SEDIMENTATION OF UTAH LAKE

This lesson plan has been created as a resource for seventh grade teachers to teach the new core standards to their students. It integrates science standards in a meaningful and fun way. To see which specific standards are addressed, please refer to them below.

OBJECTIVE:

Students will understand sorting of earth materials in stream beds and lakes is based on particle sizeS.

STANDARDS ADDRESSED:

7th Grade Science:

Standard 2: Students will understand the relationship between properties of matter and Earth's structure.

Objective 1: Examine the effects of density and particle size on the behavior of materials in mixtures.

d. Relate the sorting of materials that can be observed in road cuts, streambeds, or beaches to the density and particle size of those materials.

e. Design and conduct an experiment that provides data on the natural sorting of various earth materials.

TEACHER BACKGROUND:

Sedimentation -- Relate the sorting of materials can be observed in stream beds, road cuts, or beaches to the density and particle size of those materials. Moving water sorts materials by size and density.

This lesson will make use of a stream table to allow students to explore the effect of water flow across the landscape on the sorting of materials of different size and density. The stream table can be constructed using any long container (20"-30") with a hole drilled in one end for drainage.

Fast moving water moves larger and denser particles and as the water slows down, larger and denser particles drop out first, followed by the medium- and small-sized particles. A river deposits particles into a lake. Sand settles quickly. Fine clay sediments can remain suspended for much longer, until it settles in still water. The denser objects such as boulders and rocks will drop out first, remaining upstream. Less dense materials such as gravel, sand, silt, and clay will settle as the water enters the calmer waters of the lake.

Sediments coming downstream to the lake will be deposited in different delta formations depending on the slope of the shore. If the slope is gradual, a large flat fan will be deposited; if

it is steeper, a small narrow fan will be deposited. Fine, low density sediments, such as clays and organic debris will be deposited in the lake, depending on lake conditions (i.e., windy, calm, etc.). In most cases, some circulation occurs in the lake, and deposits of fine sediments will be influenced by the current. The fine sediments usually will be deposited in a different location than the coarse materials.

There are confounding factors in Utah Lake. Most of the sandy areas of sediment come from rivers on the east side of the lake, and waves wash the fine sediments into the lake leaving coarse rocky bottoms in the river. The lake bottom on the west side thus has more fine sediments than expected from the river delta model.

The north-south fault that runs through Utah Lake determines where the Jordan River is. The river channel extends into the lake as a depression that meanders through the lake bed. Springs on the east side of this fault are cold water with little dissolved material. These springs are fed by snow melt from the Wasatch Mountains. Springs on the west side of the fault are hot springs with high concentrations of dissolved calcium minerals.

Before the gates at the head of the Jordan River were built, the north half of Utah Lake, was a wetland that was flooded in the spring, but dry much of the year. The remains of many pit houses built by Fremont Indians can still be found on the lake bed in the north end of the lake.

Phragmites is another major source of sedimentation. The plant produces much vegetation as stems, leaves, and roots. In addition to the extensive roots, the stems and leaves fall into the water in the fall and winter and gradually fill in the lake. The plant matter eventually decomposes into peat. This process creates peat bogs. Shallow lakes that have vegetation growing in them, eventually fill in with decayed plant matter and become peat bogs.

There is a large slab of sediment on the north end around the mouth of the American Fork River with no layering. Something happened in American Fork Canyon that caused a large amount of sediment to collect at that location in a single event.

Interesting Information on Utah Lake:

- The west side of the lake has hot mineral springs contributing to precipitation of calcium minerals.
- Out near Bird Island, on the south end of Utah Lake, there are travertine deposits. (Travertine is a limestone deposited from flowing water.) These deposits are produced from springs in the lake. Bird Island was formed by these springs and the resulting travertine deposits. Water in the springs comes from rain and snow in the mountains. This water dissolves the limestone rock in the mountains and the limestone precipitates from the water when the spring enters the lake.
- Sediment is also deposited on the lake bottom from materials that precipitate in the lake. Rain water with carbon dioxide dissolves calcium carbonate (limestone) in the mountains to make soluble calcium bicarbonate. When this solution gets into the lake, algae take

up bicarbonate by photosynthesis and evaporation concentrates the solution causing the calcium carbonate to precipitate as a mixture with suspended clay particles. The precipitate hardens into a soft stone called marlstone.

