

Middle School



Teacher's Guide  
ANATOMY

Major Sponsor:



The **Field**  
Museum

## Introduction

This module is intended to be flexible and support your curriculum in a variety of content areas. All materials in this module are optional but designed to enrich your students' *Virtual Visit* experience and align to the *Next Generation Science Standards* and *Common Core*.

If you are using the research module along with the anatomy module, it is recommended that you implement the research module after you have completed the anatomy module. You may also choose to implement the research module alone.

## Background

One of the overarching themes of biology is the biological hierarchy. Multicellular organisms are made of cells, which form tissue, which make up organs that are part of an organ system, which in turn creates an organism. Squirrels have a similar anatomy to most other mammals. They have mammary glands, a backbone with seven cervical vertebrae, and four limbs. They also have circulatory, digestive, endocrine, muscular, nervous, integumentary, reproductive, and respiratory systems. All of which work together to aid the squirrel in essential life activities such as metabolism, growth, reproduction, and to maintain homeostasis.

All living things are grouped into categories based on their evolutionary relatedness, also known as taxonomy. Originally developed by Carolus Linneus based on physical characteristics, taxonomy is now much more sophisticated and uses additional characters such as DNA sequences and embryology. Still today, scientists use these principles of anatomical similarities and differences to identify organisms. Mammals are most often identified using characteristics of the skull.

Mammals are a large and diverse class of animals that also includes humans. All mammals are vertebrates and endothermic, warm-blooded. They also have hair and produce milk to feed their newborns. Rodentia is the largest group of mammals. Rodents all share the common feature of having a single pair of incisors in each jaw, which grow continually throughout life. Rodents use these incisors to gnaw and have a few molars that are used for chewing.

# NGSS Alignment

These lessons align with the following *Next Generation Science Standards*, among others.

Students who demonstrate understanding can:

**MS-LS4-2.** Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

**MS-LS1-3.** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Constructing explanations and designing solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> <li>Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> <li>Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)</li> </ul>	<p><b>LS4.A: Evidence of Common Ancestry and Diversity</b></p> <ul style="list-style-type: none"> <li>Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)</li> </ul> <p><b>LS1.A: Structure and Function</b></p> <ul style="list-style-type: none"> <li>In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns can be used to identify cause and effect relationships. (MS-LS4-2)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)</li> </ul>

**Common Core State Standards Connections:**

*ELA/Literacy -*

**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-2)

**WHST.6-8.1** Write arguments focused on discipline content. (MS-LS1-3)

**WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2)

**SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2)

Adapted from *NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.*

# Module Overview

Activity	Driving Question	Activity Overview
1 -PRE	How are different orders of mammals characterized?	Using a computer, students investigate different orders of mammals by searching what order different mammals belong in. Then, the teacher assigns a small group of students to a specific order. Groups will research the key features and examples of their order. Each group will share their findings with the class. Time: 45-60 min
2 - PRE	How do scientists identify species of rodents?	Using a computer module, students will use an interactive key to identify various species of rodents. Time: 45-60 min
3 BROADCAST	How do museums curate specimen for collection?	Students will watch a Field Museum scientist dissect an Illinois Gray Squirrel. The scientist will highlight key anatomy of the squirrel. Students will have the opportunity to ask questions to the scientist. Time: 60 min
4 - POST	What is the anatomy of a squirrel?	Students reassemble disarticulated squirrel bones and organs to re-create a complete squirrel. Time: 30-45 min
5 - POST	How is a squirrel organized?	Using their knowledge of squirrel anatomy, students will model the anatomy of a squirrel. Time: 45-60 min

## Lesson 1

Recommended as a pre-broadcast activity

45-60  
minutes**SQUIRRELS (AND OTHER SMALL MAMMALS)****After this lesson your students will be able to:**

- Compare and contrast key features of different mammalian orders.

**MAIN IDEAS**

- The Field Museum has thousands of specimens; scientists from all over the world come to study them.
- Animals are classified by scientists based on outward physical features, behavior and genetic characteristics.
- Squirrels are in the Order *Rodentia*. Rodents are the largest group of mammals.
- Class Mammalia is a small, but very diverse, class in the Kingdom Animalia.

**MATERIALS**

- Squirrels are Rodents are Mammals student worksheets; S1, S2, and S3
- Computers with Internet to access the website:

<http://www.enchantedlearning.com/subjects/mammals/classification/>

**DIRECTIONS**

1. Review information from the Main Ideas section with your class.
2. Pass out the Squirrels are Rodents are Mammals worksheet.
3. Students may practice their graph interpretation skills by completing the Species of Mammals, by order questions as a bell ringer. Or you may choose to answer these questions as a class.
4. Using the Enchanted Learning (EL) website, have students identify what order each animal belongs in on the *Look it up!* section of their worksheet.
5. As students are working, partner them up and assign them an order from the following list:
  - a. Artiodactyla, Carnivora, Cetacea, Insectivora, Lagomorpha, Perissodactyla, Primate, Proboscidea, Monotrema
    - If you want to challenge a student, assign them one of the orders that is not detailed on the EL website and have them search the web instead.
6. Instruct students to use the website to complete the More Mammals section of their worksheet.
7. Project the class *Mammalia* Chart on a board. Have students fill in the chart as they complete their research.
8. When the chart is complete, ask the students to share what they found and copy the information on their own chart.

## Lesson 2 Recommended as a pre-broadcast activity

45-60  
minutes

### SQUIRRELS (AND OTHER SMALL MAMMALS)

#### After this lesson your students will be able to:

- Compare and contrast cranial features of a mammalian skull to explain species identification (adapted from MS-LS4-2).



#### MAIN IDEAS

- There are over 280 species of squirrels on the planet, found everywhere except Madagascar, Australia, New Zealand and Antarctica.
- Inquiry: Show students a map of the world. Ask, “Why do you think squirrels are not found in these places?”
- Squirrels and other small rodents may look similar but they are very diverse.
- The Field Museum has thousands of squirrels in its collection; each specimen is unique. All have to be identified and properly classified.

