Answer Key

Cranial Nerves (Part 2)
A nervous system lab activity using Visible Body’s Anatomy & Physiology

Molli Crenshaw, Instructor of Biology, TCU
This lab activity is aligned with Visible Body's Human Anatomy Atlas app.

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We've split our Cranial Nerves lab activity into two parts.

Part 1 is pre-lab exercises as well as exercises that incorporate cranial nerves I-VI. Part 2 includes exercises covering cranial nerves VII-XII as well as post-lab exercises.
1. Select the **facial nerves** and select Fade Others. Observe their location, and read their description.

2. These nerves are sensory/motor/mixed (circle one).

3. The **motor** fibers of this nerve emerge from which brain region?
   Pons

   a. How many branches are produced by the motor portion?
   Five branches

   b. What are the functions of the motor fibers of the facial nerve?
   Innervates facial, scalp, and neck muscles
c. Identify these motor branches and describe the regions they innervate:

i. **Temporal branch of the facial nerve** - The side of the scalp and forehead; the region of the face lateral to the eye

ii. **Zygomatic branch of the facial nerve** - Travels from the back of the jaw across the cheek, to the muscles and skin above the mouth and lateral to the nose

iii. **Buccal branch of the facial nerve** - Travels from the back of the jaw along the lower part of the cheek to the muscles and skin lateral to the mouth and nose

iv. **Marginal mandibular branch of the facial nerve** - Runs along the lower jaw to the chin and the muscles below the lower lip

v. **Cervical branch of the facial nerve** - Travels from the back of the jaw, down the lateral side of the neck

4. What are the functions of the sensory fibers of the facial nerve?
Transmit sensory signals from the taste buds in the anterior region of the tongue and proprioceptive signals from the muscles in the face and scalp

   a. To which regions of the brain and brain stem do these sensory fibers relay input?
   Pons and gustatory cortex

   b. Identify the **geniculate ganglion** and describe its significance.
   Located anterolaterally to the pons, prior to the branching of the 5 segments of the facial nerve; it serves the junction of the facial sensory fibers with the chorda tympani and greater superficial petrosal nerves

5. Based on your learning, how do you think damage to this nerve would present clinically?
Inability to voluntarily move the muscles of the face to create facial expressions; loss of sensation in parts of the face and scalp; loss of taste in the anterior portion of the tongue

6. Click on the pathology icon and write out the symptoms of **Bell’s Palsy**:
Most common cause of facial paralysis; can result in twitching, weakness, paralysis, drooping eyelid and corner of mouth, drooling, dry eye and mouth, excessive tearing in the eye, impaired ability to taste

7. What types of tests would you devise to test the function of this nerve in patients?
G. Identification of the Vestibulocochlear Nerves (VIII)
1. Select the vestibulocochlear nerves and select Fade Others. Observe their location and read their description.

2. These nerves are sensory/motor/mixed (circle one).

3. The **cochlear branches of the vestibulocochlear nerves** transmit signals for the sense of ____hearing____. The cochlear sensory cell bodies are found in the ____spiral ganglion____ and their fibers emerge from the organ of ____Corti____ in the ____cochlea____.

4. The **vestibular branches of the vestibulocochlear nerves** transmit signals for ____equilibrium____. The vestibular sensory cell bodies are found in the ____vestibular ganglion____.

5. The cochlear and vestibular nerves pass through the ____internal auditory meatus____ in the ____temporal____ bone.
6. In the search bar, search for “inner ear”. Identify the following in the app, and on a model or specimen if provided:

   a. Cochlea
   b. Vestibule
   c. Superior semicircular canal
   d. Posterior semicircular canal
   e. Lateral semicircular canal
   f. CN 07 (VII) Facial nerve
   g. CN 08 (VIII) Vestibulocochlear nerve

7. From the view generated above, click on the vestibule and answer the following questions from its description:

   a. Each of the semicircular canals has an expansion at one end called an _____ampulla_____, which contains extracellular fluid known as _____endolymph_____, and a small elevation, the _____crista_____, with a cluster of hair cells.

   b. As the head rotates or moves, the movement of _____endolymph_____ in the _____ampullae_____ causes the _____hair cells_____ to bend, which generates _____nerve impulses_____.

8. Based on your learning, how do you think damage to this nerve would present clinically?
Loss of hearing and loss of equilibrium (balance)

9. What types of tests would you devise to test the function of this nerve in patients?
H. Identification of the Glossopharyngeal Nerves (IX)

1. Return to the view of the cranial nerves under Nervous System Views. Hide the temporal, sphenoid, and frontal bones along with the cerebellum as before. Then select the glossopharyngeal nerves and select Fade Others. Observe their location and read their description.

2. These nerves are sensory/motor/mixed (circle one).

3. Where do fibers of this nerve originate?
   Medulla oblongata

4. The fibers exit the skull through which opening? (Tip: Select the occipital bone and fade it to make these foramina more visible.)
   Jugular foramen in the occipital bone

5. The motor fibers arise from nuclei in the _____medulla oblongata_____.

CN 09 (IX) Glossopharyngeal
a. These motor fibers innervate the **stylopharyngeus** muscle. What is the action of this muscle?
To elevate the pharynx and larynx

b. The motor fibers of this nerve also innervate the **parotid gland** to stimulate secretion of **saliva**.

