International Journal of Social Education
Volume 23, No. 2, Fall-Winter 2008, Pg 35-44

# Ice and Sand: Linking the Sandbox to Geographic Features in Elementary Social Studies Classrooms

What do the sinking of the Titanic, the Grand Tetons National Park, and Indian Dunes have in common? The answer is that all three are testaments to the forces of glaciations.

At first, there might seem to be little in common between a yawning hole torn in a ship, the U-shaped valleys found in places like the Grand Tetons and Yosemite National Parks, and dunes that border a lakeshore. But ship-sinking icebergs are the chunks that fall off the edge of glaciers at sea, U-shaped valleys have been cared by glaciers descending from mountain tops, and the dunes are boundaries of the lake left behind after a glacier mass hollowed, compacted, and scooped out depressions in the sand.

Glaciers are an excellent subject for elementary social studies classes. Their effects are easy for students to model with inexpensive teaching supplies, such as sand and ice. Students can conduct research nationally with virtual field trips or locally with real field trips. The models and research can be used as starting point for a discussion of how the impact of glaciations on land had affected individuals and communities-how people encountered the land and respond to it though labor, industry, and recreation. People discover mineral wealth more easily in land where glaciers have stripped away the topsoil. Where glaciers have deposited drift – know as "till," consisting of rocks, stone, sand, dirt, and clay – the result has often been good farmland and the establishment of farming communities. The valleys and lakes that glaciers leave behind have become favorite spots for visitors and tourists.

For students, modeling physical geologic forces in land is a means to a great understanding of these forces, and the impact on the environment. This reflects research finding that multiple-information formats enhance learning. For example, a study by Kulhavy, Lee and

Originally in *Social Studies and the Young Learner, 11(4),* 6-11. Reprinted with permission.

Caterino found that those fifth grade students who wrote a fictional account using a map retained more information than students who wrote a description of the map.[1] Viewing the map was responsible for an increase in recall of written work. Maps also serve as mnemonics. Another study found that studying an intact map before text analysis set up a mnemonic device to help the reader analyze supporting text.[2] Spatial relationship maps encourage the retrieval of information. Student remembered facts, feature names, and location on reconstructed maps. Furthermore, student errors in map location remained smaller. Like maps, models may serve as useful mnemonic structures.

Diagrams also help people solve comprehension problems. Larkin and Simon point out that a diagram can gather all necessary information, use location as a grouping tool, and support numerous perceptual inferences.[3] Another study found that students who study diagrams before text recalled more facts and features than did students who read the text before seeing the diagram or used only text.[4] Models should have a similar effect on the ability of students to interpret text. Models that are presented at the beginning of instruction will best help students organize information.

Glaciations changed the land and past changes impact life today as reflected in the social studies standard People, Places, and Environments. Early Grades —"e. locate and distinguish among varying land forms and geographic features."[5] It also reflects the following national geography standards: 4. Places and Regions – the Physical and Human Characteristics of Place. 5. That People Create Regions to Interpret Earth's Complexity.[6] These standards support the examination of land forms and the way land forms influence people.

## Building the Models

During this activity, students construct models to explain glacial action. They use what they learned with each model to help them start the next model. The teacher helps students make connections to local features – what types of geographic features are represented, why they can be classified as glacial regions, and so forth. Materials necessary for glacial model-making include a bag of playground sand, a bag of ice, paper cups, paper towels, and old dishpans.

Each section starts with a model that students build to recreate glacial processes. A brief discussion follows explain how glaciers changed the land. Example can include local and national properties that display glacial features. Students examine the economic implication of glaciations and use maps to identify the location and effects of the glaciers.

### Snow and Ice

*Model Making and Discussion.* Students start to explore the effects of glaciations by squeezing two ice cubes together with their hands. The students predict what will happen. The students explain that the ice cubes fuse or freeze together under pressure.

*Application.* Snow stacks up on the glacier, and this snow mass freezes into ice under its own weight. Ice sheets and glacier still form around the world from snow fall. Examples of snow packing into ice include the ice field in Rocky Mountain National Park, or, on a smaller scale, the snow packed into ice on a driveway driven across before shoveling. In both examples snow compresses into ice. Students identify an ice field on a globe. The students point to places such as Greenland and Antarctica. Students generalize that extreme latitude harbors glaciers and ice fields.

## Spreading Ice

*Model making and Discussion.* Students work together to stack ice vertically for height on top of a table. The students predict what will happen to the ice. The students observe that it spread horizontally, it spreads in all direction, lobes move forward from the main section, and chucks break off the mass at the edges. When students describe the motion of the ice, the teacher helps the students look for connections to glacial movement.

*Application.* Ice fields spread horizontally due to accumulated snow fall. Ice follows the path of least resistant in Denali National Park glaciers. Chunks fall off the edge of glacier at sea. These float and sailor call them icebergs. Lobes of ice move at different paces, as in the last glaciations, when ice covered various parts of Ohio, Indian, and Illinois.

