Answer Key

The Muscular System: Torso and Abdomen

A muscular system lab activity using Visible Body’s Human Anatomy Atlas

Stephanie Wallace, Instructor of Biology, TCU
This lab activity is aligned with Visible Body’s Human Anatomy Atlas app.

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PRE-LAB EXERCISES

Before coming to lab, get familiar with a few muscle groups we’ll be exploring during lab. Go to the Views section in Human Anatomy Atlas. Under Systems, scroll down to the Muscular System views. Select View 9. Inhalation and find the following muscles. When you select a muscle, note the book icon in the content box. Selecting this icon allows you to read the muscle’s definition.

1. External intercostals
2. Pectoralis minor

Define the following terms:

1. Flexion
2. Extension
3. Elevation
4. Depression
IN-LAB EXERCISES

Use the following modules to guide your exploration of the thoracic and abdominal regions of the muscular system. As you explore the modules, locate the muscles on any charts, models, or specimen available. These muscles are located on the thorax, abdomen, and back, and serve to protect the cavities they enclose as well as provide movement.

These muscle groups will have different jobs depending on where they are located. Those muscles on the chest wall around the ribs play roles in changing the size of the thoracic cavity for inspirations and expirations. Muscles located along the spine are involved in movement of the back, and muscles lining the abdomen help to protect the organs underneath while also allowing for movement of the trunk.

The long names of some of these muscles can be daunting, but they are often very descriptive. You can find origins, insertions, actions, and/or locations of these muscles simply in the names. When reviewing the action of a muscle, it will be helpful to think about where the muscle is located and where the insertion is. Muscle physiology requires that a muscle will “pull” instead of “push” during contraction, and the insertion is the part that will move. Imagine that the muscle is pulling on the bone or tissue it is attached to at the insertion.

Access 3D views and animated muscle actions in Human Anatomy Atlas, which will be especially helpful to visualize muscle actions. When you select a structure in Atlas, you’ll see options to read the definition and hear the pronunciation in the content box. When you select a muscle, be sure to select the blue pin icon in the content box. This will give you the option to view origins and insertions as visible pins on the muscle (select Attachments), view the blood supply, and/or the nerve supply.

In the modules below, identify the following:

- Muscle location
- Origin(s) and insertion(s)
- Muscle action
- Nerve supply
A. Inspiratory Muscles


Go to Muscle Actions and view Muscle Action: Ribs elevation.
These muscles are responsible for inspiration during pulmonary ventilation. Although the diaphragm and, to a lesser extent, the external intercostals are primarily responsible for inspiration, additional accessory respiratory muscles can contract to assist in a more forceful inspiration.

Anatomically, the diaphragm marks the division between the thoracic and abdominal cavities. Observe the openings in the diaphragm that allow the passage of the esophagus and major blood vessels.

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diaphragm</td>
<td>Xiphoid process, cartilages of ribs 7-12, anterior surface of lumbar vertebrae</td>
<td>Central tendon that blends with anterior longitudinal ligament of vertebral column</td>
<td>Expands thoracic cavity, compresses abdominal cavity</td>
<td>Phrenic nerve</td>
</tr>
<tr>
<td>External intercostal</td>
<td>Ribs 1-11</td>
<td>Ribs 2-12</td>
<td>Elevates the ribs</td>
<td>Intercostal nerves</td>
</tr>
<tr>
<td>Pectoralis minor</td>
<td>Ribs 3-5</td>
<td>Coracoid process of the scapula</td>
<td>Elevates ribs, draws scapula down and medially</td>
<td>Medial pectoral nerve</td>
</tr>
<tr>
<td>Serratus anterior</td>
<td>Ribs 1-8</td>
<td>Medial border of scapula</td>
<td>Protracts and upwardly rotates scapula, holds scapula close to thoracic wall, elevates ribs when scapula is fixed</td>
<td>Long thoracic nerve</td>
</tr>
<tr>
<td>Serratus posterior superior</td>
<td>Supraspinal ligament, ligamentum nuchae, spinous processes of C7-T3</td>
<td>Ribs 2-5</td>
<td>Elevates upper ribs</td>
<td>Intercostal nerves 2-5</td>
</tr>
<tr>
<td>Scalenae</td>
<td>Transverse processes of C2-C7</td>
<td>Ribs 1-2</td>
<td>Unilateral: Bend spinal column laterally, tilt head</td>
<td>Spinal nerves C3-C8</td>
</tr>
</tbody>
</table>
B. Expiratory Muscles


Go to Muscle Actions and view Muscle Action: Ribs depression.
These muscles are responsible for expiration during pulmonary ventilation. In a normal, quiet exhalation, the relaxation of the diaphragm and external intercostals are responsible for air departing the lungs. However, accessory respiratory muscles may be used in a more forceful exhalation.

It can be easy to confuse the external and internal intercostals. The external intercostals are so named because they are superficial to the internal intercostals. It will also be helpful to pay attention to the direction of the fibers in these two muscles since they run in opposite directions.

