Introduction to Trilobites

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for

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An Introduction to Trilobites

This kit is provided by the Museum of Geosciences at Virginia Tech. It was written and designed by Amy C. Smith with the objective to introduce the extinct class of animals known as the trilobites to students through hands-on inquiry based learning. This kit focuses on the basic morphology of trilobites, as well as particular aspects of their behavior and ecology.

Kit Purposes

This kit was designed to introduce students to the morphology and living habits of trilobites, an extinct group of marine arthropods. It emphasizes observation, comparison and contrast, deductive reasoning, and explanatory support of hypotheses.

Appropriate Grade Levels

This kit is best suited for grades 3 and older. The first two activities involve observing, comparing, and contrasting the overall morphology of trilobites and may be addressed by students in elementary through high schools. The third activity discusses such concepts as hypothesized locomotion and habitat, and is better suited to students in middle and high schools.

Kit Inventory

- 1 kit binder
- 1 copy of *Trilobites of New York*, by T. E. Whiteley, G. J. Kloc, and C. E. Brett
- Specimen A: 1 *Isotelus* cast
- Specimen B: 1 *Calymene* fossil
- Specimen C: 1 trilobite fossil
- Specimen D: 1 trilobite fossil
- Specimen E: 1 trilobite fossil
- Specimen F: 1 trilobite fossil
- Specimen G: 1 trilobite fossil
- Specimen H: 1 trilobite fossil
- Specimen I: 13 unrolled trilobite fossils
- Specimen J: 13 rolled trilobite fossils
- Specimen K: 1 brachiopod fossil

Virginia Science Standards of Learning Addressed by This Kit

3.4 The student will investigate and understand that adaptations allow animals to satisfy life needs and respond to the environment. Key concepts include

a) behavioral adaptations; and
b) physical adaptations.

4.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

a) distinctions are made among observations, conclusions, inferences, and predictions.

4.5 The student will investigate and understand how plants and animals, including humans, in an ecosystem interact with one another and with the nonliving components in the ecosystem. Key concepts include

a) plant and animal adaptations.
d) habitats and niches

5.5 The student will investigate and understand that organisms are made of one or more cells and have distinguishing characteristics that play a vital role in the organism's ability to survive and thrive in its environment. Key concepts include

b) classification of organisms using physical characteristics, body structures, and behavior of the organism.

5.7 The student will investigate and understand how Earth's surface is constantly changing. Key concepts include

c) Earth history and fossil evidence.

6.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

a) observations are made involving fine discrimination between similar objects and organisms.

LS.4 The student will investigate and understand how organisms can be classified. Key concepts include

d) the characteristics that define a species.

LS.13 The student will investigate and understand that populations of organisms change over time. Key concepts include

b) evidence of evolution of different species in the fossil record.

ES.9 The student will investigate and understand that many aspects of the history and evolution of Earth and life can be inferred by studying rocks and fossils. Key concepts include

a) traces and remains of ancient, often extinct, life are preserved by various means in many sedimentary rocks.

BIO.6 The student will investigate and understand bases for modern classification systems. Key concepts include

a) structural similarities among organisms;
b) fossil record interpretation.

BIO.7 The student will investigate and understand how populations change through time. Key concepts include

a) evidence found in fossil records.

Kit Background Information

This kit enables students to study a particular class of fossils called the trilobites. By doing so, students will be able to experience the ways in which paleontologists learn from fossils in general and how to use the fossil record to figure out what life may have been like millions of years ago.

Trilobite Overview

Trilobites were a class of arthropods (segmented animals with hard outer skeletons) that lived in the ocean during the Paleozoic Era. In the Middle Cambrian period, the trilobites reached their peak in diversity and had multiplied into thousands of species. They existed for 325 million years before they all became extinct due to predation and inefficient molting.

Teaching about Fossils

It is important that students understand the following key points when discussing fossils:

1. **Fossils are the remains, traces, or evidences of organisms that once lived.** This is why things like rocks and minerals are not fossils.
2. **Fossils must be found in either rock or sediment to be considered a fossil.** Although there is no time requirement for an organism to become a fossil (e.g., they do not have to be a certain number of years old) fossils are in human terms extremely old and have been buried for far longer than our lifespans. For example, a shell on the beach is not yet a fossil, but a shell found within a rock (which is solidified sediment) is a fossil. Both are remains of living organisms, but the shell in the rock has been deposited a substantial amount of time ago.
3. **In one location, rocks of different ages can contain different types of fossils because life has evolved through time.** This occurs because rock layers containing fossils that are on top of other rock layers were deposited sequentially, and the upwards progression through rock strata represents progression through time.
4. **In several different locations, rocks of the same age can contain different types of fossils because different organisms lived in different environments.** This is because environments change over long periods of time, and these changes are marked by the rock and fossil record.