- Much of the northwest corner of the lake bottom is marlstone because there are many hot mineral springs in the area. Marlstone is made from calcium carbonate and clay. Lincoln Beach also has calcium carbonate deposits that coat pebbles and other rocks.
- There is a deep spring, at least 63-ft deep in Utah Lake. Water exiting the spring prevents sediment from building up, causing its depth.
- The Lake Bonneville benches are composed of gravel, sand, and silt that were sorted and deposited by rivers and wave action. On average, about 1 mm of sediment is deposited on the lake bed each year.

TEACHER / STUDENT MATERIALS:

- Stream Table Lab Worksheet
- Stream Table Lab materials (per group)
  - Stream table (A plastic tub 20”-30” long with a hole drilled in one end for a drain. Drill the hole so a rubber stopper or cork will fit.)
  - Drip containers (1 quart container with different 1/4” hole drilled in the center of the bottom. Optional - Provide additional containers with holes that are 1/8” and 1/2” in diameter.)
  - Water pitcher
  - Wood blocks (used to increase slope of stream table)
  - Ruler or thin piece of wood long enough to span the stream table (used to support drip containers)
  - Container for collecting water
  - Wood scraper (a piece of wood the width of the stream table, used to push and smooth sand)
  - Soil mix (Mix 1 cup pea gravel, 4 cups coarse sand, 4 cups fine sand, 1 cup garden soil. These can be found at a home improvement store. Soil from the yard or garden can be used but tends retain more water from one experiment to the next.)
- Utah Lake Sediments worksheet
- Colored pencils or crayons

PROCEDURE:

Day 1

1. Organize students into groups and provide each group with student materials.

2. Pass out the Stream Table Lab worksheet and review the procedure with them.

3. Have students carry out the experiment using the procedures on the worksheet.

4. Circulate among students to ask questions and check for understanding.
   Example questions include,
   - "What do you see happening as the water flows down the soil?"
   - "Why does the water flow through the soil that way?"
   - "Where do you see the coarse sand, fine sand, soil, and pea gravel flowing to?"
   - "What causes the different sediments to move to different areas of the stream table?"

5. Have students complete the student worksheet and clean up their area.

Day 2

1. Review what students learned from stream table activity.

2. Provide students with Utah Lake sediments map.

3. Students will color contours for each type of sediment. Color code each type of sediment on the map and complete the questions on the back.

ASSESSMENT:

- Students will complete lab and answer analysis questions.
- Students will complete Utah Lake Sediments worksheet with accompanying questions.

EXTENSIONS:

