

## Neurotransmission: “Muscle Messages”

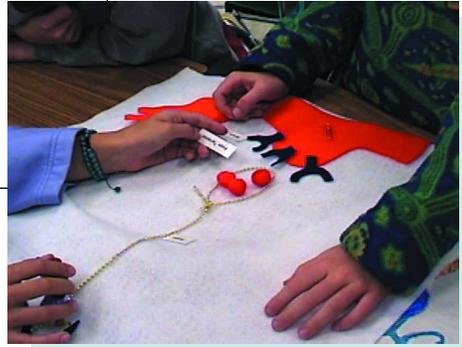
### GOAL

The goal of this unit is to reinforce the process of neuromuscular transmission with hands-on materials.



### Set-up:

- Reaction Time poster
- Nerve-muscle poster
- Synapse poster
- Neurotransmission felt kits
- Synapse worksheet



### PROCEDURE

#### *Engage (10 minutes) Student Inquiry*

- Review neuron structure with students.
- Ask students “How can these neurons send messages to each other and to the muscle cell?”
- Let students hypothesize as to what structures might be involved in neurotransmission, which is the process of communication between nerve cells and other cells in the body.

#### *Explore (10 minutes) Neurotransmission - Spinal Cord to Hand*

- Review the reaction process required to catch the ruler on the board: the eye, the visual cortex, the motor cortex, the spinal cord, and the muscle.
- Tell students, “Let’s focus on the neuron that carries the message from the spinal cord to the muscles in the hand.” This nerve cell body is in the spinal cord and its axon stretches out to the hand muscles.
- Students may enjoy estimating the length of their axons by measuring the distance from the spinal cord to the hand with a meter stick.
- Tell students that they will next learn all the details about how the message gets from the nerve cell to the muscle cell.

#### *Explain (10 minutes) Introduction to Neurotransmission*

- Use the neurotransmission poster to explain the following sequence of events..
  1. The dendrites of the nerve cell in the spinal cord get a message from the nerve cell in the motor cortex.



## PROCEDURE

2. The nerve cell in the spinal cord gets excited which causes an electrical signal, or action potential, to move down the axon of the nerve cell (ie. the axon that travels down the arm from the spinal cord). Use the neuron and synapse posters to clarify the process.
3. Once the action potential reaches the axon terminal, neurotransmitters are released and travel through the synaptic cleft (the space between the axon terminal of the nerve cell in the spinal cord and the receptors on the muscle cell) to neurotransmitter receptors on the muscle cell.
4. The neurotransmitters and neurotransmitter receptors bind, which causes the muscle cell to get very excited.
5. Once the muscle cell is excited then the muscle contracts (or moves).
  - There are different levels of excitation in the receiving muscle cell. Excitation is increased with the the increase in neurotransmitters that are released. The cell must be excited to a certain state before the muscle is able to contract.

### *Expand: (25 minutes) Reaction Time Felt Kit*

- Explain to students that they now will put together and narrate the steps of neuromuscular transmission using a felt kit.
- Introduce the felt kit parts and labels: placemat (white felt), neuron cell body with dendrites (blue felt), axon and axon terminal (gold bead chain), action potential (lightening bolt), neurotransmitters (fuzzy balls), neurotransmitter receptors(y-shaped felt), and muscle cell (arm, hand, and muscle felt shape).
- Demonstrate the process once for the class, setting up and moving the various parts. Repeat the sequence of events for the students.
- Students work in groups to put together the "neurotransmission scheme" on the placemat.
- Encourage students to use the labels for each part of the kit and to practice narrating the process to each other using the labels.
- Come together as a class and have a few student volunteers narrate the process for the class.
- Be sure to remind students to use the materials carefully and make sure all the pieces get back in the bag for the next class.

### *Evaluate: (15 minutes) Synapse Worksheet*

- In the box, students should draw and label the synapse using all the words listed
- Students should then number the steps of neurotransmission from 1-6 beginning with # 1 (the nerve cell in the spinal cord receives a message from the nerve cell in the motor cortex).

- **Key Cognitive Skills:**  
Sequencing, Labeling, Manipulating, Narrating
- **Vocabulary:**
  - Neuron/nerve cell
  - Neurotransmitters
  - Nucleus
  - Action potential
  - Axon terminal
  - Neurotransmitter receptors
  - Synapse
  - Synaptic cleft
- **Specific Outcomes:**

Students label and manipulate the components/structures involved in neuromuscular transmission using an engaging felt kit.

Students verbally describe the process of neuromuscular transmission.

Students understand how the sequence of events involved in neurotransmission relates to the reaction time process and all body processes.

PROJECT 2061 BENCHMARKS FOR SCIENTIFIC LITERACY

5C Some organisms' cells ... perform very different roles in the organism.

