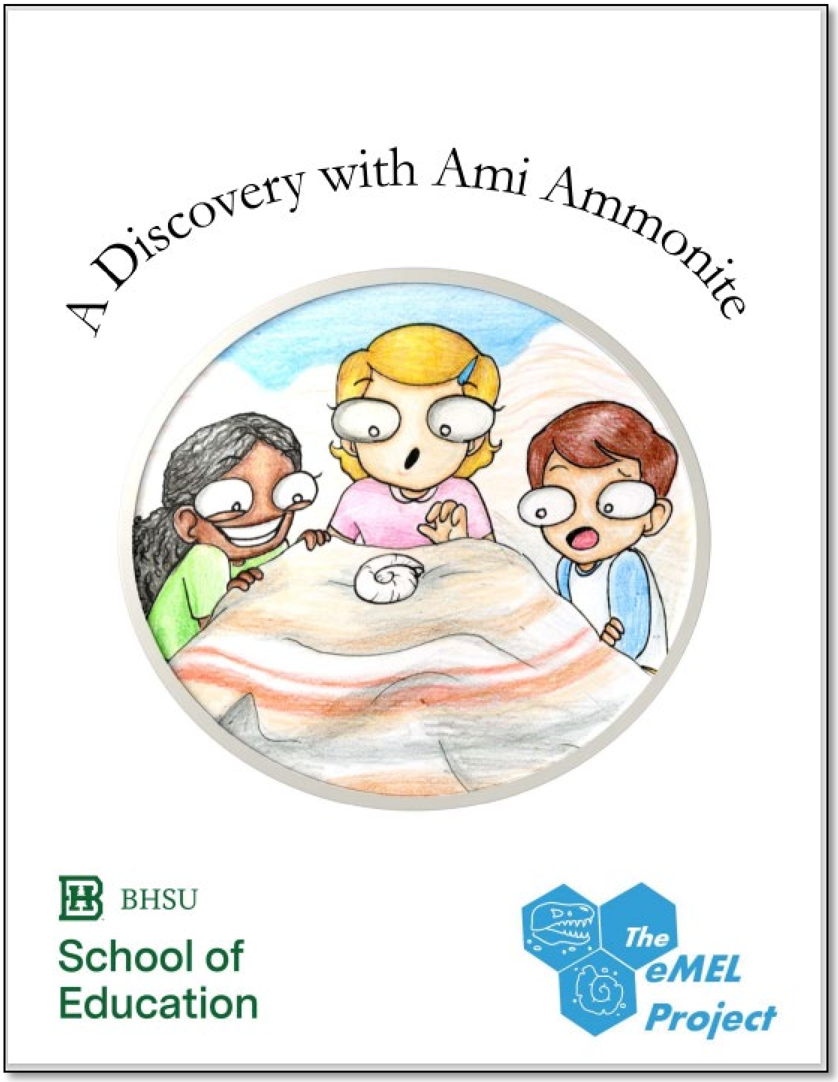
A Discovery with Ami the Ammonite:

A Quick Start Guide to the Elementary Model-Evidence Link Diagram Activity



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Introduction

The Elementary Model-Evidence Link Diagram (eMEL) activity is the result of an ongoing investigation into how elementary school students use plausibility judgements to deepen their scientific evaluation of the relationship between scientific evidence and explanatory models of phenomena. We know that this is a mouthful, but we believe strongly that elementary students can do this kind of work in their science lessons. This quick start guide will give a brief overview of how the Ami the Ammonite lesson provides third and fourth grade students with a scaffold to support higher levels of scientific critical evaluation.

