SEA MONSTERS
A PREHISTORIC ADVENTURE

GRADES 6-8

Geography Standard 17   Science Standards A, D, G

# SCIENCE ON SCREEN: EVIDENCE AND INFERENCE

Paleontologists and filmmakers use evidence and inference to reconstruct the past. In this lesson, students explore the relationship between evidence and inference, and learn how scientific research informs the development of a science-based film. In Activity 1, students observe and apply evidence and inference. In Activity 2, students study a storyboard from *Sea Monsters: A Prehistoric Adventure* to understand the role of scientific research during the development of the film. In the Closing Activity, students storyboard a new scene, applying scientific thinking supported by evidence and inference.

**Vocabulary** (see Glossary)

evidence
fossil
inference
observation
paleontology
prey
scavenge

## *Try This First!*

**Ask students: Imagine you're producing a scientific film about an extinct animal that lived millions of years ago. How would you know what it looked like and how it behaved? Explain that scientists study fossils to learn about an animal's size and skeletal structure, when and where it lived, and sometimes what it ate or was eaten by. They study behaviors of living animals for clues to their ancient relatives. Scientists and filmmakers make models and use computers to help bring the past to life.**

*Guiding Question:*

**How do filmmakers use evidence and inference to make a science-based film about prehistoric marine reptiles?**

| Activity | Objectives | Instructional Strategy | Materials |
|---|---|---|---|
| ACTIVITY 1<br>Unpack the Evidence<br>20 min. | Students will:<br>- Understand the definitions of evidence and inference; and<br>- Distinguish between evidence and inference. | - Discussions<br>- Visual Instruction<br>- Large-group Instruction | - Student or teacher backpack filled with school items |
| ACTIVITY 2<br>Behind the Scene: Science Notes<br>35 min. | Students will:<br>- Identify examples of evidence and inference; and<br>- Learn how filmmakers incorporate evidence and inference to create science-based films. | - Discussions<br>- Visual Instruction<br>- Large-group Instruction | - "Behind the Scene: Science Notes" |
| CLOSING ACTIVITY<br>Storyboard a Scene<br>45 min. | Students will:<br>- Create and present a storyboard based upon scientific notes. | - Discussions<br>- Visual Instruction<br>- Large-group Instruction | - "Behind the Scene: Science Notes" (Activity 2 handout) |

Activity 1

# Unpack the Evidence

20 min.

**Students practice scientific thinking to understand evidence and inference.**

## Directions:

1. **Preparation.** Prepare a backpack with books and other items you will show the class. Include items students can use to hypothesize about the person who owns the bag.

2. **Group activity.** Show students the backpack and ask them to use scientific thinking to learn more about this backpack. As you examine the backpack and its contents, guide students through the following steps.

3. **Ask students, "What can you observe?"** Prompt students to describe the backpack and the contents inside.
***Possible answers:*** *size, color, style, descriptions of objects as they are shown.*

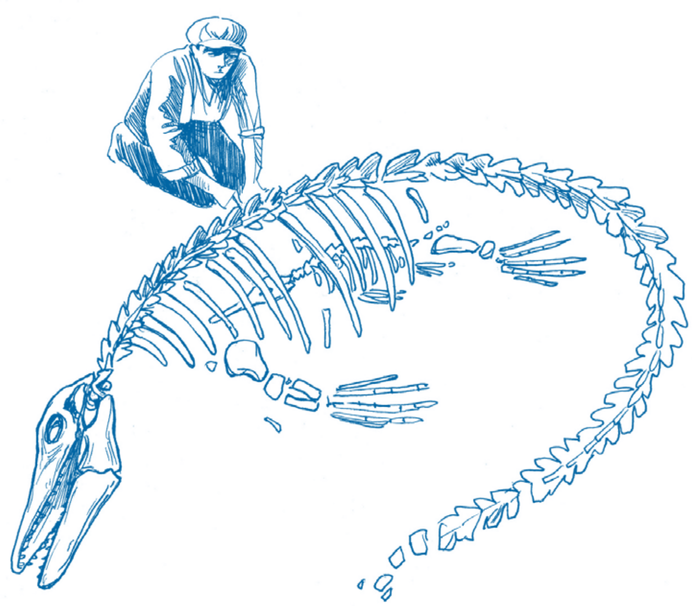
4. **Ask students, "To whom does it belong?"** Ask students what they can infer about the person who owns the backpack, based on the information they have acquired. What behaviors can they infer about the owner, based on the contents and how they might be used?