- Observation is a key scientific skill.
- Skull and skin Keys, which show key features of anatomy, are useful tools for scientists when identifying specimen



#### MATERIALS

- Computers with projector to show the Skull key: VV\_skullkeynote.ppsx



#### DIRECTIONS

1. Review information from the Main Ideas section with your class.
2. Project the provided PowerPoint (VV\_Skullkeynote.ppsx) to the entire class, model for students how to use the key module. Have students follow along on the Skull Search Worksheet.
  - *Tip:* Practice using the key before class to familiarize yourself with the vocabulary and think about possible student misconceptions.
3. Instruct students to identify at least three species on their own using the key module. Tell students to write down the Specimen # and *Genus species* after each identification.
  - While students are working, circulate to make sure they are fully utilizing the key and not guessing.
4. To conclude the class, project the final slide Which is a Rodent? and have students discuss which one they think belongs to the Order *Rodentia*.

# Lesson 3 This is the Broadcast day activity

60  
minutes

## SQUIRRELS DISSECTION BROADCAST

### After this lesson your students will be able to:

- Identify the skeletal and organ anatomy of a squirrel.
- Explain how a squirrel uses different organ systems to perform various life functions.



### MAIN IDEAS

- Squirrels have key features that separate them from other *Rodentia*.
- Squirrels are made up of several organ systems that allow them to perform specific functions.
- Many steps are taken to incorporate a specimen into the Museum's collection.
- Squirrels are made up of systems of organs that help carry out essential life functions.
- Squirrels have a skeletal anatomy similar to other mammals.



### MATERIALS

- Computer with Internet access.



### DIRECTIONS

1. Follow the technical guide provided to set up the Virtual Visits broadcast.
2. While waiting for the broadcast to begin, review information from the Main Ideas with you class.
3. OPTIONAL: Provide students with a sheet of paper to record questions that they come up with during the broadcast.
4. Follow the broadcast with a class discussion on what was learned and what students would like to investigate further.

# Lesson 4

Recommended as a post-broadcast activity

30-45  
minutes

## SQUIRREL ANATOMY

After this lesson your students will be able to:

- Identify key anatomy of the Illinois Gray Squirrel *Sciurus carolinensis*
- Model key anatomy of the Illinois Gray Squirrel *Sciurus carolinensis*



### MAIN IDEAS

- Key anatomy of squirrels
- Identification of key anatomy of the Illinois Gray Squirrel *Sciurus carolinensis*



### MATERIALS

- Skeletal and Organ Diagram Activity worksheets; S4, S5, and S6
- Optional:
- Colored pencils, markers, or crayons
  - Textbook, for reference



### DIRECTIONS

1. Pass out the Skeletal and Organ Diagram Activity
2. Have your students label and/or create a color code to correctly identify the features of this specimen from the list included.
3. In-class option: Print the skeleton and organs on transparency paper and have a student or two attempt to assemble in front of the class, getting feedback from students as they follow along. Reconstruct the features in order to reassemble the specimen.