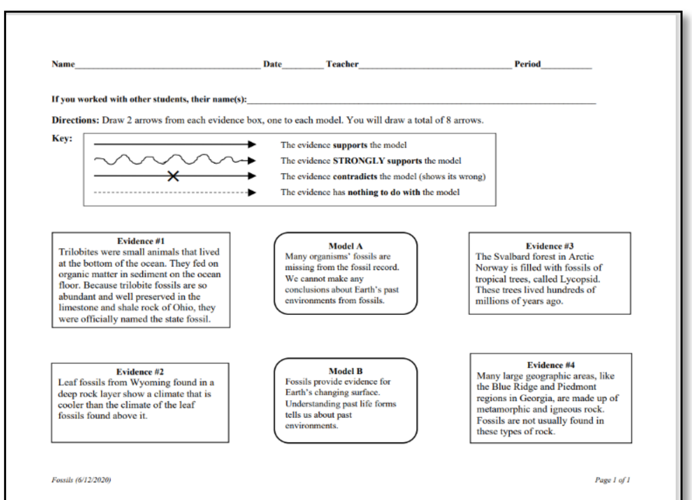
How It Works

Plausibility

This activity is an attempt to engage students in the process of making plausibility judgements about the potential truthfulness of competing scientific explanations of a particular phenomenon. In this case, the phenomenon that the students will be investigating is the usefulness of fossils when attempting to describe past environments on the Earth's surface. Plausibility is useful for scientists because it is a tentative judgement that can be more easily changed than belief judgments. This allows scientists to change their views on the scientific knowledge that they create in the light of new evidence. Prior to completing the Model-Evidence Link Diagram activity (MEL), each student rates the plausibility of each model on a scale of 1-10.

The Model-Evidence Link Diagram

The MEL is a graphical scaffold that supports students' evaluation of the relationship between scientific evidence and explanatory models. After reading about a piece of evidence, the students evaluate the nature of its relationship to each of the competing explanations and draw the appropriate arrow to the models.


Name________________ Date_______ Teacher________________ Period_________

If you worked with other students, their name(s):________________

Directions: Draw 2 arrows from each evidence box, one to each model. You will draw a total of 8 arrows.

Key:
The evidence **supports** the model
The evidence **STRONGLY supports** the model
The evidence **contradicts** the model (shows its wrong)
The evidence has **nothing to do with** the model

Evidence #1
Trilobites were small animals that lived at the bottom of the ocean. They fed on organic matter in sediment on the ocean floor. Because trilobite fossils are so abundant and well preserved in the limestone and shale rock of Ohio, they were officially named the state fossil.

Model A
Many organisms' fossils are missing from the fossil record. We cannot make any conclusions about Earth's past environments from fossils.

Evidence #3
The Svalbard forest in Arctic Norway is filled with fossils of tropical trees, called Lycopsid. These trees lived hundreds of millions of years ago.

Evidence #2
Leaf fossils from Wyoming found in a deep rock layer show a climate that is cooler than the climate of the leaf fossils found above it.

Model B
Fossils provide evidence for Earth's changing surface. Understanding past life forms tells us about past environments.

Evidence #4
Many large geographic areas, like the Blue Ridge and Piedmont regions in Georgia, are made up of metamorphic and igneous rock. Fossils are not usually found in these types of rock.