5. **Write "evidence" and "inference" on the board, and discuss these terms with students.**

   Evidence is data that can be measured, observed, examined, and analyzed to support a conclusion. Ask students to share what they know about the backpack and its contents that are based on evidence.
   ***Possible answers:*** *descriptions of the bag and its contents.*

   Inference is an explanation derived by reasoning. Ask students to share information they acquired during the backpack activity that is based on inference, i.e. ideas they have that cannot be directly observed in the contents.
   ***Possible answers:*** *Descriptions of the type of person who may own the bag and how they used the objects found inside.*

6. **Making a connection.** Introduce students to the work paleontologists do. Paleontologists search for, uncover, and study fossil remains, which is evidence of prehistoric animals. As was done in the backpack activity, paleontologists draw inferences from the evidence they uncover. Example: A shark's tooth embedded in a fossilized bone may lead a paleontologist to infer that a shark bit the animal.



# Activity 2 Behind the Scene: Science Notes

35 min.

**Students create a chart to identify examples of evidence and inference in a scene from *Sea Monsters: A Prehistoric Adventure.***

*"Behind the Scene: Science Notes"*

## Directions:

**1. Review.** Review the concepts of evidence and inference. Ask students to look for examples of these concepts as they watch the film, *Sea Monsters: A Prehistoric Adventure.*

**View *Sea Monsters: A Prehistoric Adventure.***

**Discussion.** Discuss the film with students. What elements did they think were based on evidence? What elements did they think were based on inference?

**2. Distribute "Behind the Scene: Science Notes."** Explain that one of the scientific advisors on the film has shared his notes from a scene in the film. Ask students to read the notes on the handout.

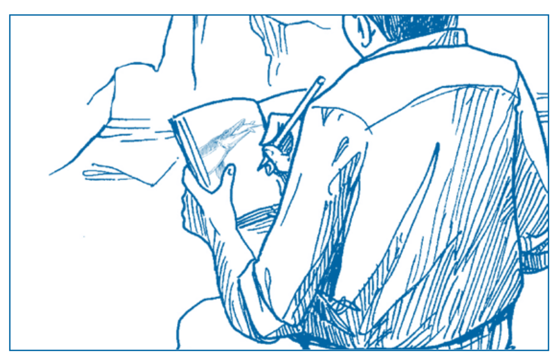
**3. Create a chart.** On a separate piece of paper, have students make a chart with two columns. Students should label these columns "Evidence" and "Inference." Across from each example of evidence, students should list the inferences based on it (sometimes there is more than one).

***Note:*** *There are seven examples of evidence and ten examples of inference. See answer key at right.*

**4. Review and discuss.** Discuss students' answers. Ask them to share their reasoning. What physical evidence supports an answer of "evidence"?

