

Name:

Date:

Class:

## Plasticity Pre-Assessment **Answer Key**

### Directions

Answer the following questions the best you can. You are not expected to know the answers, and this assignment will not be graded.

1. How do sound waves get converted to electric impulses (spikes of neurons) in our ear?

Sound waves cause mechano-receptors to open and make the receptor (neuron) fire. The sound waves physically moved the receptor to open (energy transfer), and the flow of ions makes the receptor fire. The receptor firing results in electrical energy that then gets transmitted via the nerve to the thalamus and the amygdala.

2. How does sound get transmitted from the ear to the amygdala, the fear center of our brain? Do normal sounds cause the amygdala to elicit fear, and if so, how?

Sound gets transmitted from the ear to the auditory thalamus via electrical impulses, or neuronal spikes. The neuron in the auditory thalamus then sends an electrical impulse to the amygdala.

Normal sounds do not elicit fear in the amygdala. The electrical impulses sent to the amygdala are not strong enough (too neutral) to make it fire.

3. Similar to the previous question, what is the neural pathway for the transmission of shock to the amygdala? Do you think shock causes the amygdala to elicit fear and if so, how?

The neural pathway remains similar. The shock waves cause pain receptors to open and make the receptor (neuron) fire. The shock waves move the receptor open via energy transfer, and a flow of ions makes the receptor fire. The receptor firing results in electrical energy that then gets transmitted via the nerve to the thalamus and the amygdala.

Yes, shock causes the amygdala to elicit fear. The synaptic input (electrical energy) from the shock is strong enough to make the amygdala fire (because pain is present? Pain -> survival instinct?)

**Commented [BM1]:** This looks like it needs clarification/finalization.

4. What does it mean that the amygdala learns fear?

The amygdala does not fire (elicit a fear response) when the tone is presented by itself. The amygdala does fire (elicit a fear response) when the shock is presented by itself. In order for the amygdala to associate fear with a tone response, the tone and shock signals must be paired.

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5. Explain how the pairing of tone and shock causes the amygdala to learn fear.

As we know from above, the shock pathway makes the amygdala spike and therefore elicit a fear response. This is because the shock pathway is firing at a higher frequency than the tone pathway, and the synapse connecting the pain thalamus to the amygdala is strong. This synapse is strong due to humans' innate survival instinct, and the synapse cannot be learned or change strength (non-plastic). The synapse connecting the auditory thalamus to the amygdala is weak and therefore cannot get the tone to fire on its own.

When tone and shock are fired together, the amygdala will fire because shock is eliciting a fear response. Synaptic plasticity occurs in the synapses in the tone pathway. The synapse connecting the auditory thalamus to the amygdala learns and becomes stronger, allowing the tone played by itself to elicit a fear response.

