The Synapse

1. Type of channels that open in axon terminal when AP arrives.
2. Which way does calcium flow, and why?
3. Intracellular effect of calcium entry.
4. What is contained in synaptic vesicles?
5. Name the neurotransmitter that best fits the hints below:
    - NT that mediates fight or flight (sympathetic effects)
    - NT that mediates rest and digest (parasympathetic effects)
    - NT that is involved with learning/memory/habits
    - Inhibitory NT
    - Feel-good, reward NT associated with virtually all drug highs
    - Mood-stabilizing NT
6. What are the types of receptors that NE binds to?
7. What are the types of receptors that ACh binds to?
8. In the CNS, what type of channel might open if GABA bound to a receptor?
9. Compare channels that would open on the PS membrane to cause an EPSP graded potential vs. an IPSP graded potential.
10. What types of "targets" are there in the peripheral nervous system?
11. Which NT binds to skeletal muscle cell receptors?
12. Which type of receptor (specifically) responds to this NT?
13. Which type of channels open on the muscle cell in response to NT binding?
14. What happens inside the skeletal muscle cell as a result of these channels opening?
15. How does the NT come off the receptor to end stimulation?
16. Which type of receptor (specifically) responds to NE on cardiac muscle cells?
17. Which type of receptor responds to ACh on cardiac muscle cells?
18. How does ACh affect a cardiac muscle cell action potential?
19. How does NE affect a cardiac muscle cell?
20. How does atropine work?
21. How does a Beta Blocker work?

Answers:

The Synapse

1. Type of channels that open in axon terminal when AP arrives.
   Calcium channels

2. Which way does calcium flow, and why?
   Calcium flows in because it is more concentrated OUTSIDE the cell, thus it moves into the cell, down its concentration gradient.

3. Intracellular effect of calcium entry.
   Calcium entry triggers exocytosis of synaptic vesicles

4. What is contained in synaptic vesicles?
   Neurotransmitters

5. Name the neurotransmitter that best fits the hints below:
   - NT that mediates fight or flight (sympathetic effects)
     - **Norepinephrine**
   - NT that mediates rest and digest (parasympathetic effects)
     - **Acetylcholine**
   - NT that is involved with learning/memory/habits
     - **Glutamate**
   - Inhibitory NT
     - **GABA**
   - Feel-good, reward NT associated with virtually all drug highs
     - **Dopamine**
   - Mood-stabilizing NT
     - **Serotonin**

6. What are the types of receptors that NE binds to?
   Adrenergic Receptors

7. What are the types of receptors that ACh binds to?
   Cholinergic Receptors

8. In the CNS, what type of channel might open if GABA bound to a receptor?
   K+ or Cl-, because GABA is inhibitory, and if K+ or Cl- channels open, the membrane potential would decrease (hyperpolarize), thereby decreasing the likelihood of an action potential occurring at the axon hillock.

9. Compare channels that would open on the PS membrane to cause an EPSP graded potential vs. an IPSP graded potential.
   Na+ or Ca++ channels opening would cause an EPSP; K+ or Cl- channels opening would cause an IPSP.

10. What types of "targets" are there in the peripheral nervous system?
Skeletal muscle, smooth muscle, cardiac muscle, and glands

11. Which NT binds to skeletal muscle cell receptors?
Acetylcholine

12. Which type of receptor (specifically) responds to this NT?
Nicotinic cholinergic receptors

13. Which type of channels open on the muscle cell in response to NT binding?
Na+ channels

14. What happens inside the skeletal muscle cell as a result of these channels opening?
Depolarization that leads to contraction. We call this excitation/contraction coupling.

15. How does the NT come off the receptor to end stimulation?
Enzymes break down and remove the NT from the receptor.

16. Which type of receptor (specifically) responds to NE on cardiac muscle cells?
Beta-1 adrenergic receptors

17. Which type of receptor responds to ACh on cardiac muscle cells?
Muscarinic cholinergic receptors

18. How does ACh affect a cardiac muscle cell action potential?
Hyperpolarizes it, lowering the resting membrane and decreasing the likelihood the cell will reach threshold. This slows the heart down and decreases force of contraction.

19. How does NE affect a cardiac muscle cell?
It increases the rate and force of contraction.

20. How does atropine work?
It blocks the ability of Acetylcholine to bind to muscarinic cholinergic receptors. This will ultimately increase heart rate and force of contraction. Interestingly, it also causes dilation of the pupil and decreased salivation (since these functions require Acetylcholine, too).

21. How does a Beta Blocker work?
It blocks the Beta-1 adrenergic receptor and thereby decreases the ability of NE to stimulate the cardiac muscle cells. Heart rate will slow and contractility will decrease.