### Answer Key:

| Evidence | Inference |
|---|---|
| 1. Based on Sternberg find in 1918—a *Dolichorhynchops* (nicknamed "Dolly") within the ribs of a *Tylosaurus* (we'll call "Tylo"). | 1. Since only the skeleton of the Tylo remains, we assume the region is where the stomach was, but can't say for sure. |
| 2. Tylo lacked hands to hold prey. | 2. Thus, it had to either bite and shake large chunks out of prey, or swallow prey whole. |
| 3. Like snakes, Tylo had two rows of teeth way back on the roof of the mouth. | 3. Like snakes, we believe it used these teeth to help swallow prey. |
| 4. Dolly had a short, rigid body and long flippers. | 4. Flippers may have worked like wings to help it "fly" under water—similar to a penguin. |
| 5. Tylo had a long body and tail. | 5. It probably swam with an eel-like movement.<br>6. Thus we suppose it was a much slower swimmer than Dolly.<br>7. One way a slow Tylo could have caught a fast Dolly was if Dolly was dead (and Tylo scavenged).<br>8. Another way was if Tylo made a surprise attack. |
| 6. We can see from Dolly skeletons that its blind spot was immediately behind and below its body. | 9. We can assume that could have been the direction of a surprise attack. |
| 7. Fossil skin impressions show Tylo had very small, overlapping, lizard-like scales. | 10. Since most large marine animals are drab and/or dark, we assume the same might have been true for Dolly and Tylo. |



Closing Activity

# Storyboard a Scene

45 min.

**Students storyboard a new scene, applying scientific thinking supported by evidence and inference.**

## Directions:

1. **Introduce the activity.** Students will storyboard frames of a new scene using the scientific notes on the handout in Activity 2. Students should note the evidence and inference that supports their scene.

   ***Note:*** *Students can use the storyboard in Activity 2 as a model.*

2. **Student presentations.** Display completed storyboards on the wall and ask students to present their work to the class.

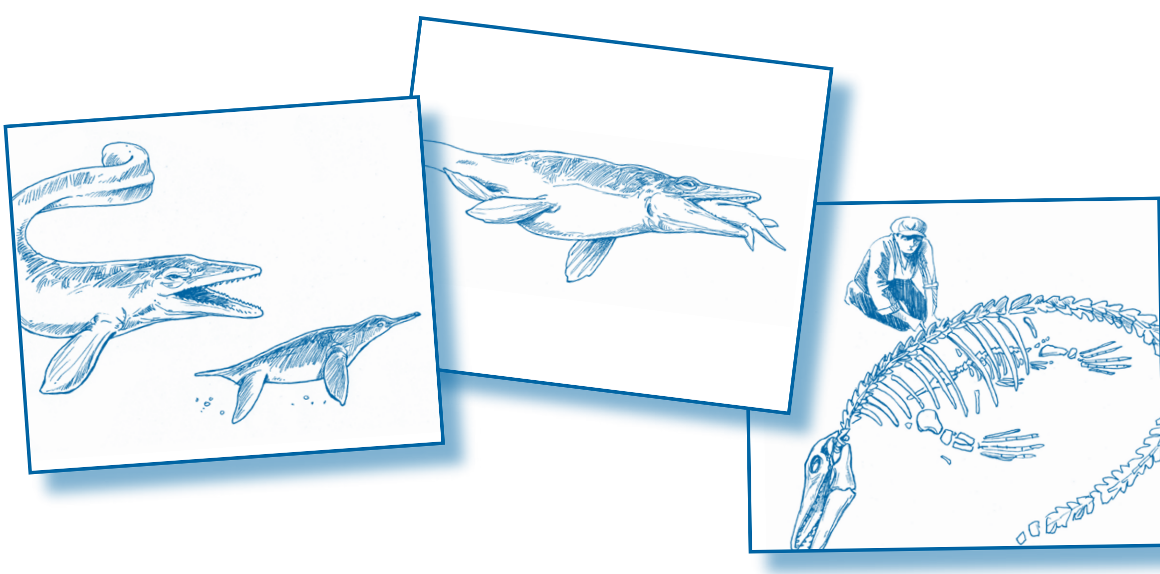
3. **Discussion.** While the events depicted in *Sea Monsters: A Prehistoric Adventure* are based on scientific evidence, the storyline of the prehistoric animals is a dramatization. Why did the filmmakers use this approach? What challenges do filmmakers face when they set out to create a film that is both scientifically accurate and entertaining?

## STUDENT ASSESSMENT

Assess students' storyboards based on their appropriate depiction and labeling of evidence and inference in their scene and their creativity in developing a new storyline.