<table>
<thead>
<tr>
<th>Expiratory Muscles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Muscle</strong></td>
</tr>
<tr>
<td>Internal intercostal</td>
</tr>
<tr>
<td>Transversus thoracis</td>
</tr>
<tr>
<td>Serratus posterior inferior</td>
</tr>
<tr>
<td>Rectus abdominis</td>
</tr>
<tr>
<td>Internal oblique</td>
</tr>
<tr>
<td>Transversus abdominis</td>
</tr>
</tbody>
</table>
C. Back Muscles


View 15. Lower Back

Left semispinalis cervicis muscle

Left multifidus muscle

Right rotatores muscles

Right intertransversarii muscles

Right intertransversarii muscles
These muscles located along the vertebral column function to support and extend the neck and/or back. The spinalis, longissimus, and iliocostalis are part of the erector spinae group, which lie parallel to the spine and extend the back. The transversospinales group, composed of the semispinalis, multifidus, and rotatores muscles, are so named because of their position between the transverse and spinous processes on the vertebrae.

Some of these muscles are deep to other muscles listed, so be sure to use the Hide function on the superficial muscles on one side of each of the views to reveal the deeper muscles.

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<tr>
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<th>Origin</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Splenius capitis</td>
<td>Ligamentum nuchae, spinous processes of C7-T3</td>
<td>Mastoid process of temporal bone and occipital bone</td>
<td>Supports the head in the erect position, draws head directly backward, draws head to one side and slightly rotates it, turning face to same side</td>
<td>Dorsal rami of middle cervical spinal nerves</td>
</tr>
<tr>
<td>Splenius cervicis</td>
<td>Spinous processes of T3-T6</td>
<td>Transverse processes of C1-C3</td>
<td>Supports the head in the erect position, draws head directly backward, draws head to one side and slightly rotates it, turning face to same side</td>
<td>Dorsal rami of spinal nerves C1-C6</td>
</tr>
<tr>
<td>Semispinalis capitis</td>
<td>Processes of C4-T6</td>
<td>Between superior and inferior nuchal lines of occipital bone</td>
<td>Extends vertebral column, draws head directly backward, rotates face to opposite side</td>
<td>Dorsal rami of spinal nerves</td>
</tr>
<tr>
<td>Semispinalis cervicis</td>
<td>Transverse process of T1-T6</td>
<td>Spinous process of C2-C7</td>
<td>Extends vertebral column, draws head directly backward, rotates face to opposite side</td>
<td>Dorsal rami of spinal nerves</td>
</tr>
<tr>
<td>Semispinalis thoracis</td>
<td>Transverse processes of T6-T12</td>
<td>Spinous processes of C6-T4</td>
<td>Extends vertebral column, draws head directly backward, rotates face to opposite side</td>
<td>Dorsal rami of spinal nerves</td>
</tr>
<tr>
<td>Spinalis</td>
<td>Spinous processes of C7, T11-L2 ligamentum nuchae</td>
<td>Spinous processes of C2-C5 and upper thoracic vertebrae</td>
<td>Extends the spine and head</td>
<td>Dorsal rami of upper cervical nerves</td>
</tr>
<tr>
<td>Longissimus</td>
<td>C5-L5</td>
<td>Mastoid process, C2-C6, T1-T12, ribs 3-12</td>
<td>Extends and laterally flexes spine, extends head</td>
<td>Middle and lower cervical spinal nerves</td>
</tr>
<tr>
<td>Muscle</td>
<td>Origin</td>
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</tr>
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<td>------------------------</td>
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<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Iliocostalis</td>
<td>Ribs 1-12, iliac crest</td>
<td>C4-C7, ribs 1-12</td>
<td>Extends, laterally flexes, and rotates spine</td>
<td>Dorsal rami of spinal nerves</td>
</tr>
<tr>
<td>Multifidus</td>
<td>Sacrum, posterior superior iliac spine (PSIS), C4-L5</td>
<td>Spinous process 2-4 vertebrae superior to origin</td>
<td>Stabilizes vertebrae in local movements</td>
<td>Posterior branches of cervical, thoracic, and lumbar spinal nerves</td>
</tr>
<tr>
<td>Rotatores</td>
<td>Transverse process of each thoracic vertebra</td>
<td>Spinous process of the vertebra superior to origin</td>
<td>Extend and rotate vertebral column</td>
<td>Cervical, thoracic, spinal nerves</td>
</tr>
<tr>
<td>Interspinales</td>
<td>Spinous process of each vertebra</td>
<td>Spinous process of the vertebra above each respective origin</td>
<td>Extend vertebral column</td>
<td>Cervical, thoracic, and lumbar spinal nerves</td>
</tr>
<tr>
<td>Intertransversarii</td>
<td>Transverse process of each vertebra</td>
<td>Adjacent vertebra superior to each origin</td>
<td>Flex the vertebral column</td>
<td>Cervical, thoracic, and lumbar spinal nerves</td>
</tr>
<tr>
<td>Quadratus lumborum</td>
<td>Aponeurosis from iliolumbar ligament and iliac crest</td>
<td>Rib 12 and transverse processes of L1-L4</td>
<td>Stabilizes lumbar spine, lateral flexion of lumbar spine, raises pelvis</td>
<td>Spinal nerves T12-L2</td>
</tr>
</tbody>
</table>

**TIME TO PRACTICE!**
GO TO THE MUSCULAR SYSTEM QUIZZES MENU AND COMPLETE QUIZ 21. POSTERIOR THORAX.
D. Abdomen

Left rectus abdominis muscle

Left external oblique muscle

Left transversus abdominis muscle

Left internal oblique muscle
The abdominal wall is composed of four muscles whose fibers run in different directions. These muscle layers protect the underlying organs, assist in forced respirations, and cause rotation of the trunk when contracted.

