Grade 4	**UTAH FOSSILS: Map & Inferences**	4th Grade Science Standard IV - Fossils (lesson 4 of 5) Davis 'Finding Fossils'

Science Standard(s): USOE Science Standard IV Objective I & II

Content Objective(s):

Teacher objective:
The students will work as partners to create a fossil map of Utah, using symbols to represent fossil locations based on the information provided them in order to make inferences about changes in Utah environments over time.

Student objective [posted]:
Today I will work with a partner to create a fossil map of Utah, using symbols to show where fossils have been found in order to make inferences about changes in Utah environments over time.

Language Objective(s):

Teacher objective:
The students will cite evidence from the fossil map to support each inference about past Utah environments and will use sentence frames to draw further inferences about how Utah environments have changed over time.

Student objective [posted]:
Today I will cite evidence from the fossil map to support each inference about past Utah environments and will use sentence frames to infer how Utah environments have changed over time.

Essential Questions:
What is a fossil?
What can we learn from fossils?

Materials:
- Objectives written ahead of time
- Map with symbols as an example
- Recording sheet [1 per student]
- Utah Counties Fossil Map [1 per student]
- Utah Fossil locality Information page [1 per pair]
- http://www.fossilsites.com/STATES/UT.HTM
- Utah maps with current climatic regions detailed
- Any additional information/ pictures representing the types of fossil organisms being discussed.

Required Academic Vocabulary for Word Wall:
Listen/Speak/ Read/ Write: symbol, map, key, legend, trilobite, environment, dinosaur, fossil, inference, sedimentary rock
Zuhören/sprechen/reden/schreiben: das Symbol/Zeichen, der Schlüssel, die Legende, der Trilobit, die Umwelt/Umgebung , der Dinosaurier, das Fossil, die Schlussfolgerung, das Sedimentgestein

Sentence Frames:
- Here it shows that _(fossils)_ are/were found in _(county)_.
- This evidence leads us to conclude that in the past the environment in _(county)_ was _(environment)_. Today it is a _(environment)_ environment, so it must have changed _[HOW?]_ because of _[WHY?]_.

Satzbau:
- Hier wird gezeigt, dass ___(Fossilien), in ____(Land) gefunden wurde/wurden.
- Das führt uns zu der Schlussfolgerung, dass die Umgebung in ___(Land) früher ____(Umwelt/Umgebung) war. Heute ist es ____(Umwelt/Umgebung), also muss es sich verändert haben. [WIE?] und [WARUM?]

Additional Lesson Vocabulary:
Allosaurus, Diplodocus, Stegosaurus, Utah Raptor, Trilobites, Petrified Wood, Dinosaur Tracks, Coal Deposits, Oyster Shells, Fern Fossils, Sea Lilies, Mollusks (snails), Mammoth, Shells

der Allosaurus, der Diplodocus, der Stegosaurus, der Utahraptor, die Trilobiten, das versteinerte Holz, die Dinosaurierspuren, die Kohlevorkommen, die

	Austernmuscheln, die Farnfossilien, die Seelilien, die Weichtiere, das Mammut, die Muscheln

Lesson: **Instructional Time:** 40 min.

Opening: (5 minutes)

- Establish or Reinforce Management Routines/Procedures.
- Draw a variety of symbols on the board and ask students to define them. [Examples: #number, @at, $money, %percent, &and]

T: What is a symbol? [wait] **A symbol is something that represents something else. We are surrounded by symbols - McDonald's arches, car logos, clothing logos, etc. Symbols can be very helpful in communicating information especially when space is limited. One place we use symbols is on a map.**

- Show students a map with symbols.

T: Today we will use symbols on a map to represent fossils discovered in Utah. Remember our Essential Questions.

- Essential Questions: What is a fossil? What can we learn from fossils? – Focus on #2 Making INFERENCES
- Objectives: Read content objective [teacher & then whole class] and verify that the students understand their task for the day and then read the language objective [teacher & then whole class] with more questions to check for understanding.