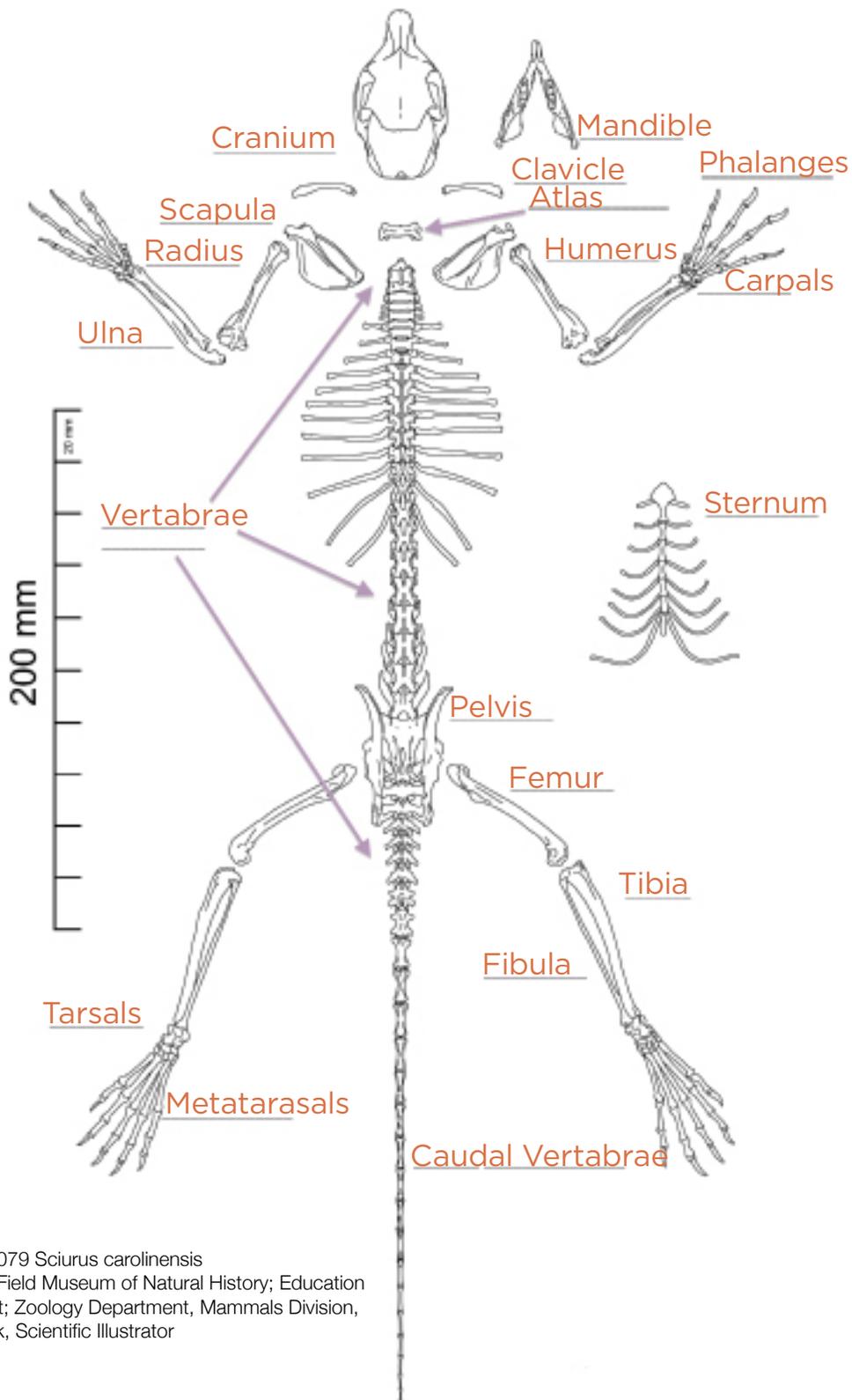


# Section 4: Squirrel Diagram Activities

## Skeletal Diagram Answer Key

### DIRECTIONS

Write the name of the skeletal part next to the bone on the lines provided.

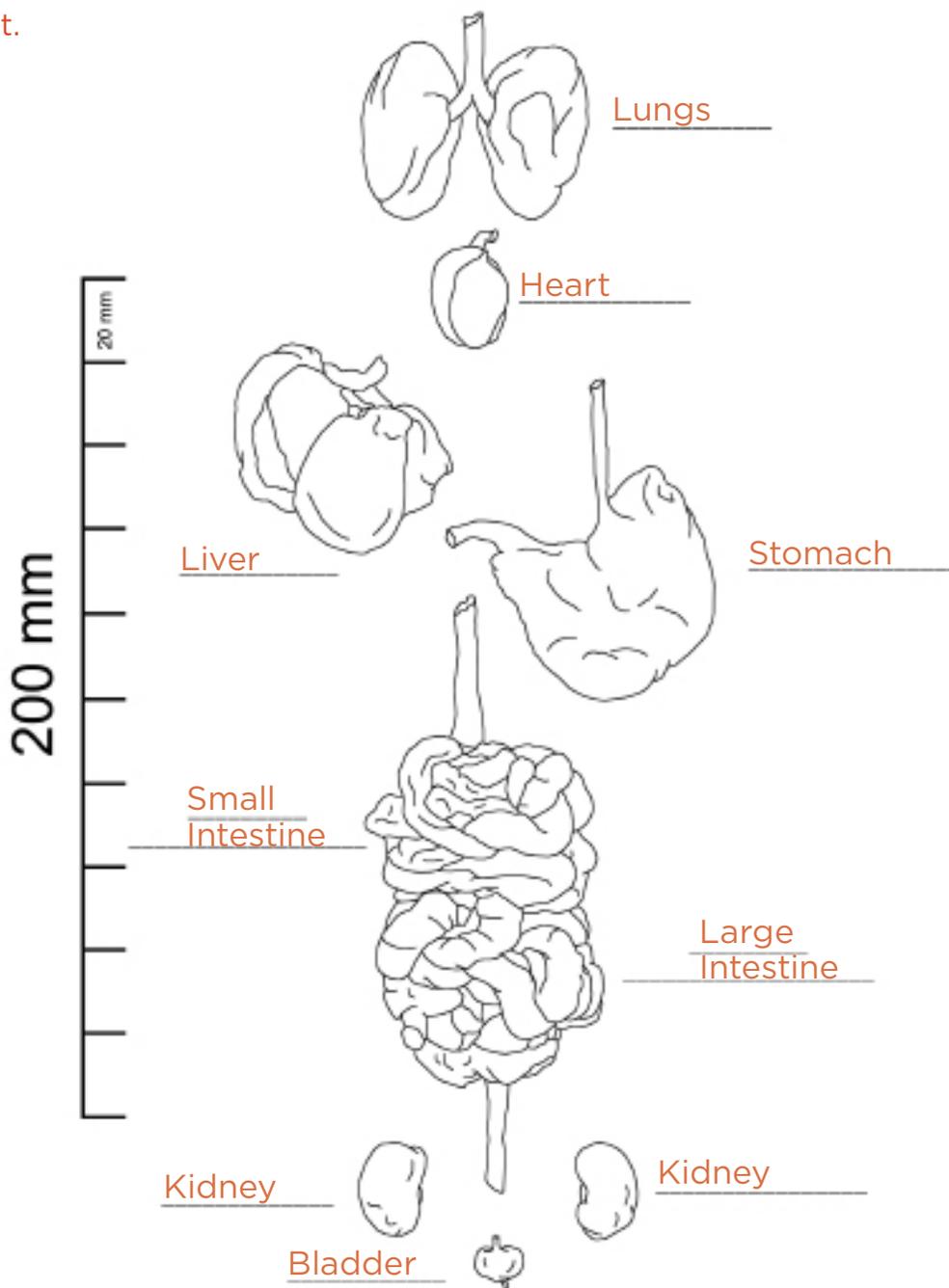


FMNH 178079 *Sciurus carolinensis*  
 Copyright: Field Museum of Natural History; Education Department; Zoology Department, Mammals Division, R. Banaziak, Scientific Illustrator

# Disarticulated Organ Identification A Answer Key

## DIRECTIONS

Write the name of the organ on the line next to it.