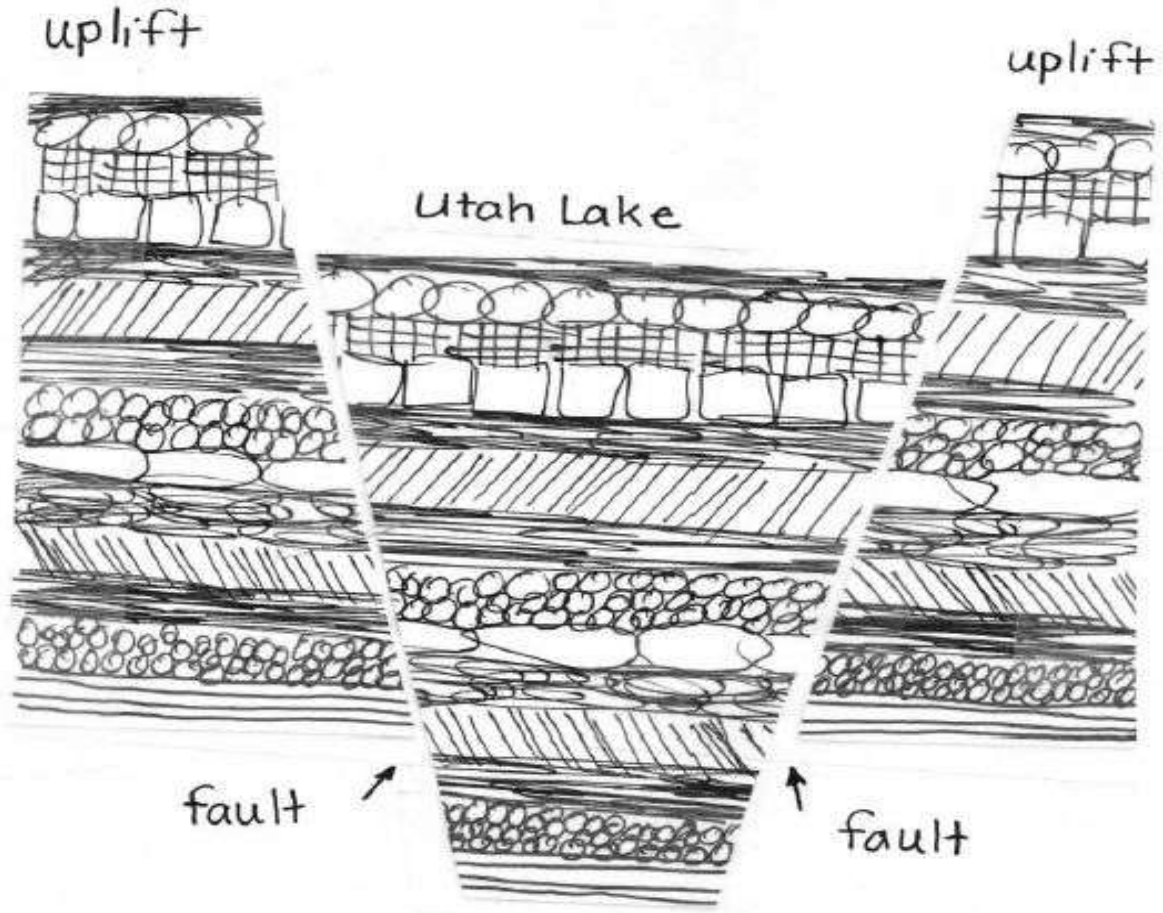
- Students may choose to explore a similar experiment with one type of the sediments.
  - How does sand behave?
  - How does clay behave?
  - How does gravel behave?
- Students may choose to explore the effect of changing the rate of water flow by using different sized holes in the drip container.
  - How does a higher flow rate affect the movement of sediments?

ADDITIONAL REFERENCES:

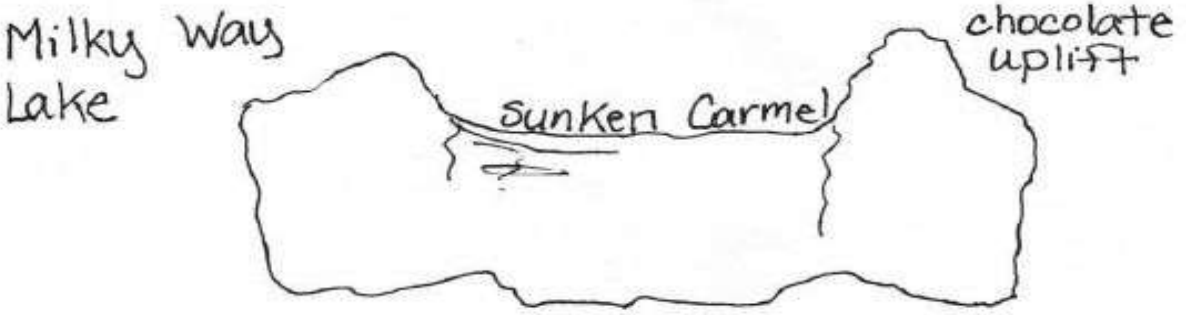
- *Utah Lake: Legacy* video clip — Chapter 6 Characteristics of a Shallow Lake
  - (*YouTube Link*); (*UEN Link*)