11A Systems

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

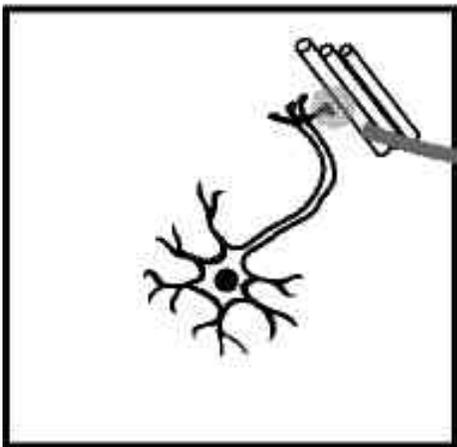
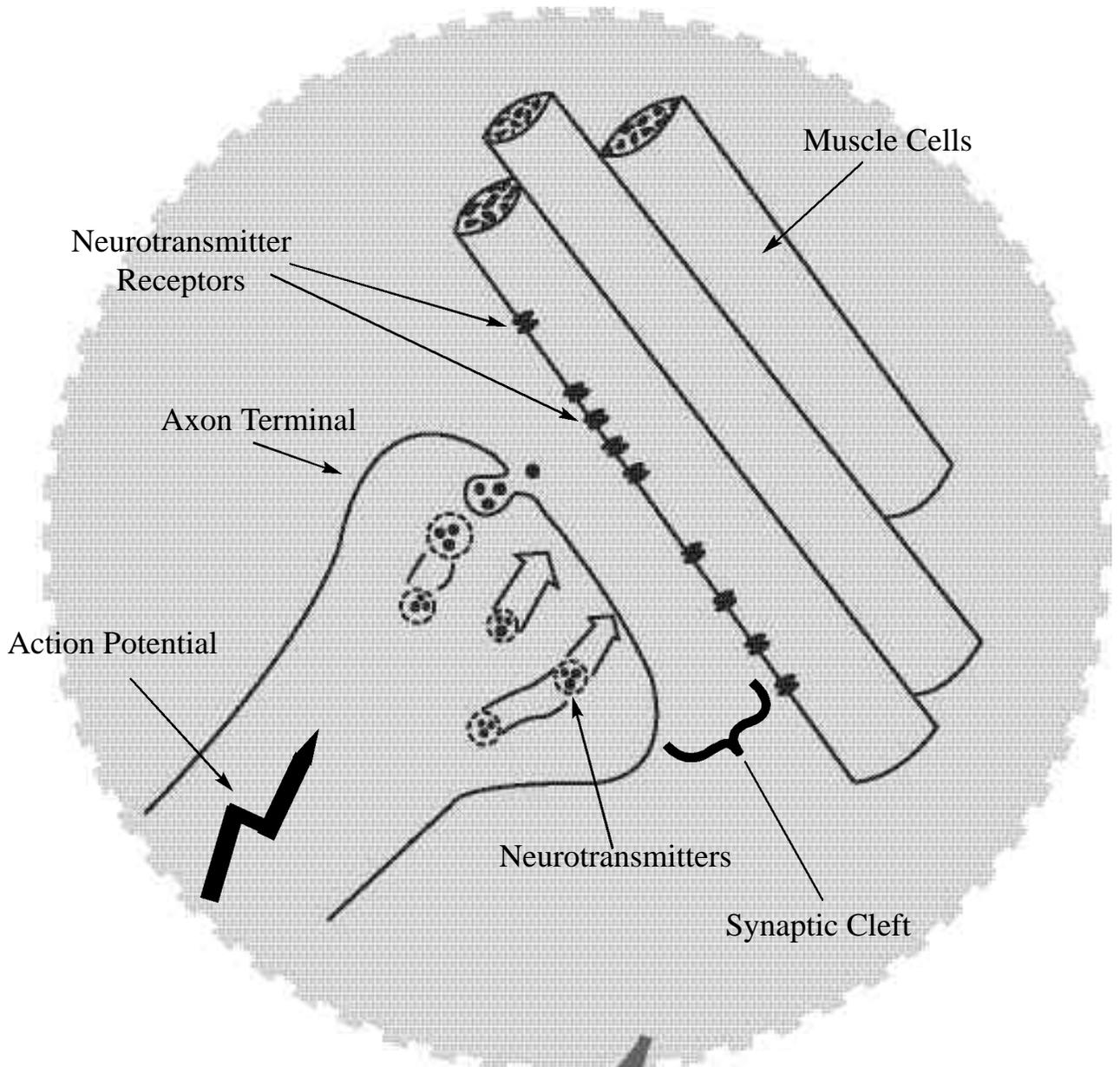
11B Models

