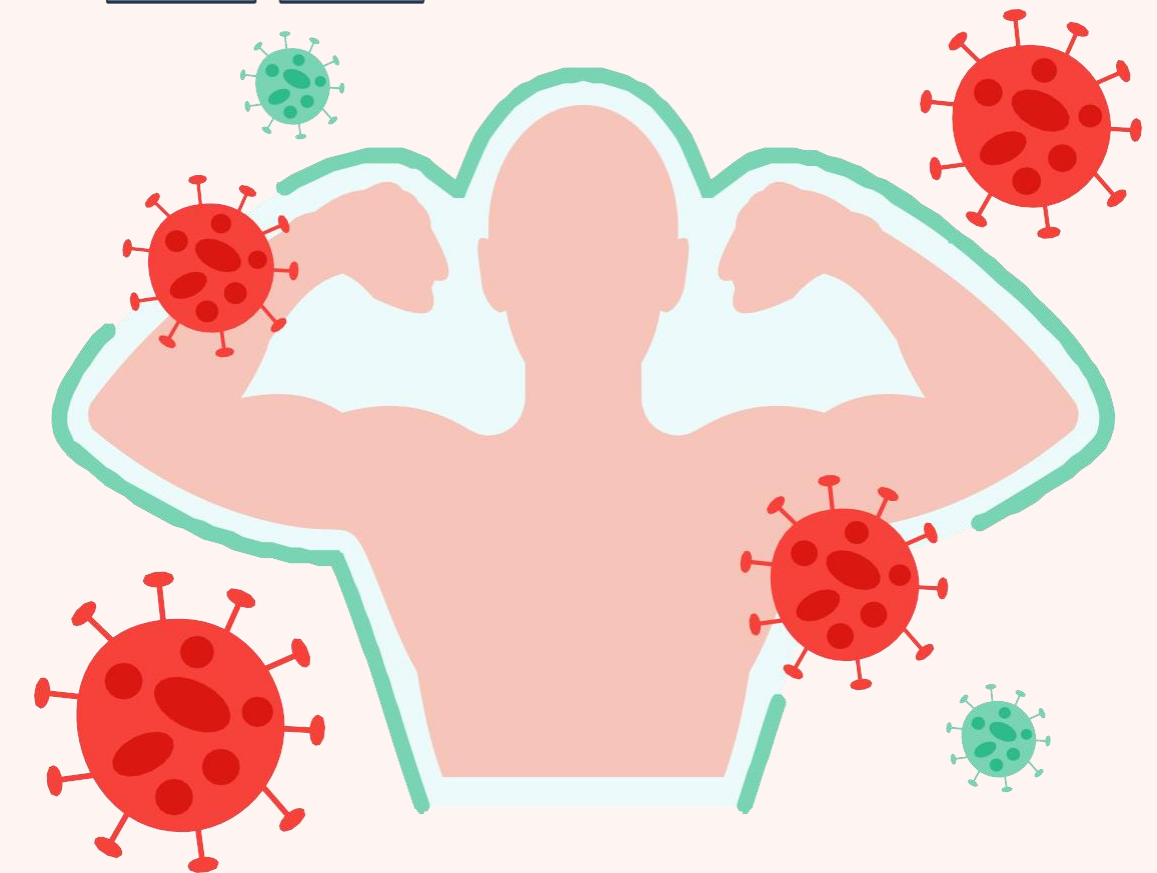
Stimulus: Cut on skin

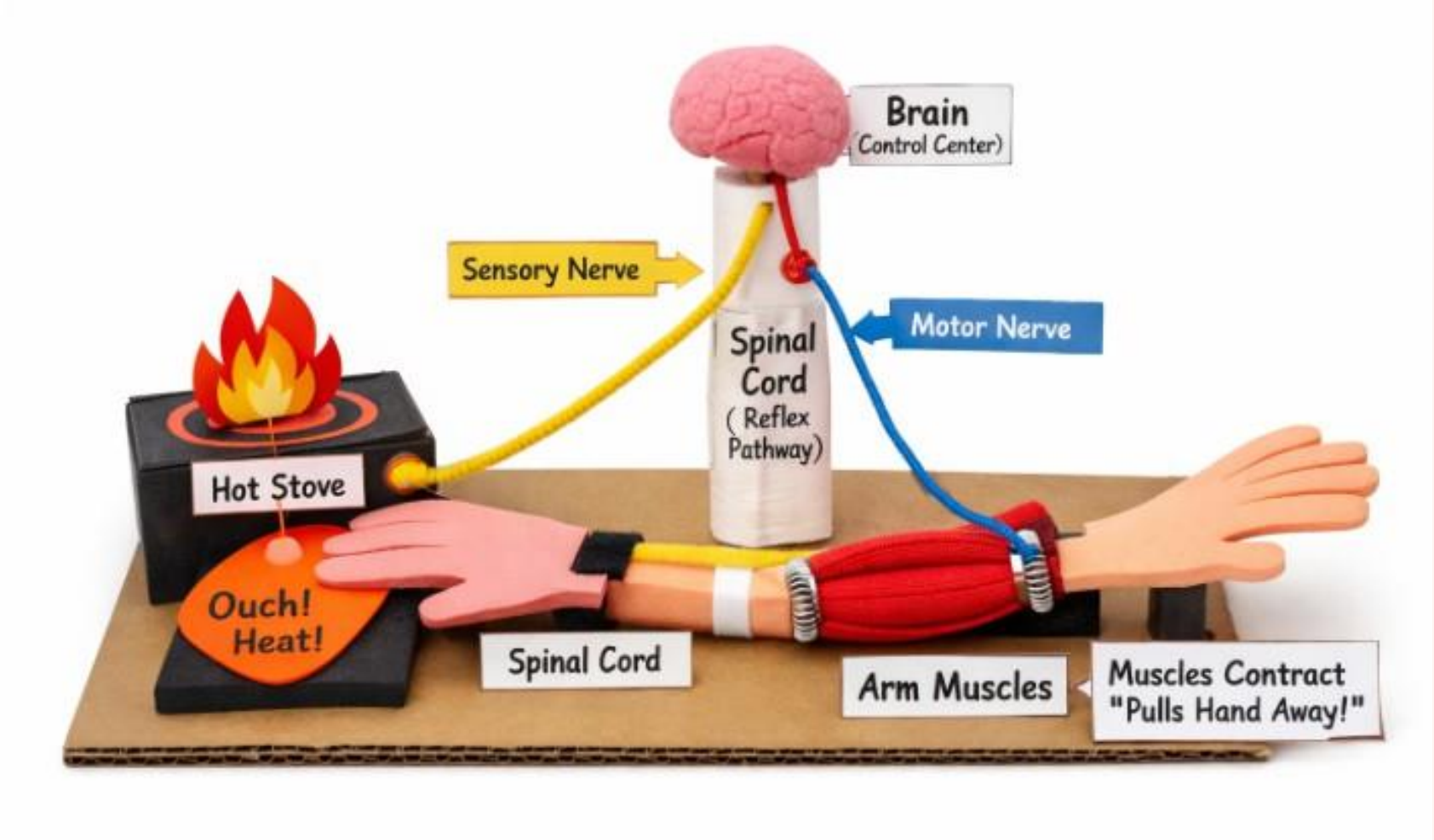
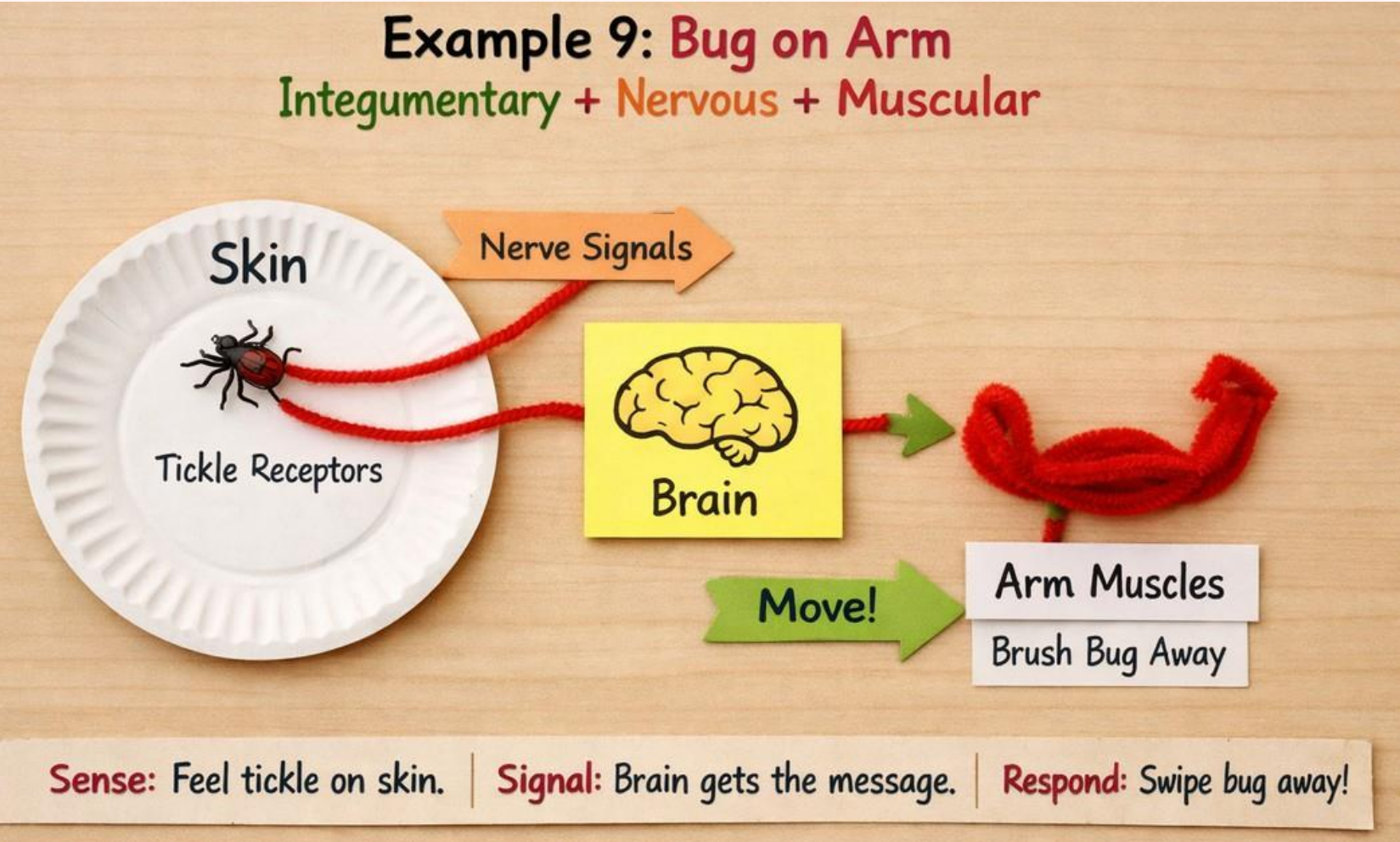
Sense: Immune cells detect pathogens

Signal: Chemical signals released into bloodstream

Response: White blood cells travel to wound

Why it helps: Prevents infection and promotes healing





Examples