SEDIMENTATION OF UTAH LAKE

Sample Student Notes

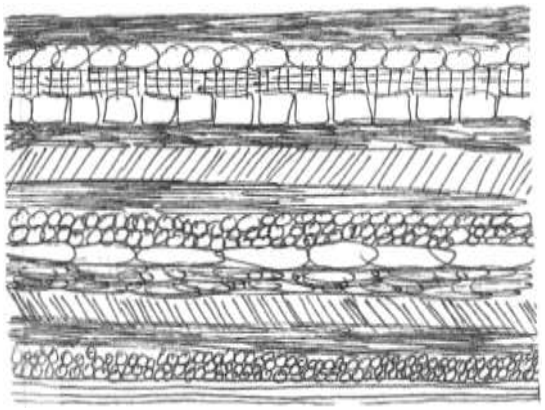


Students could draw a sketch of their candy representation of Utah Lake Formation.

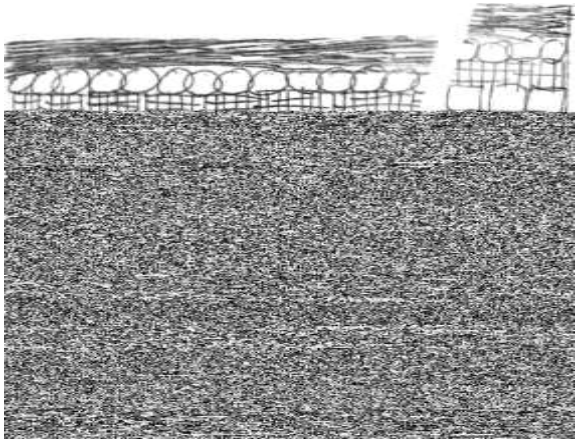


Guide Sheet for Utah Faults

Original Cut

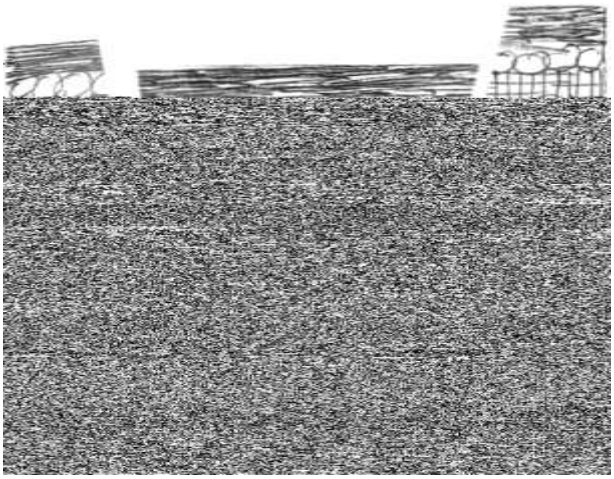


1st Cut



2nd cut

This will be taped or glued to students' journal or note taking paper.



Name_____

Date _____

Period_____

Purpose: The purpose of this lab is to investigate the sorting of materials based on size and density as they are carried by water from streams to lakes.

Question: What causes the sorting of earth materials in stream beds?

