



AP Bio FRQ Fridays

2018 #8
Receptors, Ligands, & Regulation



FRQ Friday #18

2018 #18

Acetylcholine receptor (AChR) proteins are found at the synapse between neurons and skeletal muscle cells. Acetylcholine released from neurons binds to a specific site on the receptor proteins, which causes an ion channel in the receptors to open and allow sodium ions (Na^+) to enter muscle cells. The resulting depolarization of muscle cells initiates muscle contractions. Another molecule, nicotine, can also bind to certain types of AChR proteins and activate the receptors.

A researcher is investigating two different types of AChR proteins: type 1 and type 2. To determine which stimuli activate the receptors, the researcher exposes muscle cells expressing the different types of receptor proteins to stimuli and observes the results indicated in Table 1.

TABLE 1. RESPONSE OF AChR PROTEINS TO DIFFERENT STIMULI

AChR Protein Type	Acetylcholine	Nicotine
Type 1	+	+
Type 2	+	-

+ indicates activation
- indicates no activation



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AChR Protein Type	Acetylcholine	Nicotine
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(a) Describe the difference in the structure AND function between AChR type 1 and AChR type 2.

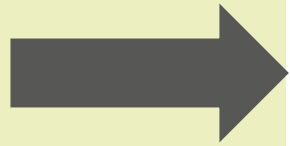
Structure (1 point maximum)	Function (1 point maximum)
Binding sites differ in shape/ specificity/number	<ul style="list-style-type: none">• Differential binding of molecules to type 1 and type 2 receptors• Activated by one (ACh) molecule or both (ACh and nicotine) molecules• No difference in response (both open channels OR both result in depolarization OR both cause muscle contraction)
Differential binding of molecules to type 1 and type 2 receptors	<ul style="list-style-type: none">• Activated by one (ACh) or both (ACh and nicotine) molecules• No difference in response (both open channels OR both result in depolarization OR both cause muscle contraction)
Receptors activated by one (ACh) or both (ACh and nicotine) molecules	<ul style="list-style-type: none">• No difference in response (both open channels OR both result in depolarization OR both cause muscle contraction)



FRQ Friday #18

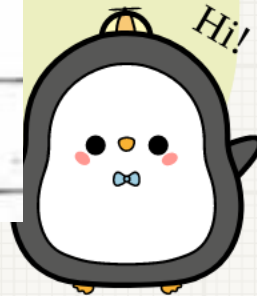
2018 #18

(a) Describe the difference in the structure AND function between AChR type 1 and AChR type 2.



Structure (1 point maximum)	Function (1 point maximum)
Binding sites differ in shape/ specificity/number	<ul style="list-style-type: none">• Differential binding of molecules to type 1 and type 2 receptors• Activated by one (ACh) molecule or both (ACh and nicotine) molecules• No difference in response (both open channels OR both result in depolarization OR both cause muscle contraction)
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a) AChR Type 1 ~~can be~~ has two binding sites, and can be activated by both Acetylcholine and Nicotine. AChR Type 2 only has one binding site, and can only be activated by Acetylcholine.



(b) Acetylcholinesterase is an enzyme that breaks down acetylcholine in the synapse. Describe the effect of inhibiting acetylcholinesterase on the muscle cells with AChR type 2.

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AChR Protein Type	Acetylcholine	Nicotine
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+ indicates activation
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Description (1 point)

- Continued activation
- Repeated opening of sodium channels OR repeated depolarization OR muscle spasms



FRQ Friday #18

2018 #18

Description (1 point)

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b) If acetylcholinesterase is inhibited in muscle cells with type 2, the cells will be unable to break down the Acetylcholine molecule. This will cause the receptor proteins to be constantly stimulated, forcing the Na^+ ion channels to stay open. Since the opening of the Na^+ channels causes muscle contractions, the inhibition of acetylcholinesterase would force repeated muscle contractions without end, akin to a seizure.