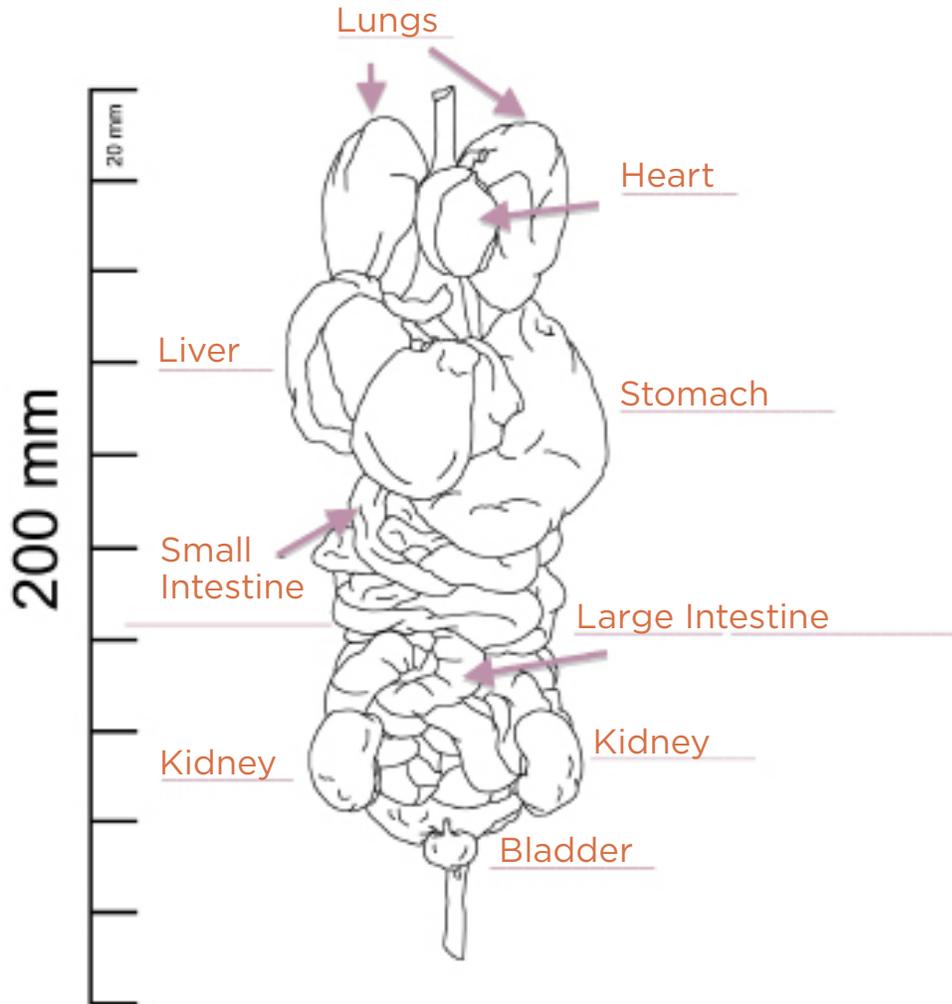


FMNH 178079 *Sciurus carolinensis*  
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# Disarticulated Organ Identification B Answer Key

## DIRECTIONS

Write the name of the organ on the line next to it.



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# Lesson 5

Recommended as a post-broadcast activity

45-60  
minutes

## SQUIRRELS ANATOMY MODELING

After this lesson your students will be able to:

- Model the skeletal and organ anatomy of a squirrel.



### MAIN IDEAS

- Organisms are organized by increasing complexity from cells to organs.
- Each structure in an organism's body carries out a specific function.
- Each structure works together to allow the organism to complete essential life functions such as metabolism, reproduction, growth, and maintain homeostasis



### MATERIALS

- Copies of student handouts S7 and S8 for each student

MODIFICATION: You can have students complete this project in pairs

- Scissors
- Glue
- Paper, plain or construction

Optional:

- Colored pencils, crayons, or markers

**TIP:** To save time, make this a group activity. Determine the maximum number of groups you would have in one class, then make that many copies of the worksheets and cut out before class. Sort and store the pieces in an envelope to reuse throughout the day.

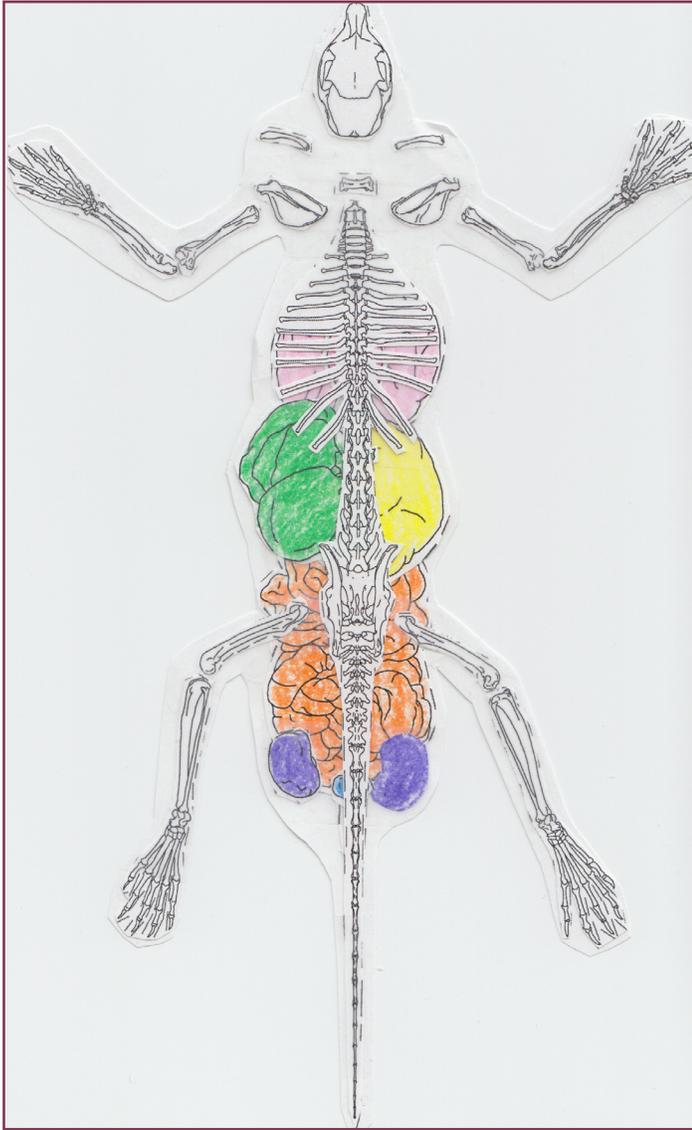


### DIRECTIONS

**NOTE:** These activities can be done as a homework extension outside of class. Simply have student paste their reconstructed squirrel onto construction paper.