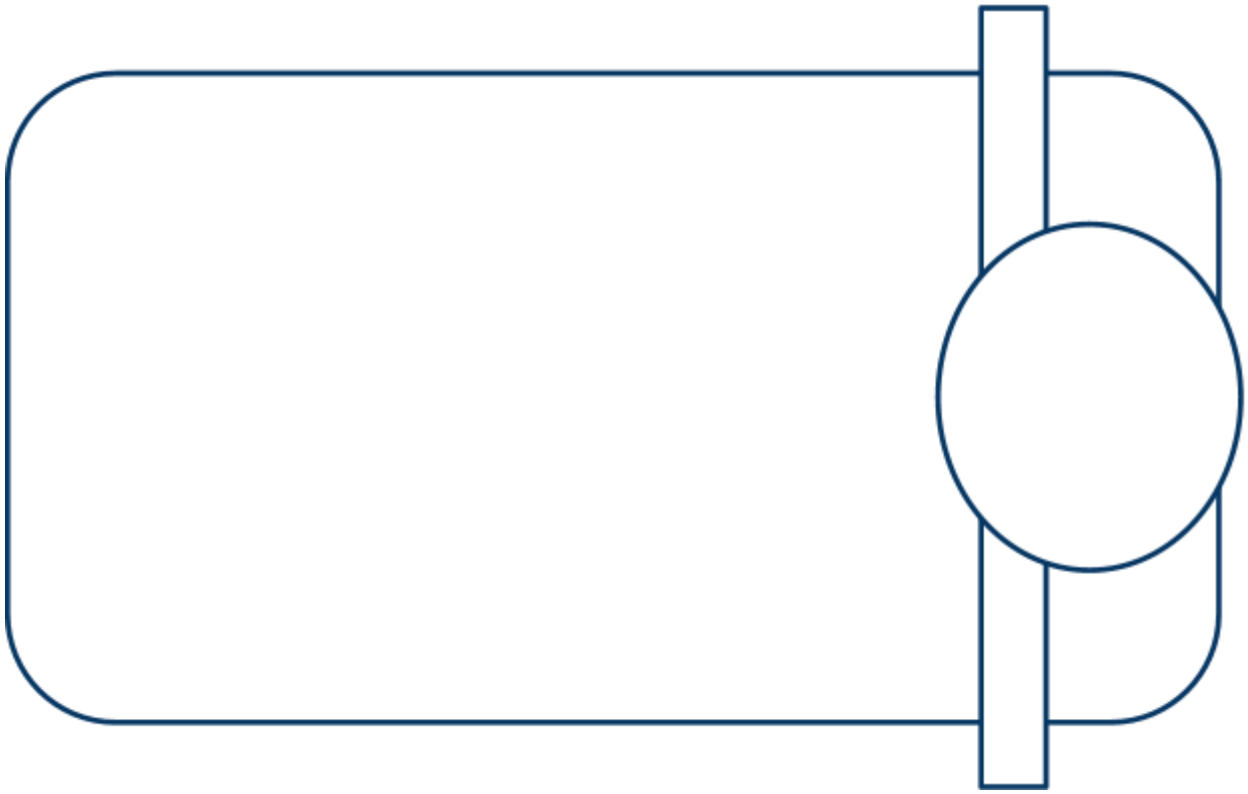
Procedure:

1. Place one end of your stream table on 2X4 blocks so that it is raised up.

2. Build a sloping pile of soil at the upper end of the stream table.

3. Place a ruler or strip of wood across the upper end of the stream table. Set the drip container so it sits on the edge of the stream table and the ruler.

4. In the box below draw, in as much detail as possible, what your “landscape” looks like. Use labels as needed.



5. Gently pour water into the drip container and let it run down the hill toward the lower end of the stream table.

6. Observe closely what happens as the water runs down. Record your observations in the space below. Be as detailed as possible.