Introduction to New Material (Direct Instruction): (10 minutes)

- Project a copy of the Utah Fossil Locality Information. Read through the list together and discuss the information in reference to different types of fossils. Display the labels page or other images of the fossil types as they are discussed in general terms. The focus is not to memorize different types of fossils, but to recognize the general type of organism they represent and the locations where they were found in Utah.
- Sedimentary Rock: Why fossils most often found in sediments and what that indicates about the locations where they're found.

Uintah County	Allosaurus, Diplodocus, Stegosaurus
Emery County	Utah Raptor
Millard County	Trilobites
Emery County	Petrified Wood
Washington County	Dinosaur Tracks
Carbon County	Coal Deposits
Wayne County	Oyster Shells
Sevier County	Fern Fossils
Tooele County	Sea Lilies
Garfield County	Mollusks (snails)
Sanpete County	Mammoth
Iron County	Shells

- Have students repeat the fossil names 3 times soft, medium, loud to familiarize themselves with the additional vocabulary needed to complete the lesson task.

T: Allosaurus, Allosaurus, Allosaurus. *Allosaurus, Allosaurus, Allosaurus.*

- Review of WHO? WHAT? WHEN? WHERE? WHY? HOW? in reference to the new fossil information.

T: WHO discovered these fossils? [wait] *Archaeologists*

T: WHAT did the archaeologists do and use to make their discoveries? [wait] *dig & clean, observe, record, identify; tools & records*

T: WHEN do these fossil finds represent? [wait] '*Then & There,' a long time ago*

T: WHERE are these fossils found & represented? *Found in Utah and represented on a map*
T: WHY are these fossils useful to us? *They can help us draw inferences about Utah Environments of 'Then & There"*
T: HOW have Utah Environments changed over time? *Inferences about past environments compared to present*

- Display the Utah Counties Map as the idea of map symbols, legends & keys is discussed. Point out the legend as it is discussed.

T: This map will help us to chart where the fossils were found and then based on that information we will be able to make inferences about the changes in Utah environments in different areas of the state. At the beginning of the lesson we discussed symbols that can be used to represent something else. Sometimes there are problems with using symbols that mean different things to different people. Pictures and colors used as symbols don't mean the same thing to everyone. Map makers know that symbols could be confusing, so they create a Key or Legend to tell the user what their symbols will mean. Today we will create our own symbols and legend for a map that shows where these different fossils have been located in Utah. Then we will be able to draw inferences about the Utah Environments of the areas where they were found.

- Review vocabulary: INFERENCE – the ability to draw conclusions about what is <u>unobserved</u> [then & there] based on what is <u>observed</u> [here & now] This time we are able to observe where the fossils have been found so that we can draw conclusions or INFERENCES about how the environment in these places has changed and why we believe it changed.

Guided Practice: Place Fossil on the Map (10 minutes)