1. Review information from the Main Ideas section with your class.
2. Distribute the materials and instruct students to reassemble the squirrel skeleton and organs and model how both systems overlay and interact, see T13 for example.
3. Circulate and monitor student progress.

## SQUIRREL ANATOMY 2D MODEL EXAMPLE



FRONT



BACK

Middle School



Student Handouts

# ANATOMY

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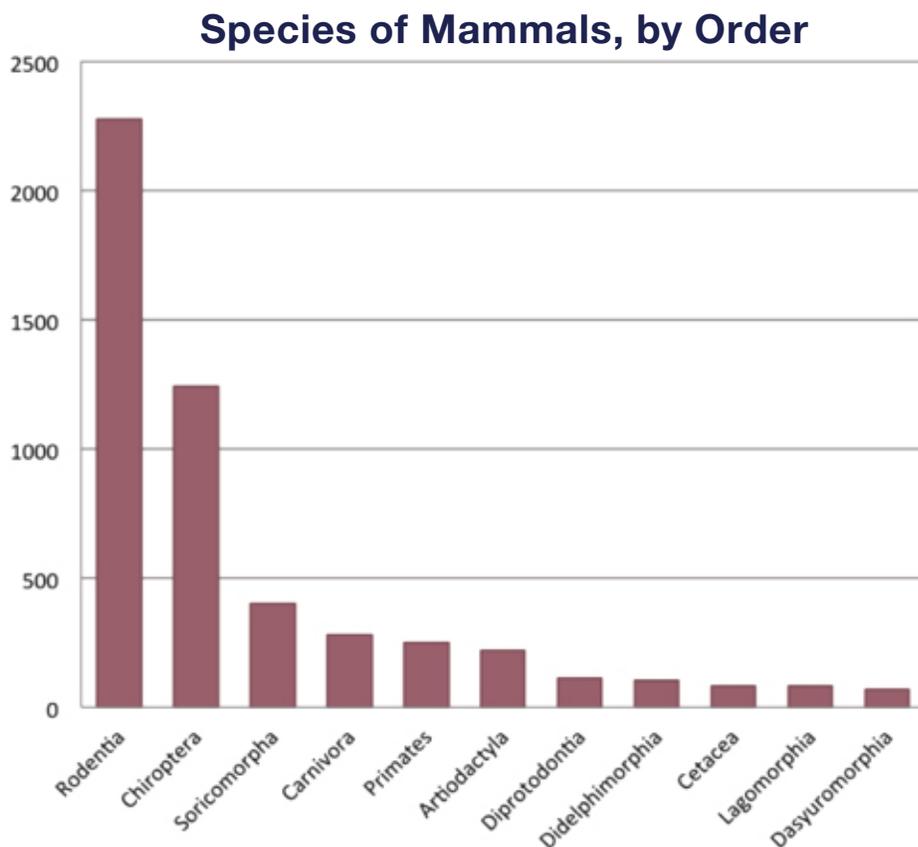


The **Field**  
Museum

NAME \_\_\_\_\_ CLASS \_\_\_\_\_ DATE \_\_\_\_\_

## Squirrels are rodents are mammals are animals

Mammals are a very diverse group of animals. With 2277 known species identified, the Order *Rodentia* is the largest of all the mammal groups. Because they share a common trait of continuously growing incisors (front teeth), squirrels are categorized as rodents along with mice, rats, beavers, hamsters and porcupines, to name a few.

**Data Interpretation Practice**

1. Which order has the second largest number of species?
2. Approximately how many species are in the Order *Chiroptera*?
3. Approximately how many more species of *Rodentia* are there than *Chiroptera*?

NAME ..... CLASS ..... DATE .....

## Look it up!

Use the Enchanted Learning website to find out what order the following mammals go in:

- |                |                 |
|----------------|-----------------|
| Dolphins ..... | Kangaroos.....  |
| Pandas .....   | Squirrels ..... |
| Apes .....     | Manatees .....  |
| Rabbits .....  | Humans .....    |
| Bats .....     | Camels .....    |

## More Mammals

In your group, research the order you have been assigned by your teacher.

Assigned Order: .....

A. Report back to the class on the key feature that characterizes your order. You can write it here:

B. List at least five animal species that are members of this group:

- a. ....
- b. ....
- c. ....
- d. ....
- e. ....