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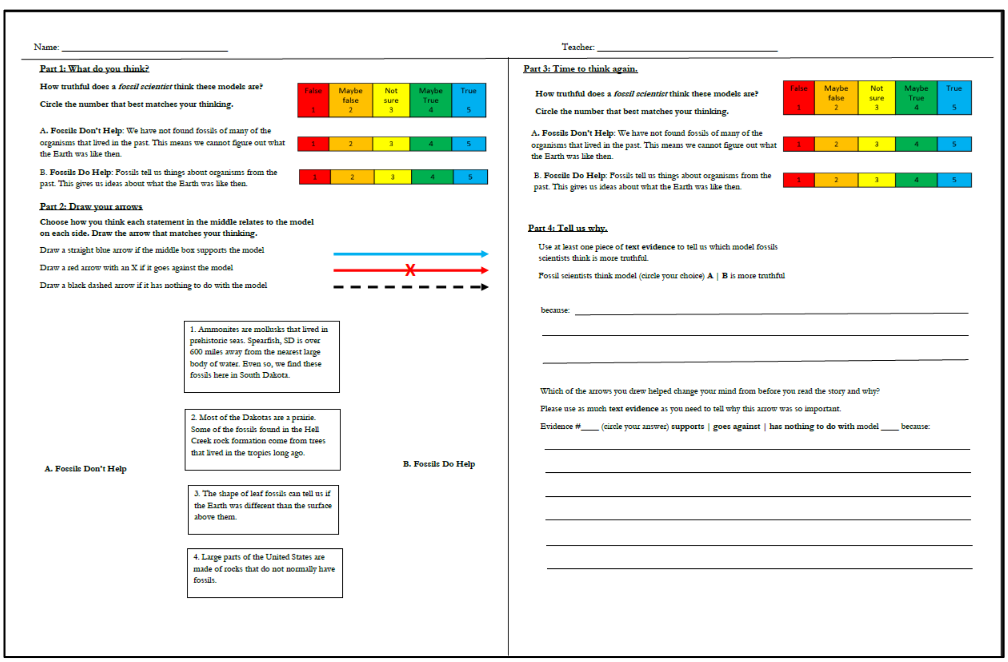
The MEL shown is an example of a secondary (grades 6-12) lesson about climate change. Each line of evidence is accompanied by a single page document that contains text, numerical, and/or graphical information that further defines the evidence. The students, working as a small group, discuss the relationship between the evidence and each model. Upon reaching consensus they draw the arrow that represents the decided upon relationship (i.e., supports, strongly supports, contradicts, and has nothing to do with).

After completing the diagram, the students once again rate the plausibility of the explanatory models. This re-appraisal of their plausibility judgements is essential to the outcome of the activity. After the re-appraisal, the students write an explanation about the arrows that were most influential to their final judgements.

Our Work

Young students are excited to explore the world around them and are curious to how that world works. The secondary level MEL activities require a fair amount of cognitive effort to complete, as well as an extensive scientific vocabulary. Additionally, each activity consists of between seven to eleven individual pages to manage.

Our work consisted of two primary tasks to make this kind of lesson accessible for elementary students. First, we created a children's narrative non-fiction book about the experiences of three children when they find a fossil. This story contained the context for the reading, the scientific evidence to be evaluated, and instructions for the students for completing their diagram.


Name: ____________________ Teacher: ____________________

Part 1: What do you think?

How truthful does a *fossil scientist* think these models are?

Circle the number that best matches your thinking.

False 1	Maybe false 2	Not sure 3	Maybe True 4	True 5

A. Fossils Don't Help: We have not found fossils of many of the organisms that lived in the past. This means we cannot figure out what the Earth was like then. 1 2 3 4 5

B. Fossils Do Help: Fossils tell us things about organisms from the past. This gives us ideas about what the Earth was like then. 1 2 3 4 5

Part 2: Draw your arrows

Choose how you think each statement in the middle relates to the model on each side. Draw the arrow that matches your thinking.

Draw a straight blue arrow if the middle box supports the model

Draw a red arrow with an X if it goes against the model

Draw a black dashed arrow if it has nothing to do with the model

A. Fossils Don't Help

1. Ammonites are mollusks that lived in prehistoric seas. Spearfish, SD is over 600 miles away from the nearest large body of water. Even so, we find these fossils here in South Dakota.

2. Most of the Dakotas are a prairie. Some of the fossils found in the Hell Creek rock formation come from trees that lived in the tropics long ago.

3. The shape of leaf fossils can tell us if the Earth was different than the surface above them.

4. Large parts of the United States are made of rocks that do not normally have fossils.

B. Fossils Do Help

Part 3: Time to think again.

How truthful does a *fossil scientist* think these models are?

Circle the number that best matches your thinking.

False 1	Maybe false 2	Not sure 3	Maybe True 4	True 5

A. Fossils Don't Help: We have not found fossils of many of the organisms that lived in the past. This means we cannot figure out what the Earth was like then. 1 2 3 4 5

B. Fossils Do Help: Fossils tell us things about organisms from the past. This gives us ideas about what the Earth was like then. 1 2 3 4 5

Part 4: Tell us why.