Activity Overviews and Set Up

Each activity is accompanied by a worksheet. During activity set up, it is best to spread out the specimens (with exception to specimens G and H, which are examined together, and specimens I and J, which are examined together) with the box lids visibly next to their specimens. This way, students can move from specimen to specimen as their work progresses.

Activity 1: An Overview of Trilobite Morphology
Each student will examine the cast of specimen A (*Isotelus*), draw and label it, and fill out the provided worksheet. Next, they will examine specimens C, D, E, and F, to address the questions about specific trilobite features. Students will need copies of the Activity 1 worksheet and Figures 2.1, 2.4, and 2.6 from *Trilobites of New York*.

Activity 2: Comparing and Contrasting Different Trilobites
Students will compare the cast of *Isotelus* (specimen A) to the *Calymene* fossil (specimen B) and note the similarities and differences between the two in a Venn diagram. Students will need copies of the Activity 2 worksheet.

Activity 3: Trilobite Behavior and Ecology
With the help of the supplied figures and text, students will examine specimens C, G, H, I, J, and K in order to draw conclusions about the lifestyles and habitats of trilobites. Students will need copies of the Activity 3 worksheet and figures 2.5, 2.3, and 2.13 from *Trilobites of New York*.

Questions for Class Discussion

The activities which these discussion topics follow are marked in bold.

- **Activity 1.** What are some animals living today that look similar to trilobites? How are they similar? Conversely, what are some living animals that look nothing like trilobites, and what makes them different? Do animals living today have the same specific parts that you labeled on your trilobite?

- **Activity 2.** Do you think that these two trilobites are closely related to each other? Why or why not?

- **Activity 2 and 3.** Do you think these two trilobites lived within the same environment? Did they share the same lifestyle habits (e.g. swimming, crawling, filter feeding, etc.)? Why or why not?

- **Activity 3.** Did all trilobites live in exactly the same environment, or did they live within different marine environments? What clues do you use to tell in which environment a fossil organism has lived?

- **Activity 3.** What aspects or behaviors helped trilobites survive predators? What aspects or behaviors made trilobites vulnerable to predators?

Activity 1: An Overview of Trilobite Morphology

Examine Figure 2.1 and read the caption. Next, closely examine the cast of *Isotelus* (specimen A) and write a detailed description of the trilobite and sketch it below. In your sketch, please label the following parts: axial lobe, two pleural lobes, cephalon, thorax, pygidium, glabella, eyes.

Next, please answer the following two questions about specific details of trilobite morphology.

1. Trilobite eyes

One of the key features of most trilobites is that many of them had the first complex eyes on earth. Trilobites that had eyes had one of three different main types, the predominant types being holochroal, which were the most common type of trilobite eye, and schizochroal, which were particular to a certain group of trilobites called the Phacopids. Figure 2.4 shows an example of each of these types of eyes. Please examine the following specimens and indicate which of these eye types you think they had by comparing them to the photographs.

Specimen E: _____

Specimen F: _____

2. Exoskeletal Pits

Some trilobites have tiny pits in portions of their exoskeletons. Examine Figure 2.6 and read the caption. These pits are hypothesized to have helped detect changes in the water currents. For the following 4 specimens, write exactly where (if at all) such pits occur. If no pits are present, just write “none”.