## NOTE TO TEACHER

Watching videos, television, and movies are popular activities for students at home and at school. It is important to help students understand that a science-based film is supported by scientific thinking and science content. When faced with a subject depicted in a film that cannot be directly observed—such as prehistoric marine reptiles—students should critically examine the evidence used to support the information presented. They should be able to differentiate between information based on evidence and information based on inference.



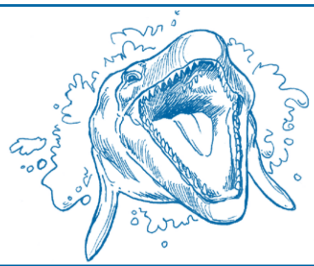
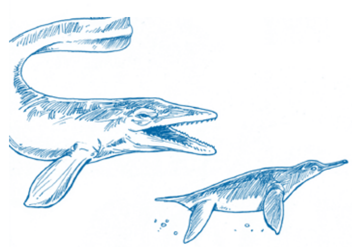
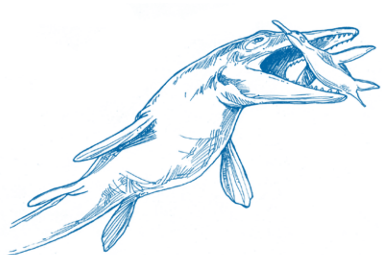
Student Handout

# BEHIND THE SCENE: SCIENCE NOTES

During the making of the film *Sea Monsters: A Prehistoric Adventure,* scientific advisors reviewed storyboards to ensure the film was science-based. Below is a storyboard with scripted voiceover (VO) and notes from Dr. Ken Carpenter, a paleontologist with the Denver Museum of Nature & Science.

**Step 1: Review the scientific notes.** Which are examples of evidence? Which are inferences based on the evidence?

**Step 2: On a separate piece of paper, make a chart with two columns labeled "Evidence" and "Inference."** List examples of evidence from the notes. Across from each example of evidence, write the inferences based on it (sometimes there is more than one). Hint: there are seven examples of evidence and ten examples of inference.

| | |
|---|---|
|  | **VO:** They had found a monster's last meal – entombed within its ribs.<br><br>**Notes:** *Based on Sternberg find in 1918 – a Dolichorhynchops (nicknamed "Dolly") within the ribs of a Tylosaurus (we'll call "Tylo"). Since only the skeleton of the Tylo remains, we assume the region is where the stomach was, but can't say for sure.* |
|  | **VO:** The *Tylosaurus* can open its mouth wide enough to swallow prey whole, like a snake.<br><br>**Notes:** *Tylo lacked hands to hold prey. Thus, it had to either bite and shake large chunks out of prey, or swallow prey whole. Like snakes, Tylo had two rows of teeth way back on the roof of the mouth. Like snakes, we believe it used these teeth to help swallow prey.* |
|  | **VO:** Because Dollies are fast, a *Tylosaurus'* best bet is to catch one by surprise.<br><br>**Notes:** *Dolly had a short, rigid body and long flippers. Flippers may have worked like wings to help it "fly" under water—similar to a penguin. Tylo had a long body and tail. It probably swam with an eel-like movement. Thus we suppose it was a much slower swimmer than Dolly.* |
|  | **VO:** The female escapes…but her brother doesn't see the danger coming.<br><br>**Notes:** *Because Tylo was a slower swimmer there were probably two ways it might have caught Dolly to eat it: either Dolly was dead (and Tylo scavenged) or Tylo made a surprise attack. We can see from Dolly skeletons that its blind spot was immediately behind and below its body. We can assume that could have been the direction of a surprise attack.* |
|  | **VO:** The Sternbergs had discovered a life-and-death moment…a story locked in time of two ancient lives intersecting.<br><br>**Notes:** *Fossil skin impressions show Tylo had very small, overlapping, lizard-like scales. Unfortunately, these impressions do not indicate skin color. We don't know the true color of any marine reptiles. Since most large marine animals are drab and/or dark, we assume the same might have been true for Dolly and Tylo.* |