_____
_____
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_____
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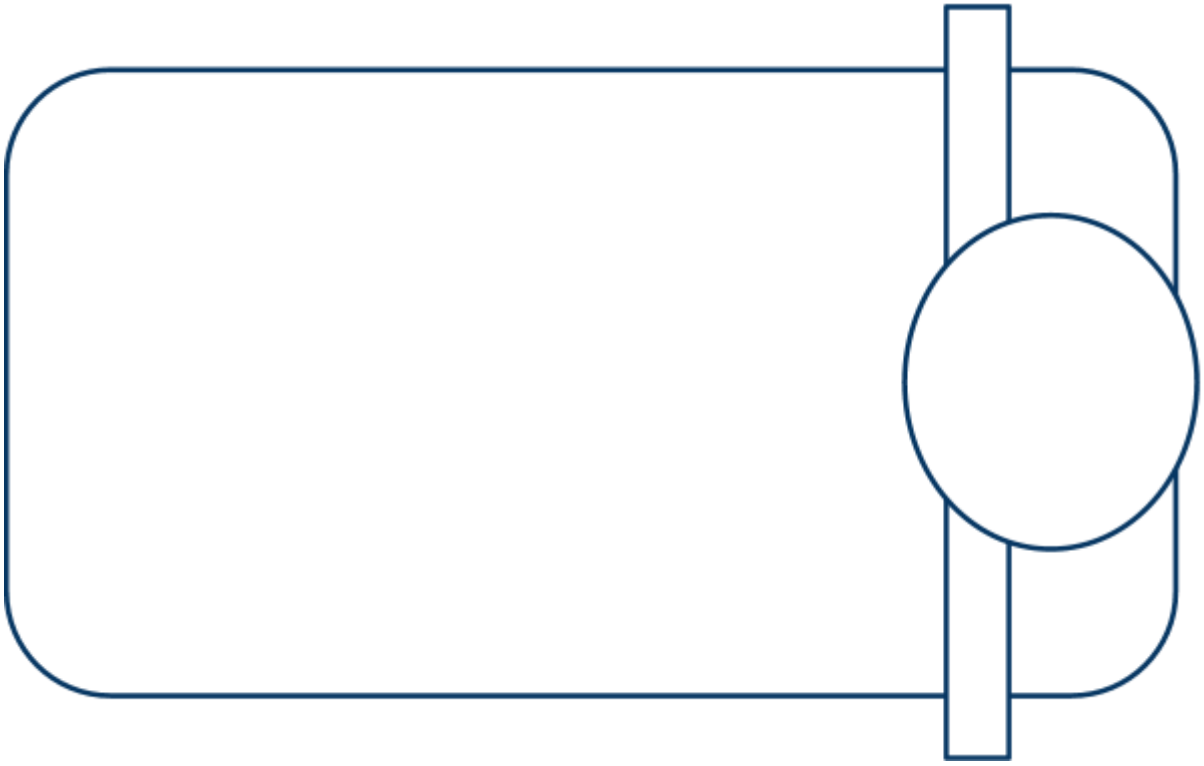
7. Draw a detailed picture of the new “landscape” in the space provided. Use labels as needed.



8. Answer the questions below.

   a. What caused the soil to move down the stream table?

   b. Describe the order in which the particles of soil and rock were sorted.

c. Why did they sort in this way?

d. How do streams and rivers affect the landscape?

