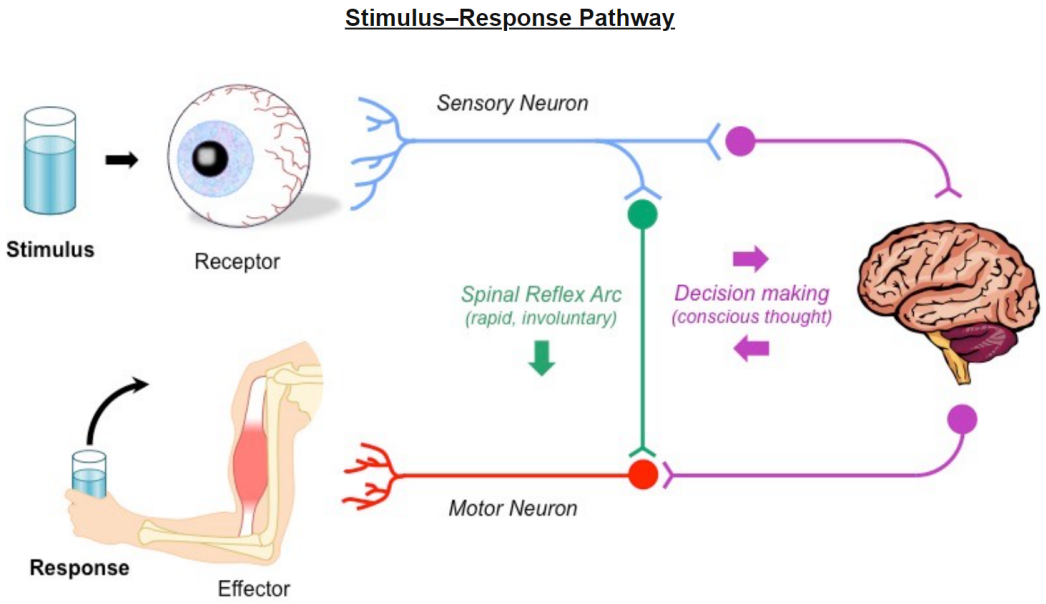
Stimulus-Response Pathway

Name: _____ Date: _____

The stimulus-response pathway is a fundamental mechanism that describes how organisms detect and respond to stimuli. It encompasses a series of steps: the stimulus, the receptor that detects it, the sensory neuron that carries the message, the decision-making process (either in the brain or via a reflex arc), the motor neuron that carries the output message, the effector that performs the action, and finally, the response.



In the picture above, the eye (receptor) is detecting a glass of water (stimulus). It sends a signal via a sensory neuron to the brain (control centre). The brain decides that it wants to pick up the glass of water. It sends a signal through the motor neuron to the muscles in the arm (effector) so it can pick up the glass (response).

Other responses do not use the brain. Moving your hand away from a sharp object, for example, uses an automatic reflex arc. The neuron travels to the spine and then directly to the muscle. These signals do not go through the brain. This is why some actions are automatic and involuntary (you cannot control them).

1. Match the terms with their definitions.

Stimulus	Action or movement due to the effect of a stimulus
Receptor	The event or change that invokes a reaction
Sensory Neuron	Detects the stimulus
Motor Neuron	Transmits signals from the receptor to the CNS
Effector	Transmits signals from the CNS to the effector
Response	A muscle or gland that carries out a response

2. Fill in the blanks for the given pathway:

   Choose the correct terms from the box below to complete the pathway:

receptors	sensory neuron	motor neuron	response	effector

   Bright light shines in the eyes. _____ in the eyes detect the light. The _____ transmits this information to the brain. The brain processes this and sends a signal via the _____ to the muscles surrounding the eyes. The muscles in the eyes (the _____) causes the eyes to squint (the _____).

3. Write the complete stimulus-response pathway based on the given scenarios. The first one is done for you. Note: If a reaction is automatic and quick, based on receptors below your neck and uses your muscles as effectors, it likely uses the reflex arc. If the action is based on making a decision, then it uses conscious thought.

   (a) A bee stings your arm. As a result, you feel a sharp pain, and almost instantly, you move your hand to swat the bee away or rub the affected area.

   Stimulus: A bee sting

   Receptor: Nerves on your arm

   Decision Making/Reflex Arc: Reflex arc through the spine.