Specimen C: _____

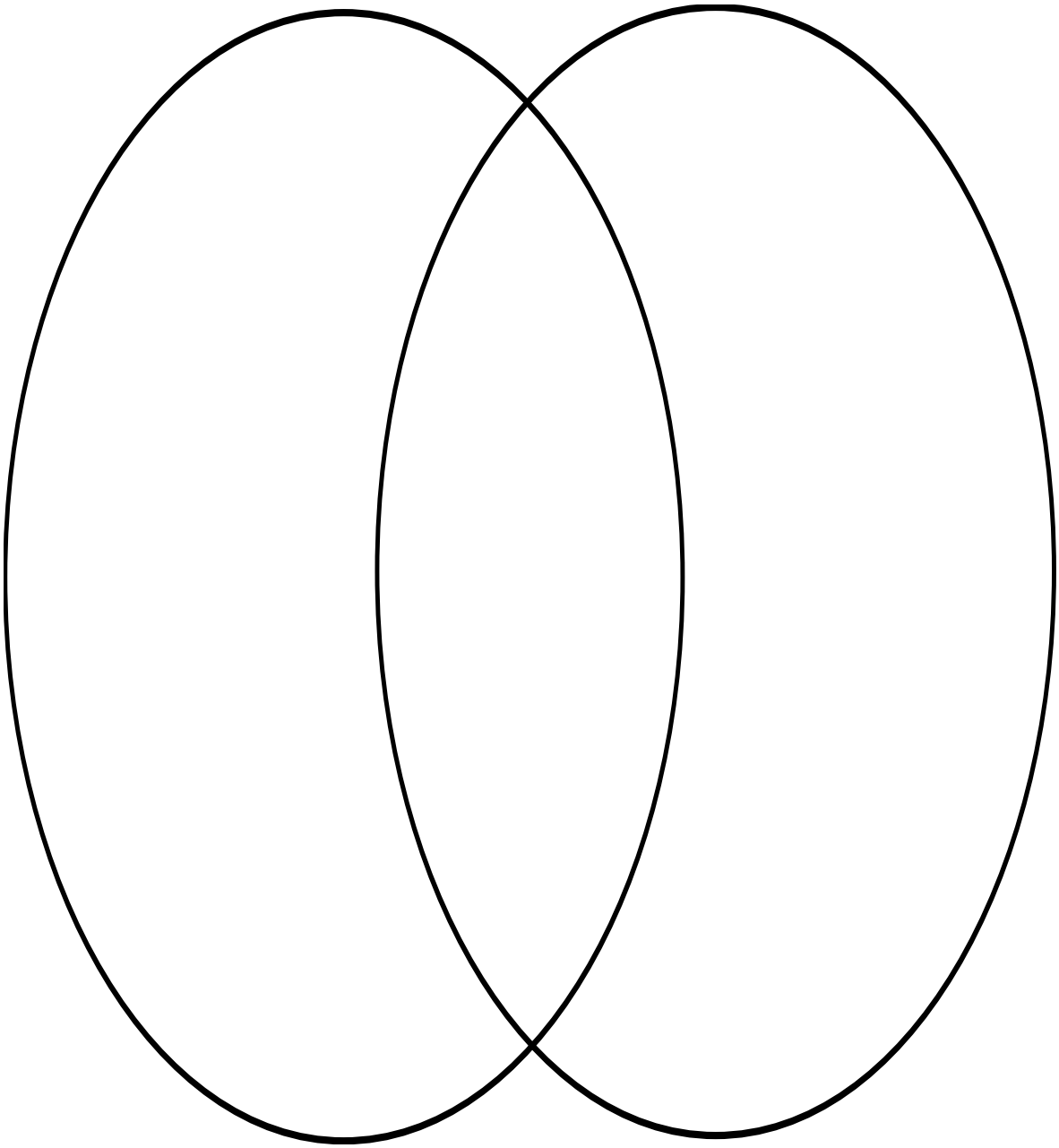
Specimen D: _____

Specimen E: _____

Specimen F: _____

Activity 2: Comparing and Contrasting Different Trilobites

Fill in the Venn diagram with the differences between the *Isotelus* cast (specimen A) and the *Calymene* fossil (specimen B) in the left and right sides (according to which trilobite the character belongs), and the similarities between the trilobites where the circles overlap. After filling in your diagram, hold a class discussion comparing and contrasting the trilobites.



Isotelus cast (specimen A)

Calymene Fossil (specimen B)

Activity 3: Trilobite Behavior and Ecology

Because all trilobites are extinct, scientists must use fossil evidence to infer the behaviors and habitats of these animals. Please use the provided fossil specimens to think about trilobite behaviors and habitats in order to answer the following questions.

1. Trilobite Rolling
Please examine a rolled up trilobite from the specimen J box and compare it to a non-rolled trilobite from the specimen I box. Why do you think a trilobite would roll up like this?

_____

Are there any animals living today that also roll up in the same way? (HINT: You might find them in the yard or garden.)

_____

Next, draw a picture of a side view of the rolled-up trilobite, labeling the cephalon and pygidium.

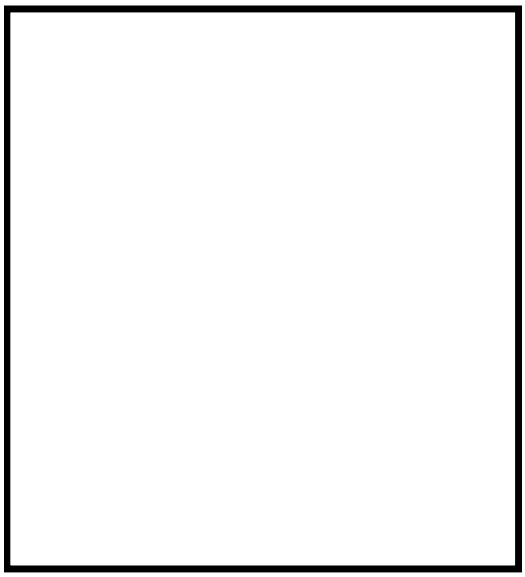
2. Trilobite Molting
Trilobites molted their hard outer shells in order to grow larger as time passed. The outer shell would separate into pieces along sutures in the cephalon, the trilobite would crawl out of its shell, and then its soft body would absorb water and expand while waiting for its new shell to harden. Figure 2.5 shows the location of sutures used to unzip the outer skeletons of different trilobites. Figure 2.3 C shows the location of the free cheeks of trilobites, which come off during molting so the trilobite can crawl out of its skeleton. Please examine specimens G and H. Of these two, which specimen still has its free cheeks, and which specimen has lost its free cheeks?