- Pass out the Utah County Fossil Maps [one per student] and the Utah Fossil Locality Information [1 per pair].
- Project a copy of the Utah Fossil Locality Information. Read through the list together and begin brainstorming ideas for symbols to represent the different types of fossils. (Note: The symbol does not have to be a picture of the fossil. Dots of color or other simple shapes will work too. You may also want to use stickers for your symbols.)
- Discuss the steps to complete the task:
    - Choose a fossil from the Utah Fossil Locality Information Chart
    - Select a symbol to represent that fossil (a simple shape or colored dot works well)
    - Write the fossil name and draw the chosen symbol beside it in the LEGEND/KEY
    - Place the symbol in the location on the map indicated by the Information Chart
- **<u>Modeling Cycle:</u>** Teacher does, Teacher does with student, student with student, all students – The modeling is primarily to emphasize the proper procedure for selecting a fossil from the list, choosing a symbol to represent it, recording the symbol on the legend, then placing the symbol on the map in the county it is associated with.
- <u>Teacher Does:</u> should model following the four steps with the trilobite from Millard County [point it out on the list as the third county listed] Show how the trilobite can be represented with a symbol like star. In the legend the trilobite should be listed with its symbol beside it and then the symbol likewise placed on the map in Millard County where it was located.
- <u>Teacher with Student:</u> Invite a student to be your partner. Have him/her design symbols for the first fossils shown on the list, the 'Allosaurus, Diplodocus, Stegosaurus' out of Uintah County. Then have the student place the names and symbols in the legend beneath the trilobite as a continuous list. Demonstrate how the three symbols are now drawn on the map in Uintah County just like the star with the trilobites in Millard County.
- <u>Two Students Do:</u> Two students work together to place the following fossil, the Utah Raptor in the legend and on the map, without allowing the other students to observe the process, so that as they finish it can be evaluated to determine if reading the information they have placed helps the class draw the correct information that the Utah Raptor fossils were located in Emry County. This is a little assessment to see if the class can make a connection between designing and reading a map.
- <u>All Students Do</u>: Have the students begin recording the information from the fossil list onto the map being sure to label and define the symbols as they work.
- Stop the partners occasionally and have them switch maps to see if they can read the symbols and glean the correct information the designing partners intended to be communicated. As they finish have partners compare finished maps. Although the symbols will vary, the locations of the fossils should be similar.

Independent Practice: INFERENCE Sentence Frames (10 minutes)

- Invite students to gather to see the projected model Utah Fossil Map & the Recording Sheet that includes the Sentence Frames.

T: In this activity the observable information is WHERE fossils were discovered and the unobservable information about which we will make INFERENCES is the HOW & WHY of what can be concluded about the different parts of Utah in the past based on the types of organisms who's fossil remains were found there. That will be our concluding assignment to make INFERENCES using the sentence frames that help us focus on the location or environments where the fossils must have originated from. First I will show you how to follow the model, using the same trilobite fossil that we started with.

Sentence Frames:

- Here it shows that _(fossils)_ are/were found in _(county)____.
- This evidence leads us to conclude that in the past the environment in _(county)_ was _(environment)__.
- Today it is a _(environment)__ environment, so it must have changed __[HOW?]_because of _[WHY?].

- **Modeling Cycle:** teacher does, teacher w/ student, two students do, whole class
- Teacher Does: Model the use of the sentence frames in the charts on the recording sheet. Be sure to have both the map and the recording page visible to the students as the example is given. Take particular pains to articulate the HOW & WHY inferences that could be drawn from the information about trilobites being located in Millard County.

T: The observable evidence is what we can find on the fossil map. Today's language objective says that the INFERENCES we make must be based on some evidence that can already be found. To model how this is done I will use the same evidence I placed on the map earlier. Here you can see the star in Millard County that represents the trilobites that were discovered in this part of Utah. According to our recording sheet these two pieces of evidence [the symbol of the fossil & the location where it was found] should be written as our evidence and then we can complete the first sentence frame.

- Highlight where the example is already written in - Millard County in the LOCATION column and trilobites, a marine animal in the EVIDENCE column. Then point to the map to verify that this evidence came from that source.

T: Now that we have the two columns complete, we see this sentence beneath them: 'Here [point to the map evidence in Millard County] it shows that trilobites are/were found in Millard County.' It includes both options of are/were because even though they were already discovered, that is why we have evidence, they do currently exist there still which can be represented with the present-tense verb 'are.'

- Now point out the next column with the UTAH ENVIRONMENT INFERENCES and the sentence frames there as you refer to them in discussing the HOW & WHY of UTAH's past.

