**3D Synaptic Puzzle – Apply in Class Protocol**

**Models printed in 3D can be delicate. Handle with care.**

**Synaptic transmission at the electrical synapse**

1. Materials:

Check the 3D-printed parts of the electrical synapse.

2. Preparation:

A. Choose one or two colleagues to work with you.

B. Carefully open the materials’ package.

C. Identify the following components:

• Synaptic buttons;

• Membranes with gap junctions;

• Sodium ions;

• Direction arrows for ion flown;

• Mitochondria;

• And negative and positive signals to illustrate membrane potential.

3. Activity execution

A. Connect the synaptic buttons using the membrane's gap junctions.

B. Using available parts, assemble the following steps of synaptic transmission at the electrical synapse, photographing each step to attach to the class report.

1) Synapse at rest;

2) Arrival of the action potential at the presynaptic terminal;

3) Sodium concentration increasing in the presynaptic terminal;

4) Passage of sodium to the postsynaptic terminal;

5) Potential distribution along the postsynaptic cell;

6) Repeat the process in reverse to illustrate the bidirectionality of the electrical synapse.

**Synaptic transmission at the chemical synapse**

1. Materials:

Check the 3D printed parts for chemical synapse.

2. Preparation:

A. Choose one or two colleagues to work with you.

B. Be careful opening the package of materials.

C. Identify the following components:

• Synaptic buttons;

• Presynaptic and postsynaptic membrane;

• Mitochondria;

• Anchoring proteins;

• Open and closed voltage-dependent calcium channels;

• Open and closed ionotropic receptors;

• Open and closed ionotropic receptors regulated by second messengers;

• Active and inactive metabotropic receptors;

• Presynaptic receptor with and without neurotransmitter;

• Open and closed vesicles with neurotransmitters;

• Neurotransmitter reuptake;

• Sodium, calcium, potassium, and chloride flow arrow;

• Neurotransmitters;

• And negative and positive signals to illustrate membrane potential.

3. Activity execution:

A. Connect the synaptic buttons using the anchorage proteins.

B. Using available parts, assemble the following steps of synaptic transmission at the chemical synapse, photographing each step to attach to the report.

1) Synapse at rest;

2) Arrival of the action potential at the presynaptic terminal;

3) Opening of voltage-dependent calcium channels, with calcium influx;

4) Fusion of neurotransmitter vesicles with presynaptic membrane;

5) Activation of the metabotropic receptor and opening of the ionotropic receptor;

6) Presynaptic receptor activation and neurotransmitter reuptake;

7) Postsynaptic potential by sodium flux via ionotropic receptor;

8) Postsynaptic potential by potassium flux via ionotropic receptor;

9) Postsynaptic potential by chloride flux via ionotropic receptor;

10) Opening of the ion channel regulated by the second messenger;

11) Postsynaptic potential by sodium flux via the ion channel regulated by the second messenger;

12) Postsynaptic potential by potassium flux via the ion channel regulated by the second messenger;

13) Postsynaptic potential by chloride flux via the ion channel regulated by the second messenger.