

Autonomic Nervous System

For each structure/organ, state the effect of sympathetic versus parasympathetic stimulation:

1. salivary glands
2. lacrimal glands
3. mucous glands
4. pancreatic glands
5. gastric glands
6. intestinal glands
7. GI smooth muscle
8. sweat glands
9. adrenal glands
10. bronchioles' smooth muscle
11. arrector pili
12. smooth muscle of vagina/uterus
13. cardiac muscle
14. adipose tissue
15. liver

Blood vessels are primarily innervated by sympathetic neurons. What effect does sympathetic stimulation have on:

1. kidney blood vessels
2. skeletal muscle blood vessels
3. coronary artery blood vessels
4. penile/clitoral blood vessels
5. skin blood vessels

Answers:

Autonomic Nervous System

GI and tear glands are all the same answer:

1. salivary glands—
dry mouth during fight/flight; saliva production during rest/digest
2. lacrimal glands—
dry eyes during fight/flight (emotional turmoil can override and cause tears); moist eyes during rest/digest
3. mucous glands—
more mucus during rest/digest; less during fight or flight
4. pancreatic glands—
more enzymes during rest/digest; less during fight or flight
5. gastric glands—
more HCl and enzymes for rest/digest; less during fight or flight
6. intestinal glands—
more enzymes for rest/digest; less during fight or flight
7. GI smooth muscle—
more motility for rest/digest; less during fight or flight
8. sweat glands—
more active during fight or flight; not innervated by parasympathetic
9. adrenal glands (your stress/fight or flight gland)—
Epinephrine, released from the adrenal medulla, enhances all organs fight/flight response; The adrenal cortex releases cortisol, aldosterone and testosterone. Cortisol increases blood sugar and fatty acids; decreases inflammation; aldosterone raises blood pressure by retaining water; and testosterone may gear brain for physical combat.
10. bronchioles' smooth muscle—
bronchioles dilate during fight/flight to increase oxygen; constrict during rest/digest to prevent hyperventilation or debris from entering lungs
11. arrector pili—
fight or flight causes hair to stand on end; not innervated by parasympathetic (see sweat glands for similar situation)
12. Vagina/Penis/Clitoris—
Both sympathetic and parasympathetic innervation are key for sexual arousal and orgasm. Note: Nitric oxide is released onto blood vessels supplying the penis and clitoris to cause vasodilation, which results in erection. Drugs for erectile dysfunction often target this aspect of sexual arousal.
13. cardiac muscle—
beats harder and faster during fight/flight; rest/digest slows it down
14. adipose tissue—
Fight or flight increases lipolysis (fat breakdown so fatty acids go into the blood; rest/digest increases lipogenesis (storage of fatty acids as triglycerides)
15. liver—
fight or flight increases glycogenolysis (glycogen → glucose in blood); gluconeogenesis (fatty acids and amino acids used to make glucose → glucose into blood); and lipolysis (fat breakdown → fatty acids into blood). Rest and digest increases glycogenesis (glucose out of blood → stored as glycogen); and lipogenesis (fatty acids out of blood → stored as triglycerides)

Blood vessels are primarily innervated by sympathetic neurons. What effect does sympathetic stimulation have on:

1. kidney blood vessels:
fight or flight causes constriction (less filtering of blood means less urine produced)
2. active skeletal muscle blood vessels:
dilation (more blood flow during exercise)
3. coronary artery blood vessels:
dilation (more blood flow during exercise)
4. penile/clitoral blood vessels:
dilation (for engorgement)
5. skin blood vessels:
constriction (to conserve blood for skeletal muscles); however, they will dilate as needed to release heat as you continue exercising