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

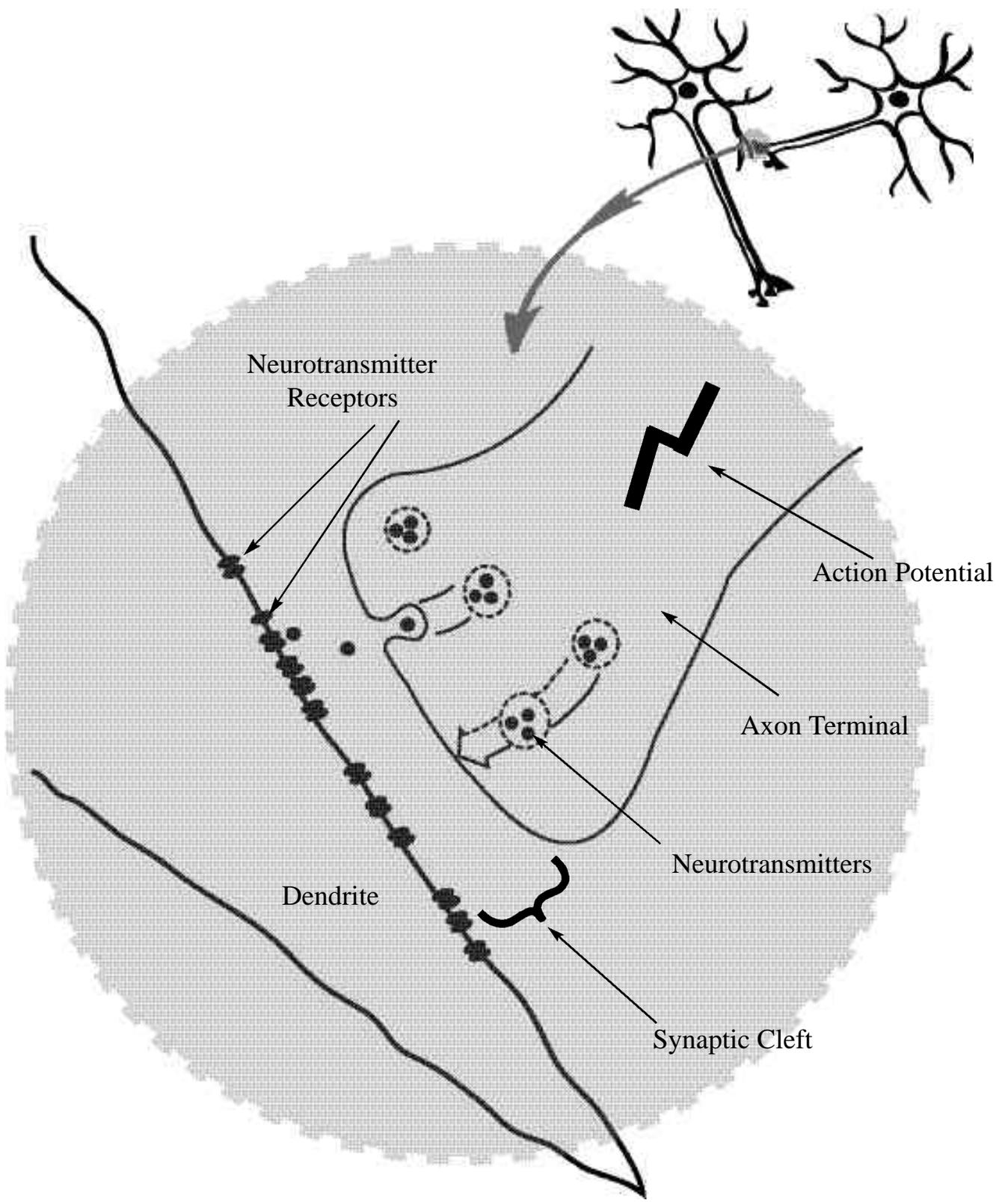
12C Manipulation & Observation

Make sketches to aid in explaining procedures or ideas.