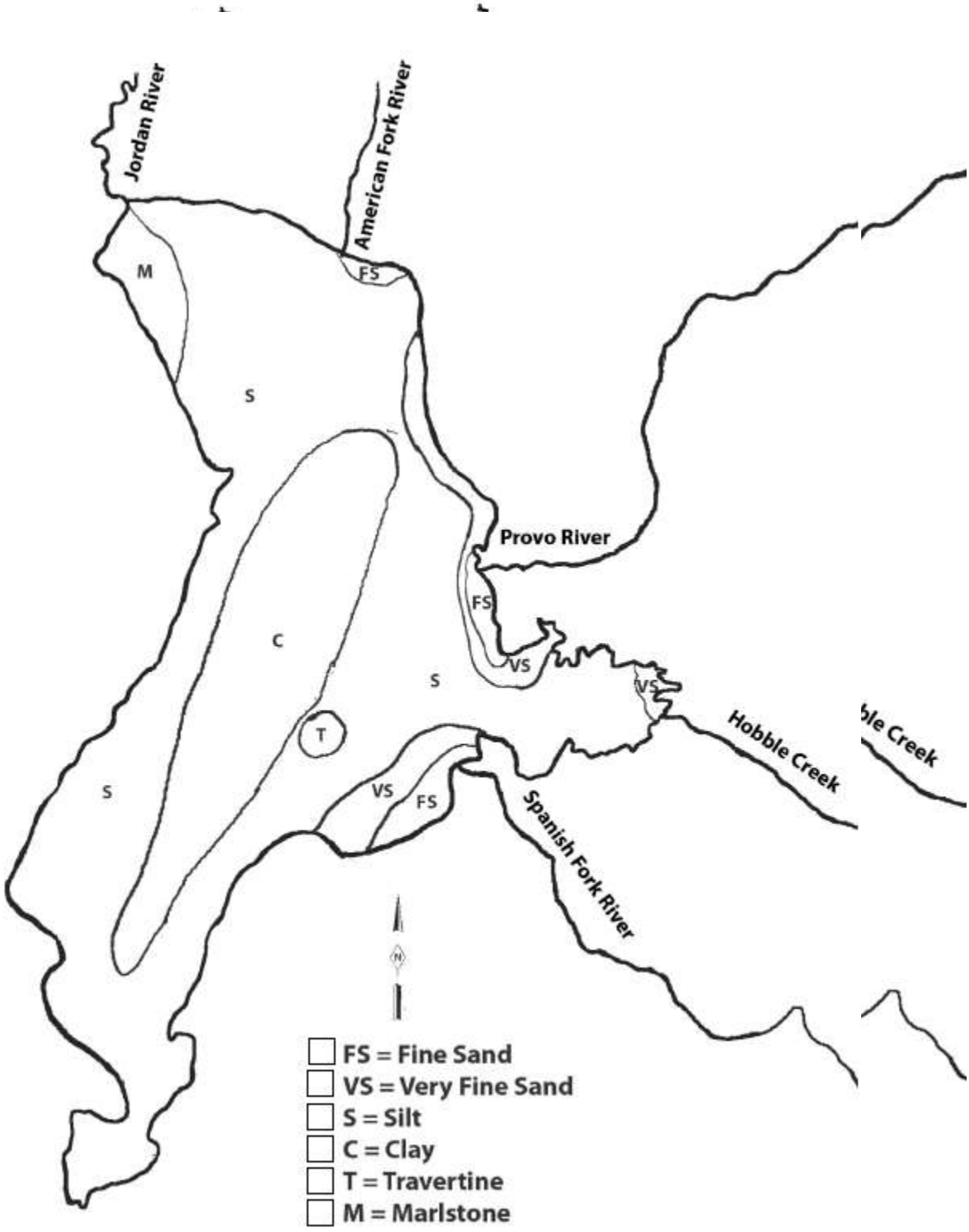
9. Holding a bucket under the drain hole and keeping the stream table at the same angle, carefully remove the stopper and allow the water to drain.

a. What do you notice was left behind at the bottom of the stream table?

b. Why do you think this happened?

10. Clean up your table as instructed by the teacher.

Utah Lake Sediments



Utah Lake Sediments

QUESTIONS

1. Where would you look for clay in the lake bed to make bricks or pottery? Clay is a finely divided, low density material.

2. The south and east shores of Utah Lake near the river mouths have a gradient of material from coarse sand on the shore to very fine clay on the lake bed in the middle of the lake. Why is this?

3. The lake bed in the northwest part of the lake is a soft rock called marlstone that is a mixture of calcium carbonate and clay. This rock is continuous with no gradient of particle size. How do you think this part of the lake bed was formed?

4. Bird Island, in Utah Lake, is made of travertine flowstone, a rock formed from minerals dissolved in spring water. Locate Bird Island on your map. What may have caused Bird Island to form in this location?

5. If you were to look for gold in the Provo River, where would be the best place to look? High in the canyon where the river flow is fast, in the valley where the flow is slow, or in Utah Lake? Remember that gold is a very dense material.

6. Why are the gravel pits, where rocks larger than one inch are mined, in Utah Valley found near the mountains and not near Utah Lake?

7. If you were to dig a trench in an old river delta in Utah Valley and find alternating layers of sand and clay, how would you explain this?

8. The northwest corner of Utah Lake with a marlstone bottom is shallower than the northeast corner of the lake. Explain what might cause this?

9. The average depth of Utah Lake is 9 feet (2.75 meters). If it is being filled with sediment at a rate of 1 mm/year, how long will it be before the lake no longer exists?

Utah Lake Sediments

10. The north end of Utah Lake is only 3 feet (0.9 meters) deep, on average. If sediment is being deposited at 1 mm per year, when will the north end of the lake become a seasonally flooded wetland?

11. Where it grows, phragmites deposits about 10 cm of biomass on the lake bed each year. Phragmites can grow in water that is up to 50 cm deep. At this depth of water, how many years does it take to fill in the lake and create a wetland peat bog?