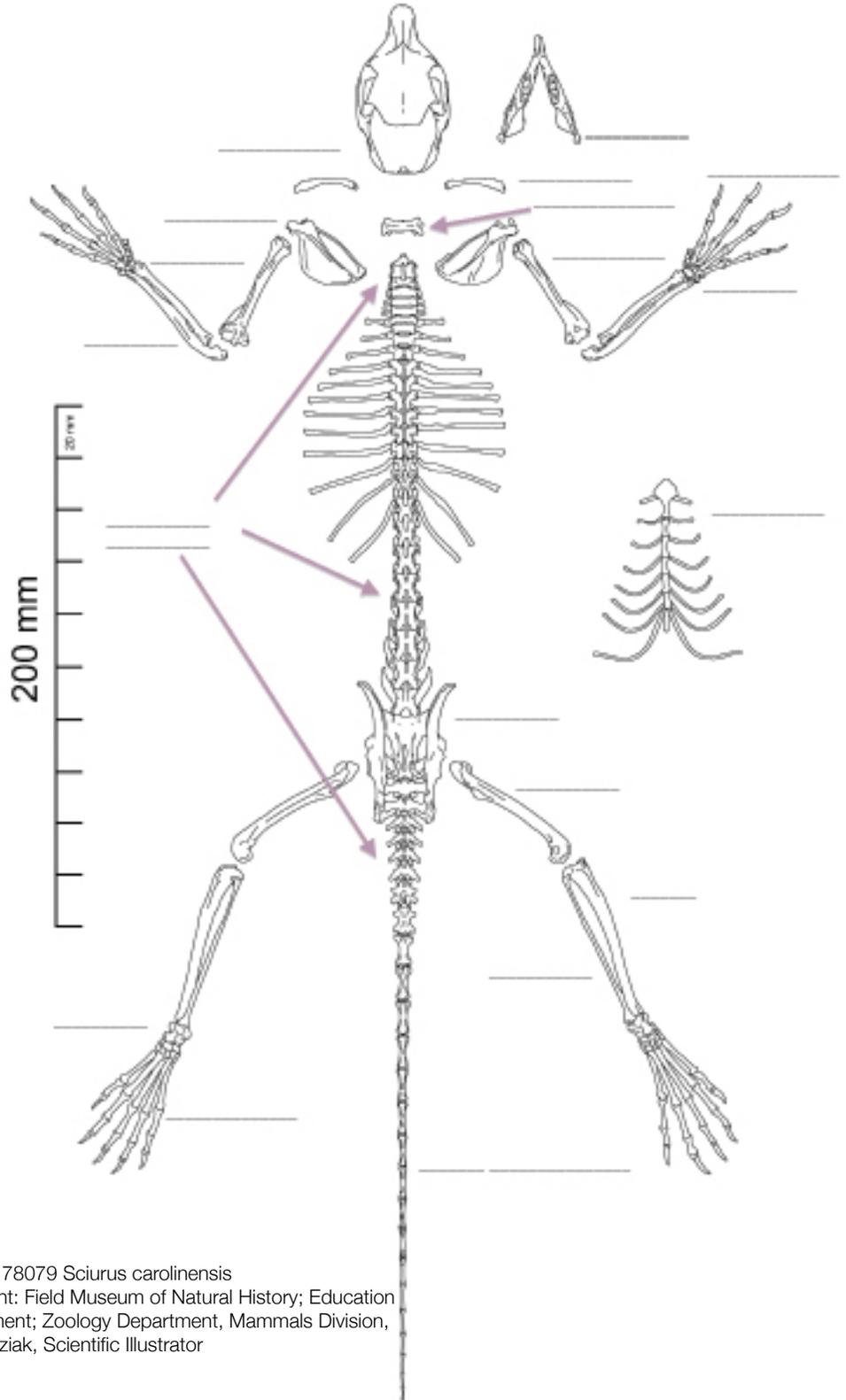
NAME \_\_\_\_\_ CLASS \_\_\_\_\_ DATE \_\_\_\_\_

## Section 4: Squirrel Diagram Activities

### Skeletal Diagram

**DIRECTIONS**

Write the name of the skeletal part next to the bone on the lines provided.



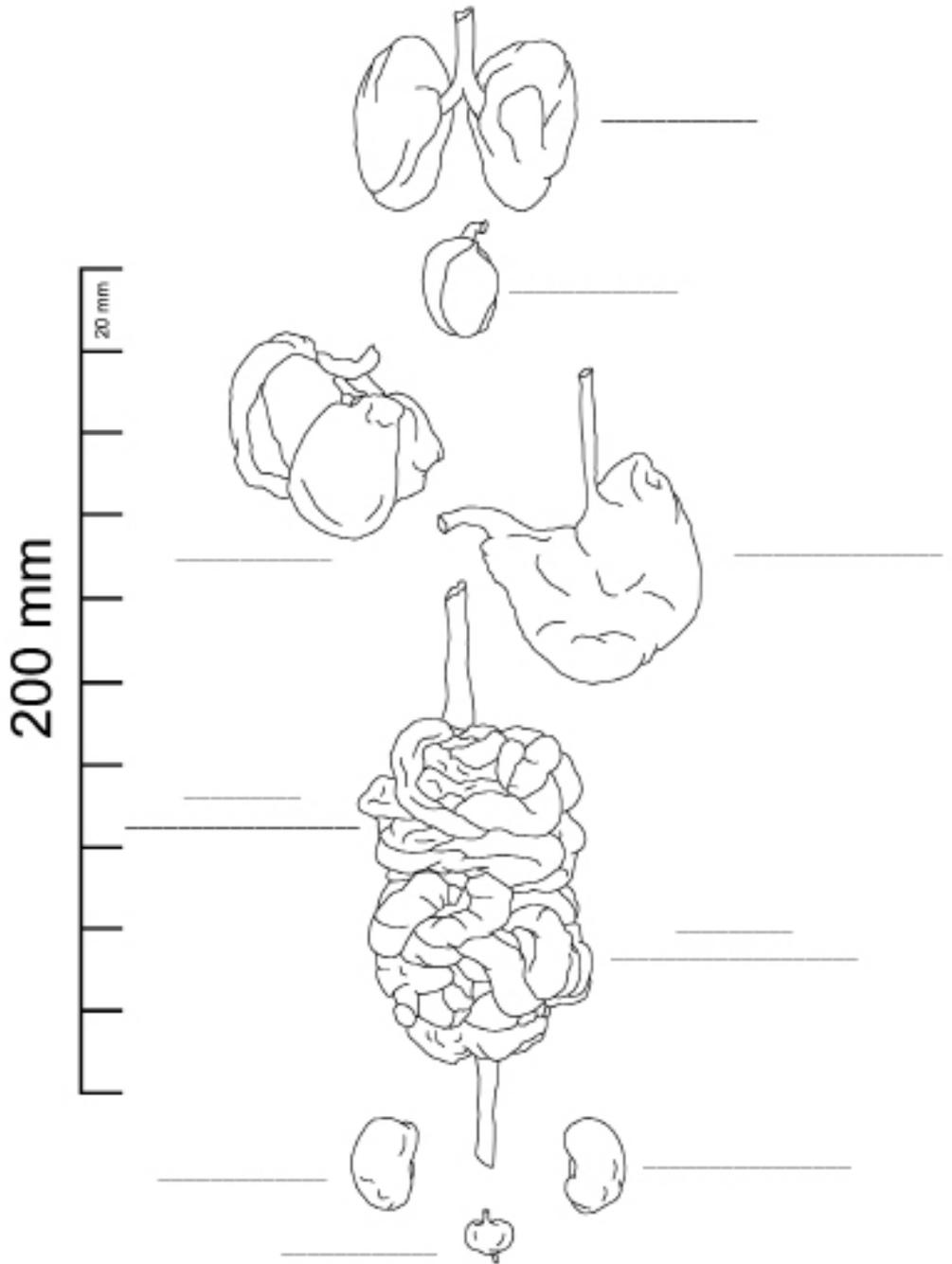
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NAME..... CLASS..... DATE.....