Use at least one piece of **text evidence** to tell us which model fossils scientists think is more truthful.

Fossil scientists think model (circle your choice) **A** | **B** is more truthful

because: ____________________

Which of the arrows you drew helped change your mind from before you read the story and why?

Please use as much **text evidence** as you need to tell why this arrow was so important.

Evidence #____ (circle your answer) **supports** | **goes against** | **has nothing to do with model** ____ because:

The second task was to develop the interactive worksheet to serve as the students' scaffold and intellectual work product. The different sections provide space for students to complete the tasks necessary for their plausibility judgements, drawing their diagram, and writing their explanations. The evaluations were simplified when compared to the secondary level lesson and the visuals were color coded to facilitate the students' work. The diagram was modified to prevent the arrows from overlapping to reduce potential confusion. Lines were provided to assist with the students' writing tasks.

Getting Started

Read the Story

We do not provide a scripted curriculum for this lesson. We support your ability to implement this lesson in ways that make the most sense for your classroom. Reading the story will help you make implementation decisions for your classroom. Do you want the students to read the story independently, as small groups, or as the entire class? Is there any vocabulary that may need further explanation prior to or during the reading? Are the directions clear for how your students function in the classroom? All of these are important questions that only you can provide the answers to in your classroom context.

Printing

We provide three different formats for printing the book. There are two sizes, 8.5x11 and 11x17, depending on the size of book you wish to print. We also have the book as a PDF for projection onto a whiteboard. Additionally, we have the interactive worksheet (11x17) and the final answer image (PDF for projection or printing). The books and the worksheet are printed in the landscape orientation. If color printing is not available, then we recommend that you print in gray scale as opposed to black and white. Files can be found here under The EMEL Project tab.

Print Details

Small Book-
8.5x11" paper, Portrait Orientation, Print on Both Sides (flipped on short edge)
Large Book-
11x17" paper, Portrait Orientation, Print on Both Sides (flipped on short edge)
Worksheet-
11x17" paper, Landscape Orientation, Print on One Side

Implementation

Now that you have decided how you want your students to read the story, you will need to decide how they will talk about each piece of evidence. Will your class be able to complete this during your designated science time or might you need to extend it into your reading period? Can they do this in small groups, with shoulder partners (the students sitting next to them in a large group), or as an entire class? Do you want to provide colored pencils for your students to help differentiate their arrows? What other considerations might you have?

Worksheet Sections

Part 1: What do you think?

The students rate how truthful a fossil scientist would find these two statements. These values are independent of each other. A student can rate one high and the other low, or both at the same level (high, middle, or low).

Part 2: Draw your arrows.

Remind the students that they need to choose an arrow for each evidence to draw to each model. We recommend that the students draw their arrows from the evidence to the model. That way it reads like a sentence, Evidence 1 supports Model A.

Part 3: Time to think again.

These are the same judgements the students made prior to completing the diagram. This is a very important step in the process.

Part 4: Tell us why.

In this section, the students explain which model they judge to be more truthful and what parts of the story helped them make that decision. They also explain the arrow that was most important in their decision and to provide evidence from the story to support that explanation.

Assessment

We consider the first three parts of the worksheet to be the students' intellectual work product and, if assessed at all, should only be assessed for completion. The written explanation is the part where your students can give you evidence of their work and thinking after considering the new content. We do not ascribe to any one framework (e.g., Claims-Evidence-Reasoning) for creating and assessing the written explanation the students develop at the end of the activity. You are free to use any framework that you may already use in your English/Language Arts lessons.

Contact Information

Should you wish to have a reference list of the research used to support this project or if you have any questions about the eMEL activity, please contact us at timothy.klavon@bhsu.edu.

This project was supported by the South Dakota Board of Regents and Black Hills State University through research seed grant funding.