Teacher's Guide: *Tiktaalik*: A Fish Out of Water

Recommended Grade Level: 5–8
(also applicable to grades 9-12 for students requiring significant support in learning)

Suggested Time: About 50–60 minutes spread over one or more class periods, plus additional time to complete a writing assignment

Goals

Following are the big ideas that students should take away after completing this lesson:

- Transitional fossils help scientists establish how living things are related
- Physical features and behaviors may change over time to help living things survive where they live

Vocabulary

- fossil
- characteristic
- transition
- tetrapod
- species
- amphibian
- evolution

Key Literacy Strategies

Following are the primary literacy strategies students will use to complete this activity:

- Categorizing basic facts and ideas (screen 10)
- Making inferences (screens 4 and 7, writing assignment 2)
- Identifying and using text features (screens 4, 6, and 9)
- Determining important information (screen 7, writing assignment 1)
- Sequencing events (screen 9)

Note: In addition to using the key literacy strategies listed above, students will use each of the strategies below to complete this lesson:

- Monitoring comprehension
- Synthesizing
- Making predictions
- Developing vocabulary
- Connecting prior knowledge to new learning
- Developing a topic in writing
- Identifying and using text features (photographs, captions, diagrams, and/or maps)

Overview

Tiktaalik: A Fish Out of Water is a student-directed learning experience. However, while students are expected to work through the lesson on their own, teachers should be available to keep the lesson on track, organize groupings, facilitate discussions, answer questions, and ensure that all learning goals are met.

The following is a summary of the lesson screens:

Screen 1: Students learn that they will explore evolutionary relationships between animal groups that do not appear to be related.

Screen 2: Students read about fossils and how one discovery (a fossil named *Tiktaalik*) shares characteristics of animals that lived in water and those that, some time later, would live on land.

Screen 3: Students read learn what the goals are for the lesson, which strategies they will be using to complete the lesson, and the important vocabulary words they will use during the lesson.

Screen 4: Students read about evolutionary transitions and the conditions that drive them. They then write down examples of living things they already know and the characteristics that help them live in their environments.

Screen 5: Students read about paleontologists and the kinds of questions they explore in their work.

Screen 6: Students read about the tree of life and the role transitional fossils play in filling in gaps in scientific knowledge.

Screen 7: Students watch a video about the discovery of *Tiktaalik* and hear what scientists learned from studying its bones. They also answer quiz questions to show their comprehension of what they learned in the video.

Screen 8: Students complete a vocabulary activity, and then choose two words from the vocabulary list and write a new sentence for each word. This demonstrates their understanding of the words' meaning.

Screen 9: Students read a passage on how *Tiktaalik* represents a species that was partway between two other animal groups. After they have finished reading, they are asked to write a simple chronology of the three life forms: *Tiktaalik*, amphibians, and primitive fish.

Screen 10: Students use an interactive activity to categorize different physical and behavioral characteristics on a concept map, according to which life form they belong.

Final Assignment: Students select and complete a writing assignment about the lesson topic.

Before the Lesson

❑ Go through each screen of the lesson, including all the interactive activities, so that you can experience ahead of time what students will be doing. As you go through each screen, jot down your own expectations for students' responses.

❑ Determine if students will be working individually or in pairs on the lesson. Some students may be able to work independently with little or no support. Students who are less familiar

with the subject area or who struggle with literacy skills may benefit from working with another student. An effective way to do this is to pair a stronger student with a less able reader. You can also have students work individually on certain tasks and in pairs on others, depending on their experience and needs. If students will be working in pairs on any portion of the lesson, let them know if they will be expected to type in their notes individually or together.

❑ Provide instruction on key vocabulary (vocabulary words are defined in the lesson).

❑ Determine what students already know about adaptations—the features and behaviors that help living things survive in their environment. Record their ideas on a chart. This will give you a sense of students' possible misconceptions and the background knowledge they have before beginning this lesson. If time allows, return to the chart after students have completed the lesson to add new learning and correct misconceptions. Note: You may want to record their new learning in a different-colored ink so they can see how much they've learned.

❑ Arrange computers with Internet access so students can work individually or in pairs.

❑ Before students begin, suggest a timeline for completing the lesson, mention the different types of media they will encounter, and let them know how you expect them to submit their work. You may want to provide an outline of this information on a chart, chalkboard, or whiteboard, or as a handout.

Lesson Assessments

The following are descriptions of the lesson features that will be part of the packet of materials that students will submit. Students will use the packet for reference when writing their final assignment. It also serves as a formative assessment tool to monitor students' work as they're progressing through the lesson.

- **Notes** – Students take notes on screens 4 and 9. If time allows, review their notes before students begin their writing assignment.
- **Multiple-choice quiz** – Students complete the quiz on screen 7. Walk around to make sure students answer all three questions in the quiz before they move on. If students click to go to the next page before they finish, their work on the quiz will not be saved.
- **Match It!** – Students complete a vocabulary activity on screen 8. They begin by placing the vocabulary terms into the correct sentences. After they finish and save their work, they will be able to check their answers against an answer key. When they are done, they will be asked to choose two vocabulary words and write a new sentence for each word. Sentences should demonstrate a clear understanding of the meaning of each word, and the words should be used specifically in the context of evidence for the evolution of life. (An example of an insufficient response is "The animal had many different characteristics.")
- **Arrange It! -** Students complete the concept map activity Arrange It! on screen 10. Students will not be able to check their answers online, so you will need to provide them with correct answers when they are finished with the lesson. You can choose to review the answers as a class or return the corrected packet of materials to students before they begin the final assignment.