Free cheeks present: Specimen _____

Free cheeks absent: Specimen _____

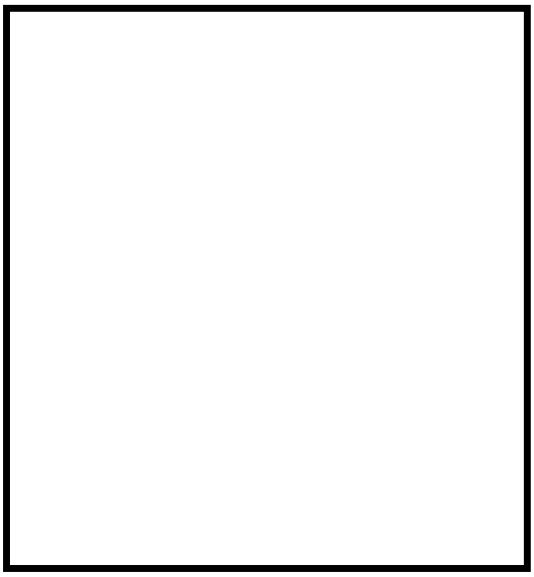
Sketch the cephalon of specimen G in Box 1 below, using bold lines for the sutures (refer to figures 2.5 and 2.3 if you need help finding them). Can you think of a more efficient placement of the sutures? In Box 2, draw a new trilobite with sutures that you think would better allow the molting trilobite to escape its exoskeleton.

Box 1



Specimen G Sutures

Box 2



Proposed Trilobite Sutures

3. Hypothesizing the Living Habits and Habitat of a Fossil Trilobite

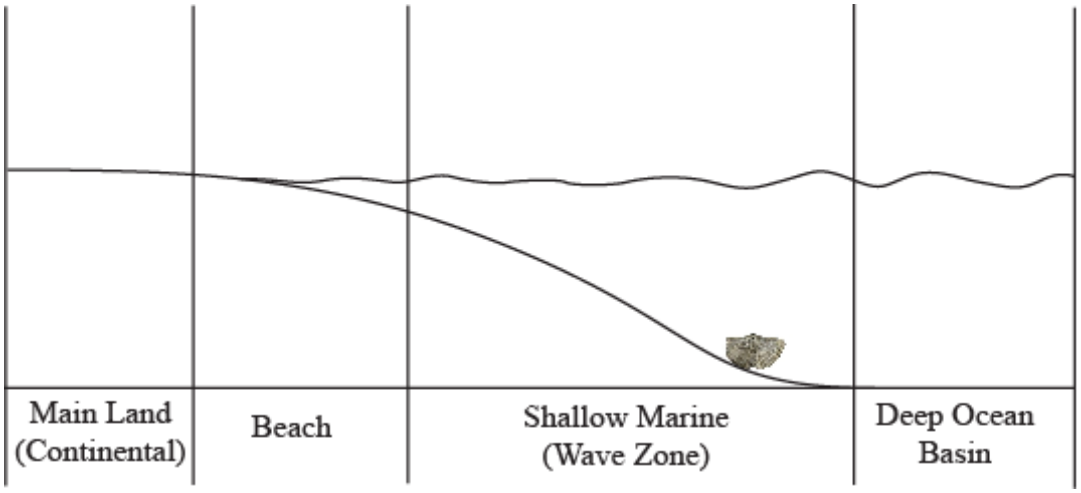
The overall body shape and specific morphological details of a trilobite can indicate to scientists how it moved, ate, and where it lived. Examine Figure 2.13 and read the caption below. Next, use this information to answer the following questions about the trilobite specimen C.

A. Did this trilobite probably swim? _____

B. How might have this trilobite fed? _____

_____

C. Below is a diagram of a suite of typical marine environments. Based on the information in Figure 2.13, your answers to the previous two questions, and the fact that all trilobites were aquatic animals, draw a small trilobite within the specific environment in the diagram according to where you think it lived.



Specimen K is a fossil of a brachiopod. Brachiopods live(d) in shallow marine settings, as shown by the shell in the above diagram. Could specimens C and K been neighbors in the same environment? Why or why not?

_____

_____