# Disarticulated Organ Identification A

## DIRECTIONS

Write the name of the organ on the line next to it.



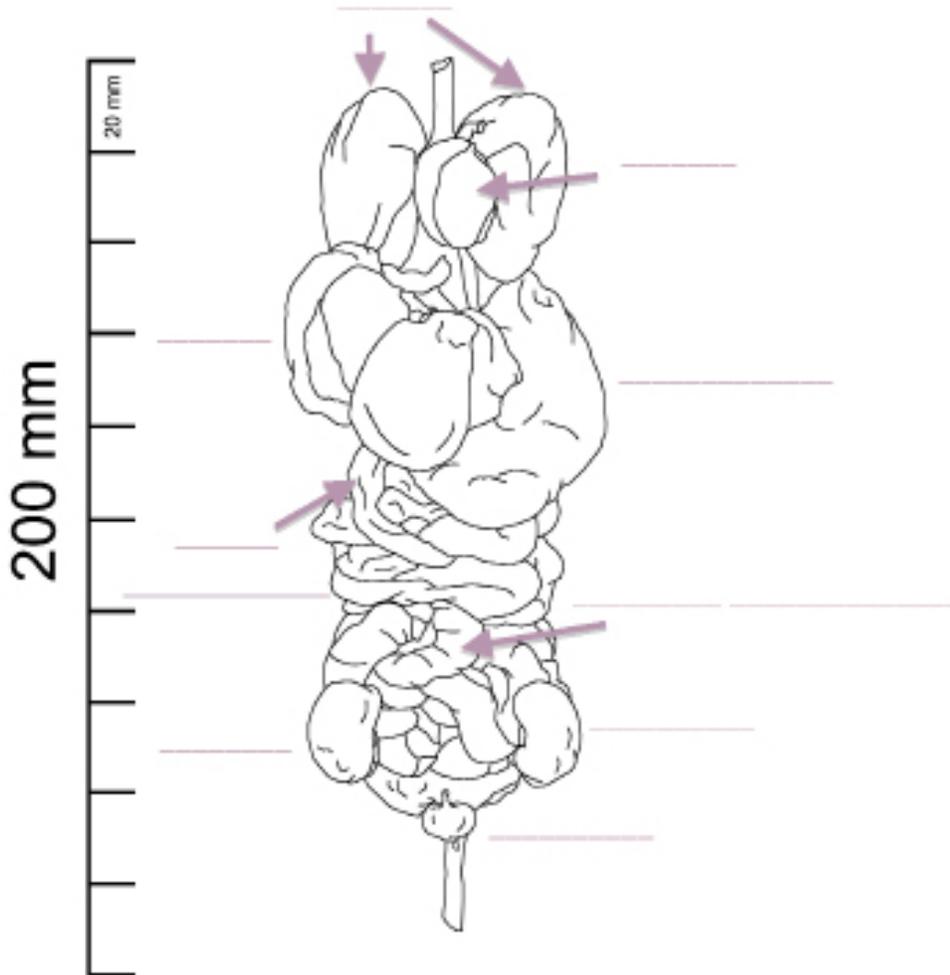
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NAME ..... CLASS ..... DATE .....

## Disarticulated Organ Identification B

### DIRECTIONS

Write the name of the organ on the line next to it.