6. Read the description of the sensory axons of the glossopharyngeal nerve, and answer the following questions:

a. What is the location and function of those on the tongue?
Taste buds on the posterior portion of the tongue; proprioceptors in swallowing muscles

b. What is the function of the **proprioceptors of swallowing muscles**?
Monitor position of the tongue in the mouth

c. What is the function of **baroreceptors in the carotid sinus**? Be sure to identify the location of these sinuses.
Monitor changes in blood pressure

d. What is the function of **chemoreceptors in the carotid body**? Be sure to identify the location of these carotid bodies.
Monitor changes in blood chemistry

e. Cell bodies of the sensory fibers are found in which two ganglia?
Superior and inferior ganglia

f. Which region of the cerebral cortex will receive sensory input from this cranial nerve?
Somatosensory cortex and gustatory cortex

7. Based on your learning, how do you think damage to this nerve would present clinically?
Loss of ability to swallow and reduction of saliva production while eating; loss of the positioning capabilities of the tongue; loss of ability to monitor changes in blood pressure and chemistry

8. What types of tests would you devise to test the function of this nerve in patients?
I. Identification of the Vagus Nerves (X)

1. Select the **vagus nerves** and select Fade Others. Observe the location of the nerves in the mediastinum.

2. These nerves are sensory/motor/mixed (circle one).

3. Where do fibers of these nerves originate?
   Medulla oblongata
4. The fibers exit the skull through which opening? (Tip: Select the occipital bone and fade it to make these foramina more visible.)

Jugular foramen of the occipital bone

5. Return to Nervous System Views and select 7. Vagus Nerve (X). Identify the following structures and note their significance. (Tip: It will be easier to see these regions if you hide the circulatory system initially.)

- **Superior and inferior ganglia** - Contains cell bodies of sensory fibers of the vagus nerve associated with the external ear, taste buds, proprioceptors in muscles of the throat and neck
- **Pharyngeal branch of the vagus nerve** - Principal motor nerve of the pharynx
- **Superior laryngeal branch of the vagus nerve** - Receives fibers from the superior cervical ganglion of the sympathetic trunk
- **Superior cervical (vagal) cardiac branch of the vagus nerve** - Contributes to the cardiac plexus that innervates the heart; contains sympathetic fibers

6. Read back through each description of the vagus nerve and make a list of all the organs and tissues innervated by the nerve.

Larynx, pharynx, lungs, heart, liver, and abdomen; soft palate for swallowing, external ear, taste buds, epiglottis, proprioceptors in muscles of the throat and neck; the heart, muscles of breathing, sweat glands, digestive organs; trachea

7. Based on your learning, how do you think damage to this nerve would present clinically?

Loss of sensation for the external ear, taste buds, neck, throat, and larynx; loss of motor control to the heart, digestive organs, regulation of breathing rate and sweating

8. Why do you think that damage to both vagus nerves is often fatal?

Since it regulates heart rate and breathing, loss of both nerves would prevent the body from self-resuscitation

9. What types of tests would you devise to test the function of this nerve in patients?
J. Identification of the Accessory Nerves (XI)

1. Return to the view of the cranial nerves. Hide the temporal, sphenoid, and frontal bones along with the cerebellum as before. Then select the accessory nerves and select Fade Others. Observe their location and read their description.

2. These nerves are sensory/motor/mixed (circle one).
3. Trace the nerves from their origin to their site of termination.
   
a. Read the description of the accessory nerves. What is the origin of these nerves?
   First five segments of the cervical portion of the spinal cord

   b. Why do you think these nerves are often referred to as spinal accessory nerves?
   They arise from the spinal cord, not from the brain.

   c. Through which foramen do they enter the cranium?
   Foramen magnum of the occipital bone

   d. Through which cranial foramina do they exit?
   Jugular foramen of the occipital bone

   e. Why do you think they are classified as cranial nerves?
   They travel through the cranium before targeting their effector organs.

4. Use the search bar to identify these target muscles and their actions:
   
a. **Sternocleidomastoid muscles** – Draws head toward shoulder of the same side, flexes cervical part of the vertebral column; assists in elevating the thorax

   b. **Trapezius muscles** – Rotation, retraction, elevation, depression of the scapulae; levitation of the clavicle; extends the neck; stabilizes the shoulder

5. Based on your learning, how do you think damage to this nerve would present clinically?
   Inability to move the neck and shoulder

6. What types of tests would you devise to test the function of this nerve in patients?
K. Identification of the Hypoglossal Nerves (XII)

1. Select the hypoglossal nerves and select Fade Others. Observe their location.

2. These nerves are sensory/motor/mixed (circle one).

3. Where do fibers of these nerves originate?
   Medulla oblongata

4. The fibers exit the skull through which opening? (Tip: Select the occipital bone and fade it to make these foramina more visible.)
   Hypoglossal canal of the occipital bone
5. Which muscles do these nerves innervate?
Extrinsic and intrinsic muscles of the tongue

