

6

Neurotransmission: “Nicotine in the Brain”

GOAL

The goal of this lesson is for students to understand the biological changes that take place in neurotransmission in the presence of nicotine that lead to physical dependence and addiction..



Set-up:

- Neurotransmission dance materials (with the addition of nicotine-related items)
 - Labels
 - Props
 - Various musical instruments
- Nicotine and Neurotransmission Poster



PROCEDURE

Engage (10 minutes) Brainstorming Reasons for Smoking

- Tell students that in today’s class they will be learning about the effects of cigarette smoke on the body and brain.
- Review the previous week’s hypotheses about the effects of nicotine on the body and brain after it enters the bloodstream.

Explore (10 minutes) Cigarette Effects

- Explain the effects of nicotine on the body:
 1. Increases in blood pressure and heart rate.
 2. Faster respiration.
 3. Constriction of arteries.
 4. Stimulation of the central nervous system.
- Tell students they will be focusing on the last item, nicotine’s effect on the nervous system.
- Review the process of neurotransmission.
- Have students identify parts of this process that could be impacted by nicotine.

Explain (15 minutes) Brain Function and Nicotine

- Ask students: what normally stimulates the nervous system? Try and illicit that when nerve cells are sending messages, neurotransmitters are required in the process to excite the cell.



PROCEDURE

- Explain to students that nicotine acts like a neurotransmitter for specific receptors on nerve cells.
- Nicotine overstimulates the cell, more than it is stimulated by the neurotransmitter which it normally binds with.
- When there is no nicotine, the cell does not get as excited as when it binds with the normal neurotransmitter. This makes the smoker want to have another cigarette to achieve the same effect.
- Be sure students understand that cigarettes have different effects for different people depending on the dose, their mood and their smoking history.
- Also, scientists are not entirely certain how nicotine causes dependency and addiction. However, nicotine's ability to alter the normal process of neurotransmission is thought to play a critical role.

Evaluate: (20 minutes) Neurotransmission Dance

- Using the Nicotine and Neurotransmission poster, clarify the effects discussed above.
- Tell students they will now do the neurotransmission dance to show nicotine's effects.
- This neurotransmission dance will include three nerve cells.
- Thus more props will be used and props for nicotine, including labels, and a nicotine costume will be introduced.
- In Dance 1 neurotransmission is normal between all three cells, and includes four neurotransmitters at each synapse.
- In Dance 2 neurotransmission does not occur between the first and second cell but nicotine enters between the second and third cell. Only two nicotine neurotransmitters are released but they excite the cell beyond normal transmission.
- In Dance 3 neurotransmission occurs between cell 1 and 2 and is normal but neurotransmission between cell 2 and 3 barely excites the cell and does not result in the message being passed on, or the action potential being released in cell 3.

Extension: (5 minutes) Addiction

- Ask students why people might become addicted to cigarettes.
- Be sure they understand that scientists are still learning about nicotine's addictive effects.

- **Key Cognitive Skills:**
Brainstorming, Hypothesizing, Sequencing
- **Vocabulary:**
Addiction
- **Specific Outcomes:**
 - Students will gain an understanding of the effects of cigarette smoke on the body and brain.
 - Students will do the neurotransmission dance to demonstrate what happens in the brain when people use nicotine.
 - Students will explore the concept of addiction and why it is very hard for people to quit smoking..

PROJECT 2061 BENCHMARKS FOR SCIENTIFIC LITERACY

6C Basic Functions

The brain gets signals from all parts of the body telling what is going on there. The brain also sends signals to parts of the body to influence what they do.

6E Physical Health

Tobacco, alcohol, other drugs, and certain poisons in the environment (pesticides, lead) can harm human beings and other living things.

11A Systems

In something that consists of many parts, the parts usually influence one another.

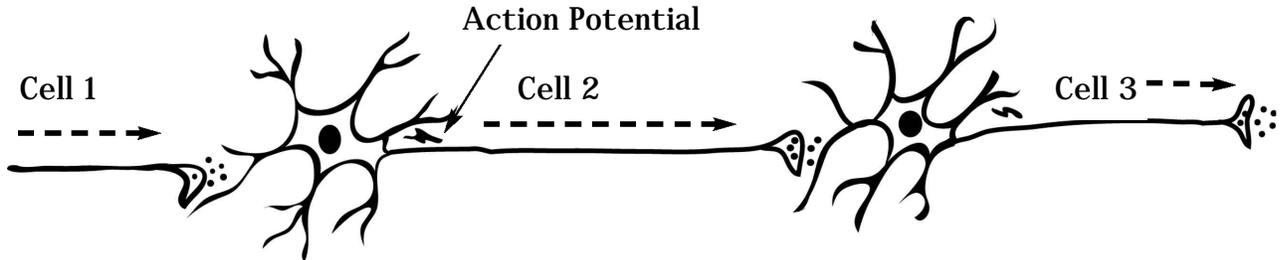
11B Models

Models are often used to think about processes that happen too slowly, too quickly, ...

Nicotine and the Brain

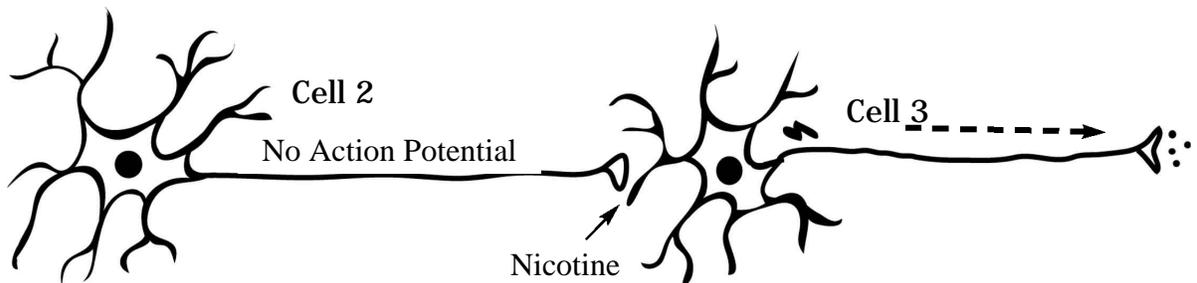
Normal Synaptic Conditions

* Under normal synaptic conditions, neurotransmitters are released from Cell 1 to stimulate Cell 2. Cell 2 then becomes excited, releases its action potential and transmits neurotransmitters to Cell 3. Cell 3 subsequently is excited and releases its action potential and the transmission process continues.



Nicotine in the Synapse

* Below, Cell 2 does not receive any neurotransmitter stimulation from Cell 1. It does not get excited and does not transmit any messages to Cell 3. Nicotine enters the synapse and binds to the receptors on Cell 3 causing heightened excitation and neurotransmission.



Synaptic Conditions After Nicotine

* In the absence of nicotine, the normal transmission process is impaired. Normal stimulation of Cell 1 and subsequently Cell 2 is not enough to excite Cell 3. Cell 3 does not receive enough stimulation to release its action potential and continue the transmission process.