When viewing the cross section, note how the abdominal muscles overlap each other, especially on the anterior side.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Rectus abdominis</td>
<td>Crest of pubis and pubic tubercle, pubic symphysis</td>
<td>Pubis, cartilages of ribs 5-7, xiphoid process</td>
<td>Flexes vertebral column, tenses abdominal wall, compresses abdominal viscera</td>
<td>Spinal nerves T7-T12</td>
</tr>
<tr>
<td>External oblique</td>
<td>Sternum, ribs 5-12</td>
<td>Pubis, linea alba, iliac crest</td>
<td>Bilateral: compresses abdomen, flexes spine; unilateral: laterally flexes trunk on same side, rotates trunk to opposite side</td>
<td>Lower intercostal, iliohypogastric, ilioinguinal nerves</td>
</tr>
<tr>
<td>Internal oblique</td>
<td>Lateral half of inguinal ligament, middle lip of iliac crest, lumbodorsal fascia</td>
<td>Pubis, inferior border of ribs 10-12</td>
<td>Bilateral: compresses abdominal viscera, flexes spine; unilateral: laterally flexes and rotates trunk on same side</td>
<td>Spinal nerves T8-L1</td>
</tr>
<tr>
<td>Transversus abdominis</td>
<td>Inguinal ligament, iliac crest, cartilages of ribs 7-12</td>
<td>Aponeurosis: Forms part of the rectus sheath and attaches to linea alba and pubis</td>
<td>Compresses abdominal viscera, tenses abdominal wall</td>
<td>Spinal nerves T7-L1, iliohypogastric and ilioinguinal nerves</td>
</tr>
</tbody>
</table>

**TIME TO PRACTICE!**
**GO TO THE MUSCULAR SYSTEM QUIZZES MENU AND COMPLETE QUIZ 22. ABDOMEN.**
PUTTING IT ALL TOGETHER

1. Based on what you’ve learned about the muscles in this exercise, what do you think the following terms mean?
   
   a. External - on the outside
   
   b. Internal - on the inside
   
   c. Oblique - diagonal
   
   d. Rectus - straight
   
   e. Capitis - head
   
   f. Spinalis - spine

2. Which muscles are used when performing the following actions?
   
   a. Rowing a boat
      i. Pectoralis minor
      ii. Serratus anterior
      iii. Trapezius
      iv. Levator scapulae
      v. Rhomboid minor
      vi. Rhomboid major

   b. Standing erect
      i. Splenius group – splenius capitis and splenius cervicis
      ii. Erector spinae group – spinalis, longissimus, iliocostalis
      iii. Transversospinales group – semispinalis, rotatores, multifidus
      iv. Interspinales
c. Twisting your torso (as when swinging a baseball bat)
   i. External oblique
   ii. Internal oblique

d. Taking a bow after a performance
   i. Intertransversarii
   ii. Rectus abdominis
   iii. External oblique
   iv. Internal oblique

e. Inhaling deeply
   i. Diaphragm
   ii. External intercostals
   iii. Serratus anterior
   iv. Pectoralis minor
   v. Serratus posterior superior
   vi. Scalenes

3. Sometimes acid that regurgitates from the stomach can irritate the phrenic nerve, causing it to fire spontaneously. What effect do you think this would have?

   Spontaneous contraction of the diaphragm, commonly known as hiccups.
Student Practice

Label all the structures on the following images:
Source: Muscular System Views: View 9: Inhalation
Source: Muscular System Views: View 9: Inhalation

- Right serratus anterior muscles
- Right pectoralis minor muscle
- Right scalene muscles
- Right external intercostal muscles
- Diaphragm
Source: Muscular System Views: View 14: Upper Back

- Left semispinalis capitis muscle
- Right splenius capitis muscle
- Left semispinalis thoracis muscle
- Right splenius cervicis muscle
- Left iliocostalis muscle
- Right spinalis muscle
- Left longissimus muscle
- Right splenius muscle
- Left quadratus lumborum muscle
Source: Muscular System Views: View 15: Lower Back

- Left semispinalis cervicis muscle
- Left multifidus muscle
- Right rotatores muscles
- Right intertransversarii muscles
- Right intertransversarii muscles
Source: Cross Sections: Abdomen (Axial): View 4: Abdomen (L02-L03)

Left rectus abdominis muscle

Left external oblique muscle

Left transversus abdominis muscle

Left internal oblique muscle