T: These frames will remind us that our INFERENCES should be focused on the environments where the fossils were found, not quite so much the type of organisms themselves, like we did in the last lesson where we observed the fossils themselves. Here, we are observing map evidence and determining what that part of the land looked like in the past. I will complete the parts that require only that I insert the evidence for trilobites I am using to model the process, then I want all of you thinking about how we will need to draw really good conclusions for the HOW & WHY blanks. 'This evidence leads us to conclude that in the past the environment in Millard County was an ocean. Today it is not an ocean/ is a desert environment, so it must have changed_____ because of _____.' First, you should recognize that the hint of trilobites being a marine animal helped me determine that marine means oceans and these fossils would have to have come from an ocean. Second, you should notice that I have used that same simple information without knowing lots about Utah today, but enough to know that there isn't an ocean anywhere near Utah, or I could be more specific if I know that Millard County is very much in a desert region of Utah. Finally, there is the task of determining HOW & WHY the change from ocean to desert took place in Millard County. This can be kind of fun and creative, but the answers we create must make sense based on the evidence we have. I think that oceans must have turned to deserts because of something that made it get drier or made a hole where the water disappeared, like a volcano erupting at the bottom of the ocean. To complete that sentence frame with this information I need to say: "so it must have changed from wet to dry when the ocean water disappeared because of

a volcanic eruption that opened a hole in the Earth beneath the ocean." That is certainly the most creative part and requires you to use good vocabulary to express your ideas, even if you're not sure that they can be completely true. Archaeologists make the best guesses possible and use evidence to support their inferences.

- Teacher does with Student: the Allosaurus, Diplodocus, Stegosaurus' out of Uintah County - conditions needed to be somewhat tropical to have helped preserve the fossil bones, but then to have dried up suddenly…..be creative.
- Two Students Do: the Utah Raptor from Emry County
- Whole Class Does [in partners]: Give students enough time to write and then verbalize their sentence frames as the justification of the inferences they are making about the unobserved conditions of the environments these fossil organisms came from compared to the current environmental conditions in which they have been located.

Closing: (5 minutes)

- Engage good conversation for students to share their ideas. Invite students to share some of their sentence frames and discuss as a class the information gleaned through the observable information. Remind them that the observable and logical connection serves as evidence or justification for their ideas about the world of these ancient fossils.

T: 1- Trilobites were found in Millard County. Trilobites are marine animals that live in the ocean. Millard County isn't covered in an ocean right now, so what happened? 2- Dinosaur fossils and coal deposits were found in Uintah and Emery county. This usually means a tropical climate, but Utah is a desert. What happened? 3- Many oysters and marine fossils are found in Utah. They live in the ocean. What does that mean?

- Review the objectives, inviting students to read them and consider if they accomplished everything they said they would.

Assessment:

Informal observation and use of sentence frames & the work recorded in the chart

Extra Ideas:

Refer to Utah Maps with current climatic information and other maps portraying the past climatic regions in Utah

FOSSILIEN IN UTAH

<table>
<tr><th>ORT:
[County]</th><th>BEWEISE:
[Gefundene Fossilien: Karte]</th><th>UMGEBUNGEN UTAH:
[Schlussfolgerungen: Veränderungen - von der Vergangenheit zur Gegenwart]</th></tr>
<tr><td>Millard County</td><td>Trilobit, Meerestiere
[KARTE]</td><td rowspan="2">Durch die gesammelten Beweise können wir darauf schließen, dass Millard County früher ein Ozean war. Heute ist es kein Ozean mehr. Es müssen also Veränderungen stattgefunden haben. ____[WIE?]____, weil/wegen _____[WARUM?]_____.</td></tr>
<tr><td colspan="2">Hier sieht man, dass der Trilobit in _Millard County___gefunden wurde.</td></tr>
<tr><td>___________ County</td><td>[KARTE]</td><td rowspan="2">Durch die gesammelten Beweise können wir darauf schließen, dass (County) früher (Umgebung) war. Heute ist es kein/keine (Umgebung) mehr. Es müssen also Veränderungen stattgefunden haben. ____[WIE?]____, weil/wegen _____[WARUM?]_____.</td></tr>
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</table>

_____ County	[KARTE]	Durch die gesammelten Beweise können wir darauf schließen, dass (County) früher (Umgebung) war. Heute ist es kein/keine (Umgebung) mehr. Es müssen also Veränderungen stattgefunden haben. ___[WIE?]___, weil/wegen ____[WARUM?]____.
Hier sieht man, dass (Fossil) in (County) gefunden wurde.		