# Nerve-Muscle Poster



# Synapse Poster



Name: \_\_\_\_\_

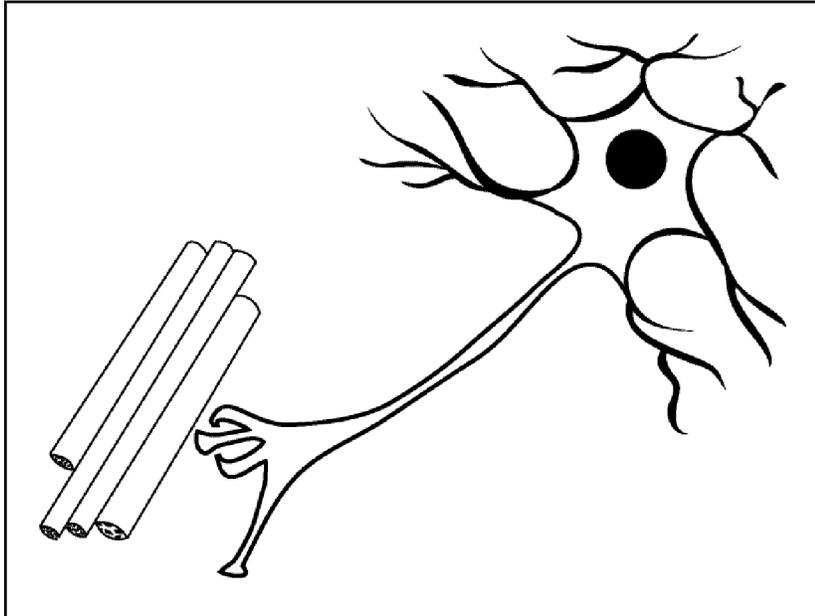
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## Brain Explorers

### Neurotransmission Worksheet      “Nerve cell to Muscle cell”

Using the words on the left, label the picture by drawing a line to the parts of the picture.

muscle cell  
cell body  
axon terminal  
dendrites  
nucleus  
nerve cell  
neurotransmitters



Put the parts of the neurotransmission process in the correct order. Label them from 1 to 6 in the boxes to the left of each statement.

	After the nerve cell gets excited, it sends the action potential down the axon to the axon terminal.
	Once the neurotransmitters bind to the neurotransmitter receptors, the muscle contracts.
	Dendrites on the nerve cell in the spinal cord receive messages from another nerve cell.
	The neurotransmitters travel to the neurotransmitter receptors on the muscle cell.
	The nerve cell gets excited.
	When it reaches the axon terminal, neurotransmitters are released.

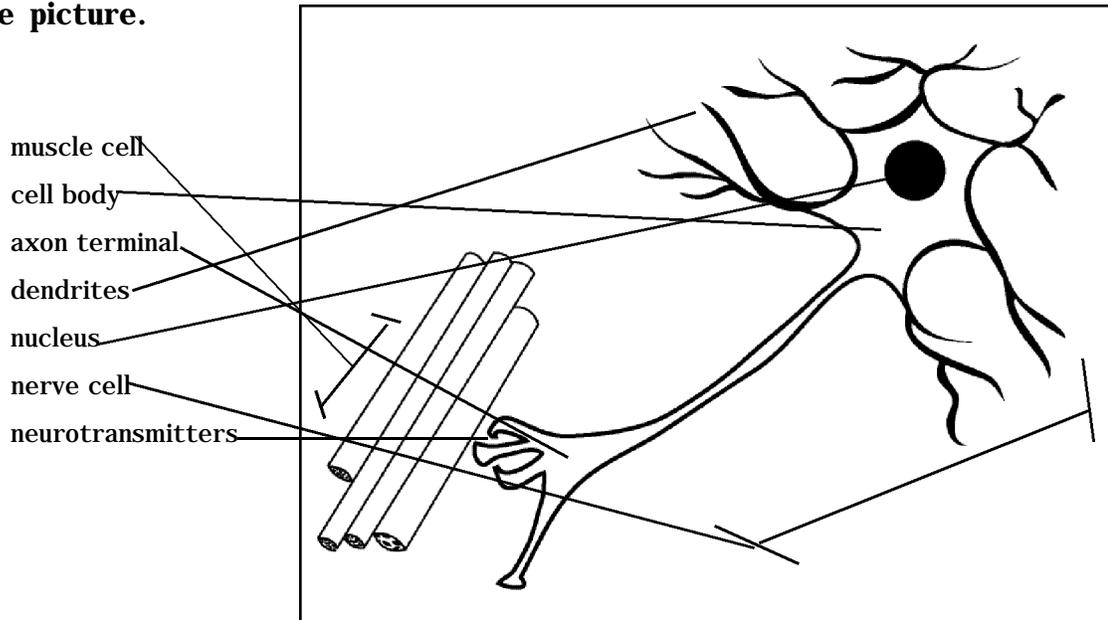
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Put the parts of the neurotransmission process in the correct order. Label them from 1 to 6 in the boxes to the left of each statement.

3	After the nerve cell gets excited, it sends the action potential down the axon to the axon terminal.
5	Once the neurotransmitters bind to the neurotransmitter receptors, the muscle contracts.
1	Dendrites on the nerve cell in the spinal cord receive messages from another nerve cell.
4	The neurotransmitters travel to the neurotransmitter receptors on the muscle cell.
2	The nerve cell gets excited.
6	When it reaches the axon terminal, neurotransmitters are released.