Following are the characteristics students will drag and drop onto the concept map in the appropriate category:

Primitive Fish

- Scales
- Fins
- Gills
- Lives in water

Tiktaalik

- Scales
- Fins
- Modified fins or limbs
- Flat head
- Eyes on top
- Neck
- Gills
- Lives in water

Amphibians

- Modified fins or limbs
- Flat head
- Eyes on top
- Neck

- **Final Assignment** – Students complete one final writing assignment. You can choose to let students make their own selection, or assign one according to your goals for the lesson. Use the rubric on page 6 to assess the writing assignments.

Lesson Aids and Extensions

Use the following suggestions to help students if they are stuck on a particular screen, as follow-up discussions to reinforce learning, and to prepare students for completing their writing assignments.

- **Watching Videos** – Encourage students to watch the video more than once. After the initial viewing, provide students with a specific content focus to frame their next viewing(s) of the video. This will help them draw connections between the main topic and the information that the video has to offer.
- **Participating in Discussions** – Organize class discussions or encourage students to talk about their questions in pairs. You may want to use the following discussion starters:
    - o Which characteristics might a species next in the evolutionary line from *Tiktaalik* (that is, one step closer to amphibians) have evolved with?
    - o Which characteristics might a species next in the evolutionary line from *Tiktaalik* have evolved without (marking a more significant departure from primitive fish)?
    - o Discuss some other transitions, such as from land to water (wolflike creatures to whales), and from land to air (dinosaurs to birds). Give reasons to support your ideas.
- **Reading the Passage** – Before students read the passage on screen 9, review the idea that by comparing physical characteristics (e.g., limb structure) among different species that may be related, scientists can establish the order in which they appeared.
- **Sharing Student Work** – It may be motivational, and a further learning opportunity, for students to post their final essays so that their classmates, peers, and/or parents can see them. This may also provide an opportunity for students to comment on and discuss each other's essays.

If you do not already have access to an online writing community, Teaching Matters™ provides TeXT, free classroom publishing tools that allow teachers and students to create and publish their own online eZine. More information and a free signup are available at Teaching Matters: TeXT (http://text.teachingmatters.org).

- **Reflection and Self-Assessment** – After students have turned in their writing assignments, you can choose to have them assess their learning. Convene students as a whole class or in small groups to discuss the following questions.
    - o What did you learn?
    - o What was surprising?
    - o What questions do you still have?
    - o What was the easiest for you to understand and do?
    - o What was the most difficult?

Final Assignment Rubric
Tiktaalik: A Fish Out of Water

1. Describe how different features and behaviors help different species survive in the conditions in which they live. In your essay, be sure to point out which characteristics of *Tiktaalik* are similar to those of primitive fish, and which are similar to those of amphibians.

2. Describe how scientists can use a transitional fossil like *Tiktaalik* to explain the general sequence in which two major animal groups (in this case, primitive fish and amphibians) appeared. In your essay, be sure to explain the importance of the discovery of *Tiktaalik*.

4	3	2	1
Provides a clear and accurate response to the question. Ideas are elaborated, with three or more relevant supporting details from the reading passage, video, and other materials in the lesson.	Provides an adequate response to the question. Topic and ideas are generally well organized, with two relevant supporting details from the reading passage, video, and other materials in the lesson.	Provides a generally accurate response, with one supporting detail from the reading passage, video, and other materials in the lesson.	Provides an inaccurate response to the question or fails to address the question. May include misinterpretations. Understanding of the topic is not apparent.
Uses at least three vocabulary words (or a form of the vocabulary words) from the lesson, and uses them all correctly.	Uses two vocabulary words (or a form of the vocabulary words) from the lesson, and uses them both correctly.	Uses one vocabulary word (or a form of the vocabulary word) from the lesson, and uses it correctly.	Does not use any vocabulary words, or uses vocabulary words incorrectly.

Scoring the Rubric

Here are two suggestions for scoring the final assignment rubric. Select the option that best meets your needs or develop your own grading system.

Option 1: This option provides one score for each submitted assignment.

Assign a score of 4 or below for the written response (first row of the rubric) and a score of 4 or below for the use of vocabulary (second row of the rubric), for a total maximum score of 8. The interpretation of scores is as follows:

Score	Grade	Narrative Interpretation
7-8	A	Excellent
5-6	B	Good
4	C	Adequate (Fair)
3 or below	D	Minimal

Option 2: This option provides two scores for each submitted assignment: one for written content and one for the use of key vocabulary. An advantage of separate scores is that you can weight students' comprehension and composition differently than you do their knowledge of vocabulary. It can also help you identify specific needs for future instruction.

Assign a score of 4 or below for the written response (first row of the rubric) and a score of 4 or below for the use of vocabulary (second row of the rubric) and then score them separately. The interpretation of scores is as follows:

Score	Grade	Narrative Interpretation
4	A	Excellent
3	B	Good
2	C	Adequate (Fair)
1	D	Minimal

The final grade may look like this: A/B (A for content and B for vocabulary use).