   Effector: Muscles in your arm

   Response: Move your hand to swat the bee

   (b) You hear a sudden loud noise. You turn your head towards the source of the sound.

   Stimulus: A loud noise

   Receptor: _____

   Decision Making/Reflex Arc: Reflex arc: automatic response to a loud sound. This is performed automatically in the brain stem.

   Effector: _____

   Response: _____

   (c) You smell a delicious aroma coming from the kitchen. You begin to feel hungry and decide to go and see what's cooking.

   Stimulus: _____

   Receptor: _____

   Decision Making/Reflex Arc: _____

   Effector: _____

   Response: _____

(d) You touch a hot pot and instantly pull your hand away.

Stimulus: _____

Receptor: _____

Decision Making/Reflex Arc: _____

Effector: _____

Response: _____

(e) You see an unfamiliar dog approaching. You stop to evaluate if the dog seems friendly or aggressive.

Stimulus: _____

Receptor: _____

Decision Making/Reflex Arc: _____

Effector: _____

Response: _____

(f) While walking on the beach, you find the sand too hot and decide to move your feet faster.

Stimulus: _____

Receptor: _____

Decision Making/Reflex Arc: _____

Effector: _____

Response: _____

4. Explain the advantage of some reflex actions, like withdrawing a hand from a sharp object, being processed through the spinal cord instead of the brain. Think about the distance from your arm to your brain versus the distance from your arm to the spinal cord.

1 Answers

Matching:

Stimulus	The event or change that invokes a reaction
Receptor	Detects the stimulus
Sensory Neuron	Transmits signals from the receptor to the CNS
Motor Neuron	Transmits signals from the CNS to the effector
Effector	A muscle or gland that carries out a response
Response	Action or movement due to the effect of a stimulus

Fill in the blanks:

Bright light shines in the eyes. Receptors in the eyes detect the light. The sensory neuron transmits this information to the brain. The brain processes this and sends a signal via the motor neuron to the muscles surrounding the eyes. The muscles in the eyes (the effector) causes the eyes to squint (the response).

Stimulus-Response examples

(a) A bee stings your arm. As a result, you feel a sharp pain, and almost instantly, you move your hand to swat the bee away or rub the affected area.

Stimulus: A bee sting

Receptor: Nerves on your arm

Decision Making/Reflex Arc: Reflex arc through the spine.

Effector: Muscles in your arm

Response: Move your hand to swat the bee

(b) You hear a sudden loud noise. You turn your head towards the source of the sound.

Stimulus: A loud noise

Receptor: Ears (specifically, the inner ear structures like cochlea)

Decision Making/Reflex Arc: Reflex arc: automatic response to a loud sound. This is performed automatically in the brain stem.

Effector: Neck muscles

Response: Turn head towards the sound

(c) You smell a delicious aroma coming from the kitchen. You begin to feel hungry and decide to go and see what's cooking.

Stimulus: Aroma of food

Receptor: Olfactory receptors in the nose

Decision Making/Reflex Arc: Decision-making in the brain

Effector: Leg muscles

Response: Walk towards the kitchen

(d) You touch a hot pot and instantly pull your hand away.

Stimulus: Heat from the pot

Receptor: Thermoreceptors in the skin

Decision Making/Reflex Arc: Reflex arc through the spine

Effector: Muscles in the arm

Response: Pull hand away

(e) You see an unfamiliar dog approaching. You stop to evaluate if the dog seems friendly or aggressive.

Stimulus: Sight of an unfamiliar dog

Receptor: Eyes (retina)

Decision Making/Reflex Arc: Decision-making in the brain

Effector: Leg muscles

Response: Stop and evaluate the dog

(f) While walking on the beach, you find the sand too hot and decide to move your feet faster.

Stimulus: Heat from the sand

Receptor: Thermoreceptors in the feet

Decision Making/Reflex Arc: Decision-making in the brain

Effector: Leg muscles

Response: Walk faster or lift feet more frequently

Short Response Question Reflex actions, such as withdrawing a hand from a sharp object, are processed through the spinal cord instead of the brain to allow for quicker responses. The spinal cord is closer to most parts of the body than the brain. Thus, the distance the signal must travel from the arm to the spinal cord and back is shorter than the distance from the arm to the brain and back. This shorter pathway facilitates a more immediate response, helping to prevent potential harm or injury. Evolutionarily, faster reactions to potentially harmful stimuli would increase an organism's chances of survival.