6. What actions do they initiate for these muscles?
Control muscles of speech and swallowing

7. Based on your learning, how do you think damage to this nerve would present clinically?
Difficulty moving the tongue to swallow and speak

8. What types of tests would you devise to test the function of this nerve in patients?
MAKING CONNECTIONS:

A. Look back through the activity to help you name each of the following cranial nerves in numerical order:

1. Cranial nerve 01 (I) - Olfactory
2. Cranial nerve 02 (II) - Optic
3. Cranial nerve 03 (III) - Oculomotor
4. Cranial nerve 04 (IV) - Trochlear
5. Cranial nerve 05 (V) - Trigeminal
6. Cranial nerve 06 (VI) - Abducens
7. Cranial nerve 07 (VII) - Facial
8. Cranial nerve 08 (VIII) - Vestibulocochlear
9. Cranial nerve 09 (IX) - Glossopharyngeal
10. Cranial nerve 10 (X) - Vagus
11. Cranial nerve 11 (XI) - Accessory
12. Cranial nerve 12 (XII) - Hypoglossal

B. Quiz yourself on cranial nerve identification! Go to the cranial nerves quiz in the nervous system section of the quizzes menu.

C. Look back through the activity to review the functional classification of the cranial nerves. Be sure to identify them both by name and by Roman numeral for practice.

1. Which three cranial nerves are designated as purely sensory?
   Olfactory (I), optic (II), vestibulocochlear (VIII)

2. Which five cranial nerves are designated as purely motor?
   Oculomotor (III), trochlear (IV), abducens (VI), spinal (accessory) (XI), hypoglossal (XII)

3. Which four cranial nerves are designated as mixed?
   Trigeminal (V), facial (VII), glossopharyngeal (IX), vagus (X)
D. Look back through the exercise and make a list of all the cranial nerves that emerge from the midbrain:
The midbrain contains nuclei for the oculomotor nerve (III) and the trochlear nerves (IV).

E. Look back through the exercise and make a list of all the cranial nerves that emerge from the medulla and pons:
Trigeminal (V), abducens (VI), facial (VII), vestibulocochlear (VIII), glossopharyngeal (IX), vagus (X), spinal (IX), hypoglossal (XII)

F. Assume you have just entered your favorite restaurant and are sitting down to eat a delicious meal:

1. Which nerve is solely responsible for the sense of sight as you see your waiter carrying your food to the table?
   Optic (II)

2. Which nerves are responsible for motor control of the extraocular muscles as you glance back and forth at the food on your plate?
   Oculomotor (III), trochlear (IV), abducens (VI)

3. Which nerve is responsible for turning your head side to side to see what your friends have ordered?
   Spinal accessory (XI)

4. Which nerve is responsible for accommodation of the lens and constriction of the pupil to enable close vision of this delicious meal?
   Oculomotor (III)

5. Which nerve is responsible for your sense of smell as the delicious aromas rise from the plate?
   Olfactory (I)

6. Which cranial nerves stimulate the production of saliva from salivary glands as you anticipate your meal?
   Facial (VII), glossopharyngeal (IX)
7. Which cranial nerve is associated with motor control of the muscles of chewing as you take the first bite?  
Trigeminal (V)

8. Which nerves would help you interpret the temperature of food in your mouth as hot or cold?  
Trigeminal (V), glossopharyngeal (IX)

9. Which nerve is responsible for your sense of hearing as you hear the crunching of food in your mouth?  
Vestibulocochlear (VIII)

10. Which three cranial nerves transmit impulses from taste receptors to the brain stem as you chew your food?  
Facial (VII) - anterior taste buds; glossopharyngeal (IX) - posterior taste buds; vagus (X)

11. Which cranial nerves regulate muscles of the tongue, mouth, and throat to facilitate swallowing?  
Glossopharyngeal (IX), vagus (X), hypoglossal (XII)

12. Which cranial nerve has parasympathetic fibers to control digestive activities of the stomach, liver, pancreas, and intestines?  
Vagus (X)

13. After you finish this meal and decide to lie down for a short nap, which cranial nerve monitors your change in equilibrium?  
Vestibulocochlear (VIII)
Student Practice

Label all the structures on the following images:
Facial Nerves (VII)

- Temporal branch
- Zygomatic branch
- Buccal branch
- Mandibular branch
- Cervical branch
Vestibulocochlear Nerves (VIII)
Vestibulocochlear Nerves (VIII)

- Lateral semicircular canal
- Superior semicircular canal
- Posterior semicircular canal
- Vestibule
- CN 07 (VII) Facial
- CN 08 (VIII) Vestibulocochlear
- Cochlea
Glossopharyngeal Nerves (IX)
Vagus Nerves (X)

Superior ganglion

Inferior ganglion

Pharyngeal branch

Superior cervical (vagal) cardiac branch

Superior laryngeal branch
Accessory Nerves (XI)

Sternocleidomastoid

Trapezius
Hypoglossal Nerves (XII)