YOUR BRAIN
NEUROSCIENCE AND SOCIETY

NEUROTRANSMISSION GAME

Objective:

To demonstrate the different components involved in the signaling pathway of neurotransmission across a synapse

Materials needed:

- Open space
- 1-2 ping pong balls per team (or any small items that can act as neurotransmitters)
- 1 spoon per team (or any commonly available item that is easily passed)
- A place to tally points for each team, like a whiteboard

Directions:

Assign students in teams of 7-8 to play the following roles (numbers can vary depending on number of students). You may wish to have the students make nametags that identify their role.

- Pre-synaptic action potential (1-2/team)
- Neurotransmitter vesicle (1/team)
- Receptors (2/team)
- Second messengers (2/team)
- Transporters (1/team)

Each team forms a line and executes a chain reaction as follows:

- The **pre-synaptic action** potentials stand a short distance away from the rest of the line. When you say "go" to start the game, they run down and tag the **neurotransmitter vesicle**, then return to their starting position.
- When tagged by the action potentials, the vesicles throw a "neurotransmitter" (ping pong ball) across a gap to the **receptors**.
- **Receptors** catch the neurotransmitters and hand a spoon to the second messengers.
- **Second messengers** take the spoon from the receptors, run over to the whiteboard and tally a point for their team to show depolarization. They then run back and hand the spoon back to the **receptor**.
- After the **receptor** gets the spoon, they throw the ball to the **transporter**, who then gives the ball back to the **vesicle**.
- Once the **vesicle** has the ball, the **pre-synaptic action potential** can restart the process.

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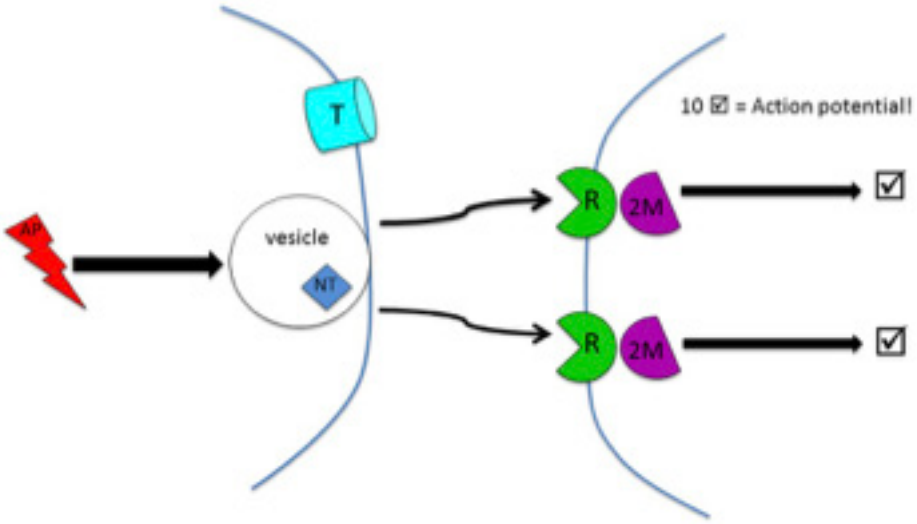
If a **receptor** drops a ball, it is out of play. The **transporter** must pick up the ball and return it to the **vesicle** to restart. The **receptor** cannot pick up any dropped balls, as receptors are bound to the cell membrane.

Once a team has tallied 10 points on the board, they have fired an action potential in the post-synaptic neuron and they win.



Game schematic, showing pre-synaptic action potential (AP), neurotransmitter vesicle, receptor (R), second messenger (2M), and transporter (T)

Activity supplement: Demonstrate the effect of a drug on neurotransmission.

Additional materials needed:
Large ball

Many drugs act by blocking the transporter and preventing re-uptake of neurotransmitters back into the pre-synaptic neuron. To model this process:

- Throw a large ball (the drug) to the **transporter**. Once they are holding the ball, they are frozen.
- Now the **receptor** holds on to the small ball, representing the greater concentration of neurotransmitters in the synapse. They can give the spoon directly back to the **second messenger**, who can go tally another point on the board. This demonstrates how drugs amplify the effect of neurotransmitters on the post-synaptic neuron.
- Take the large ball away from the **transporter**. This simulates the effect of the drug wearing off, and the process returns to normal.

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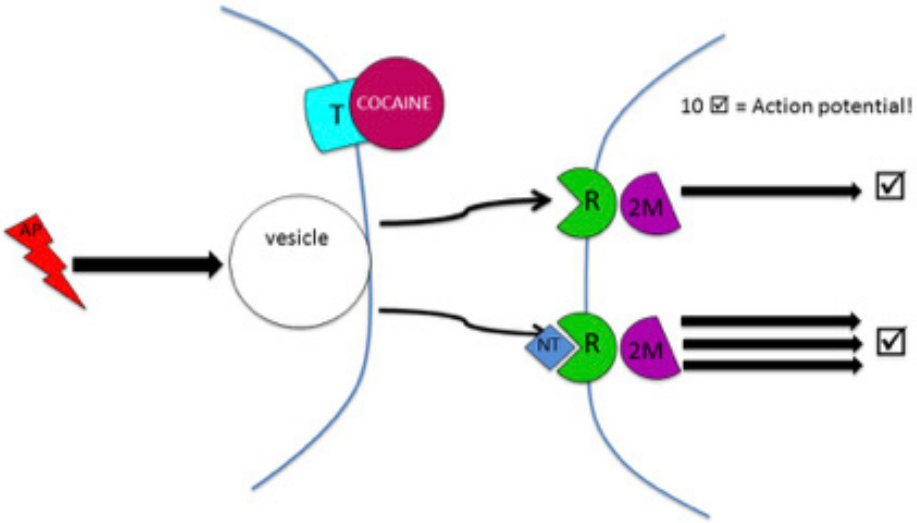
Cocaine is a good example of this scenario. Cocaine binds to the dopamine transporter and prevents dopamine from being taken back into the pre-synaptic neuron. More dopamine remains in the synapse to activate the post-synaptic receptors, increasing activity in the post-synaptic neuron.

Similarly, the antidepressant Prozac binds to the serotonin transporter and blocks serotonin re-uptake.



Schematic showing how cocaine blocks the transporter, allowing the neurotransmitter (dopamine) to remain in the synapse and increase activity in the post-synaptic neuron.

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