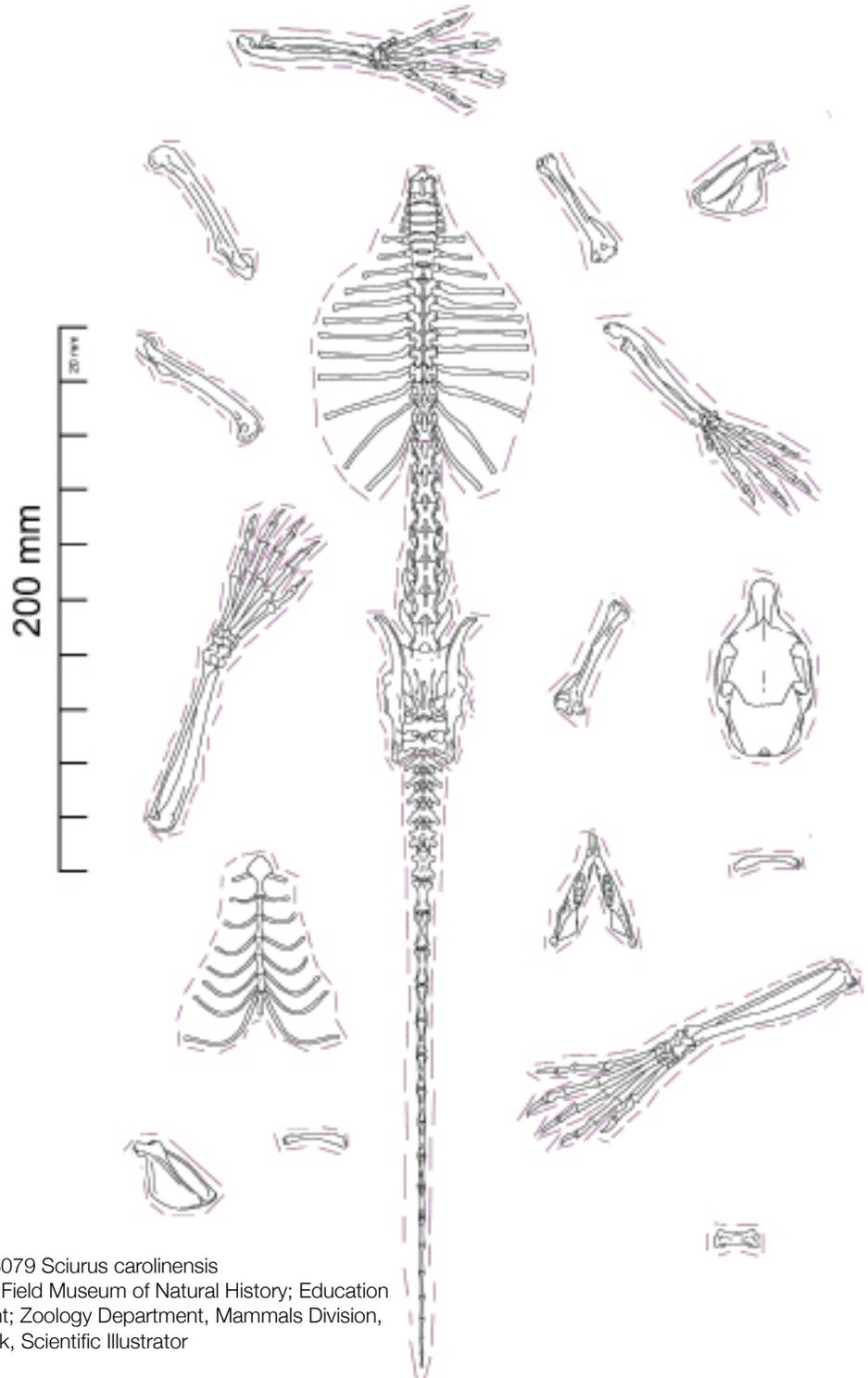
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NAME ..... CLASS ..... DATE .....

# Build-a-Squirrel PAGE 1

## DIRECTIONS

Using scissors, cut out the bones, then try to put them all back together in their correct place!



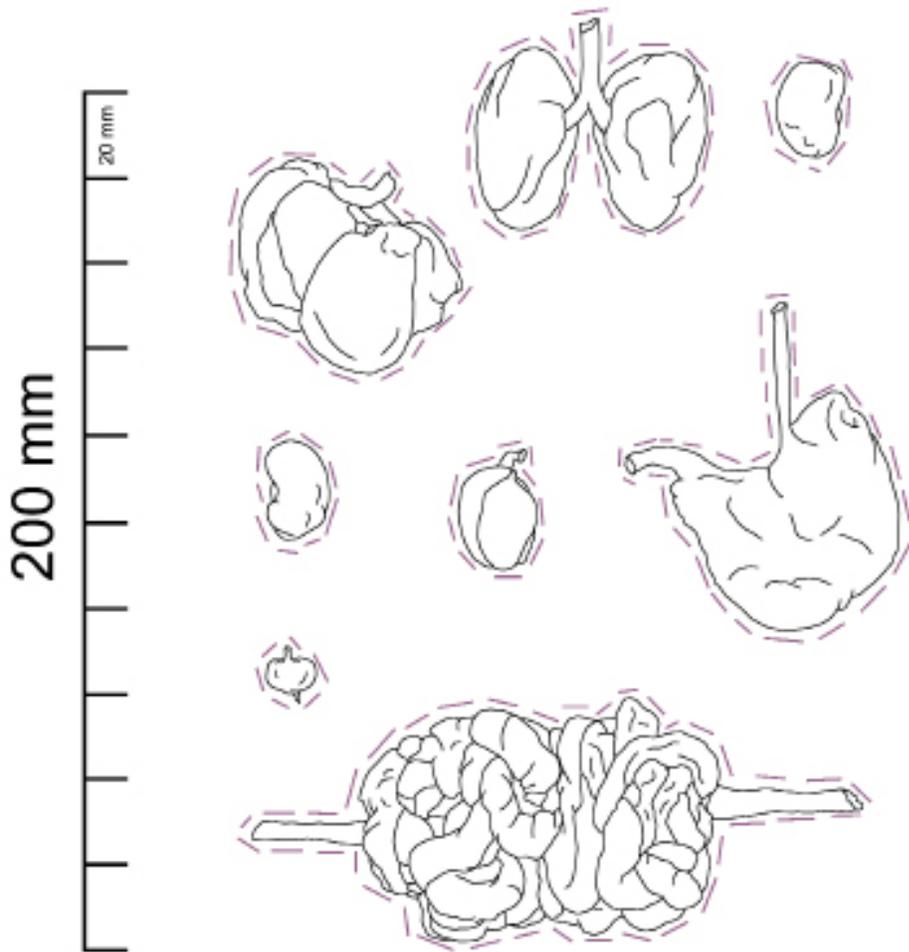
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NAME ..... CLASS ..... DATE .....

# Build-a-Squirrel PAGE 2

## DIRECTIONS

Using scissors, cut out the bones, then try to put them all back together in their correct place!



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