Fossilien in Utah

Uintah County	Allosaurus, Diplodocus, Stegosaurus
Emery County	Utah Raptor
Millard County	Trilobit
Emery County	Versteinertes Holz
Washington County	Dinosaurierspuren
Carbon County	Kohlevorkommen
Wayne County	Muscheln von Austern
Sevier County	Farnfossilien
Tooele County	Seelilien
Garfield County	Weichtiere (Schnecken)
Sanpete County	Mammut
Iron County	Muscheln

http://www.fossilsites.com/STATES/UT.HTM

Utah Fossil Locality Information

The following places are where fossil (clues) have been found in Utah:

Eastern Uintah County—fossils of Allosaurus (Utah State Fossil), Stegosaurus, Brachiosaurus, and Diplodocus indicating tropical climate; Dinosaur National Monument.

Emery County—Utah Raptor (relatively new discovery); Cleveland-Lloyd Quarry. There are also leaf fossils from the Cretaceous Period

Carbon County—massive coal deposits, a fossil fuel, indicating ancient swamps and tropical vegetation.

Western Millard County—Trilobites of many varieties in abundance near Antelope Springs indicating ancient shallow ocean during the Paleozoic Era.

Weber County—Ogden Canyon has fossils of plants, seashells (gastropods and brachiopods), and corals from the Mississippian and Devonian Periods.

Wayne County—Abundant oyster shells west of Caineville.

Washington, Kane, Grand, Garfield, and Emery Counties—These counties form a strip of land on which petrified wood is found. Ancient swamps with massive trees that may have been flooded and covered with silica-rich volcanic ash from an eruption that leveled the forests could account for these fossils.

Box Elder and Cache Counties—Trilobite, sea shell, and fish fossils.

Iron County—Oyster shell fossils from the Cretaceous Period.

Salt Lake County—Sea urchin fossils in Emigration Canyon. Other marine fossils.

San Juan County—Marine fossils near Chicken Corner Trail.

Sanpete and Wasatch Counties—A variety of marine fossils in the Green River Formation.

Allosaurus

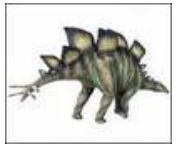
Diplodocus

Allosaurus

Diplodocus

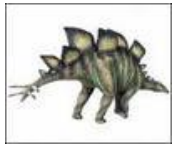
Allosaurus

Diplodocus



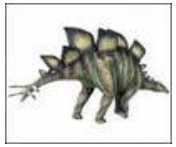
Stegosaurus

Utah Raptor



Stegosaurus

Utah Raptor



Stegosaurus

Utah Raptor

Trilobis

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Trilobis

Petrified Wood

Trilobis

Petrified Wood

Dinosaur Tracks

its

Dinosaur Tracks

Coal Deposits

Dinosaur Tracks

Coal Deposits

oyster shells

fern plants

oyster shells

fern plants

oyster shells

fern plants

sea lilies

mollusks (snails)

sea lilies

mollusks (snails)

sea lilies

mollusks (snails)

Mammoth

shells

Mammoth

shells

Mammoth

shells

Allosaurus

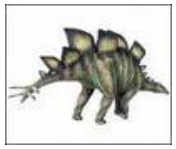
Diplodocus

Allosaurus

Diplodocus

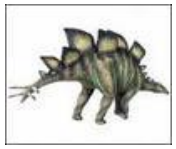
Dinosaur Tracks

Coal Deposits



Stegosaurus

Utah Raptor



Stegosaurus

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