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Program: M.Sc., Biomedical Science

Course Title : Neurobiology

**Criteria that a Chemical Must Meet to be Called a
Neurotransmitter**

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The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter

1. It must be synthesized in the presynaptic neuron -

Proof = Biochemical evidence (the biosynthetic enzymes are present in the presynaptic neuron)

The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter (cont'd)

2. It must be present in the presynaptic neuron and released in adequate quantities to serve as the transmitter at the synapse

Proof = Anatomical – the “labeled” transmitter must be present in the presynaptic terminals (*e.g.*, “feed” cell labeled precursors)

The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter (cont'd)

2. It must be present in the presynaptic neuron and released in adequate quantities to serve as the transmitter at the synapse

Proof = Physiological – Collect substance as it is released from the presynaptic neuron and demonstrate that this amount can cause the appropriate postsynaptic response. (NOTE: This has only been done for Ach at the NMJ!)

The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter (cont'd)

- 3. When applied exogenously or when its agonists (produce same effect as neurotransmitter) or antagonists (oppose effects of neurotransmitter) are applied to the postsynaptic cell, appropriate responses by the postsynaptic cell must be elicited**

Proof = Pharmacological - opens appropriate channel, activates appropriate 2nd messenger system, *etc.*

The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter (cont'd)

4. A specific mechanism exists to terminate the presynaptic signal

Proof = demonstrate one of the following mechanisms

1. enzymatic breakdown – e.g., Ach: Acetylcholine esterase is synthesized and released by the **muscle cell** into the **basal lamina** of the **neuromuscular junction**. The enzyme **cleaves Ach** into **choline** and **acetate** to terminate the signal. The **motor neuron** has transporters for **choline**, used in **resynthesis of Ach**.

The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter (cont'd)

4. A specific mechanism exists to terminate the presynaptic signal

Proof = demonstrate one of the following mechanisms

2. “presynaptic reuptake” – *e.g.*, Amino acid and biogenic amines use transporters in the presynaptic neuron or surrounding astrocytes to remove signal from synapse.

The Four Criteria that a Chemical Must Meet to be Called a Neurotransmitter (cont'd)

4. A specific mechanism exists to terminate the presynaptic signal

Proof = demonstrate one of the following mechanisms

3. diffusion – no longer clear how significant this mechanism is – remember the “tripartite synapse”