Where the glacier touched the land, it rerouted rivers and established present day drainage patterns. The drainage patterns facilitate interior trade through the Great Lakes and the Ohio Valley. Locks, dams, and canals improved these water ways. Students can trace the flow of water through the great lakes.

Students can use maps of the United States to point to and name sites where glaciers are present. Students can generalize that glacier usually exist in the United States where there is significant elevation. Students can identify national properties that contain glaciers such as Glacier National Park and Denali National park.

## Exposing Bedrock

*Model making and Discussion.* For the next model, students place two inches of loose sand at the bottom of a dishpan. Then the students place ice along one side of the pan. Stacking it about four inches high. The sand represents the land and the ice represents the glacier. The students predict what will happen when ice moves. Students use their hands to push, pull, and scrape the

ice across the sand to the other side of the dishpan. Students observe and discuss how the glacier ice scrapes clean the bottom of the dishpan.

*Application.* The glacier acted as an earth mover. The moving glacier stripped away the topsoil. Topsoil removed by the glacier exposed bedrock. Glaciers move across Canada and scraped the surface to reveal the Canadian Shield. The expose sheet of rock cleared by glaciers. At another place glaciers collided with the White Mountains to expose the rocky sides. Visitors came from around the world to see the rugged beauty of the White Mountains. Not having to go through the layers of earth makes mining discoveries and extraction easier. People discovered the mineral resource because they lie close to the surface. Student may use atlases to locate picture and mineral resource deposits available in their area. They could compare these with those on the Canadian Shield. The teacher helps students to use maps to explain the topographical feature flattened by glaciations in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Students us topographic maps to locate the Canadian Shield and the White Mountains.

## Forming Moraines

*Model Making and Discussion.* The students observe their dishpans again. Students describe the advancing ice as it plows the sand into a mound. The teacher helps the students name the sand mound a glacial moraine. The students speculate about whether the slope of the sand mound will be steep or gradual with the ice melts.

*Application.* Glaciers pile up great mounds of earth at their margins. The moraines or piles of earth left by the edge of the glacier when it retreated remain. The steep-sloped moraines have eroded with time. Students see moraines on field trips to Martinsville Indiana, or in Glacier Nation Park. In Martinsville it is possible to view moraines from the highway, while elevations

at Glacier National Park allow observation of moraines from above. People construct highways around moraines where the ground remains level. It is less expensive to build around a moraine than to cut through it. Many people prefer to have home locate on moraines because they like the view offered by the elevation. Students draw their own maps of moraines. They should label changes made by humans.

## Glacial Till

*Model Making and Discussion.* Returning to the dishpan students describe an individual ice cube that they extract from the moraine. The students see the grains of sand stuck to it and embedded with it as a dirty snowball. The students leave the dirty ice cube in the dishpan until it melts. The students wait to see what happens to the till when the ice melts. Students make connections of how much topsoil the ice carries with it as it moves, and how it acted like a huge snow plow to level the land while scooping out the great lakes.

*Application.* The aggregate or glacier drift called till removed by the glaciers included boulders, rocks, stones, sand, dirt, and clay. Because the glaciers carried so much till, the land coved with the glacier became covered with deep deposits of till, the dirt or till picked up by the glacier deposits on scraped plains when the glacier melted so they became till plains. Multiple inches of till the rich black soil seen at Chain O'Lakes State Park, covered northern Indiana. This till gave the region the name the Till Plaines. The multiple surrounding farms in this region display the dark earth. The land became good farm land because the till soil is good for farming. People moved to this area to farm in this soil. The soil yields crops of corn and soybeans. Students can survey a section of land and construct a map of the different corps grown in that section. They can color coed the map to the map key they create. They should include other uses for land beside agriculture.

## Glacial Grooves

*Model Making and Discussion.* To show the effect of glaciations on bedrock, students put a piece of notebook paper on their desk before sprinkling a few grains of sand over the paper. The students place one ice cube on the paper before pressing down on the ice cube and dragging it across the paper. Some of the students became distressed when their paper rips or the ice cuts great grooves into the paper. Students compare this model to glaciers and think about what a glacier does to rock.

*Application.* The glacier picked up dirt, sand, and gravel. Trapped in the ice, boulders froze and refroze in the moving gravel-laden glacier. As the glaciers moved, they polished and scoured some rocks, and they carved great grooves in other rocks. The glacier functioned as sand paper cutting though solid rock because the glacier both carried rock and had great mass.

Students may see grooves in Grand Teton National Park. The grooves testify to the slow grinding power of the glacier. When the glacier came down the mountains, it carved that valley into a U-shaped glacier valley instead of a V-shaped erosions valley. Tourists prize glaciated valleys such as those observed in the Tetons and Yosemite National Park. People value unspoiled natural locations for recreation. Students can use a grid to locate a national park on a map. Students can also give the coordinates from a map. Students use latitude and longitude after they have mastered coordinates.

## Compacting the Land

*Model Making and Discussion.* Place two inches of loose sand in a dishpan. Have the students slowly press their fist into the sand. The teacher asks students to make observations about what happens to the sand. Students say that they hollowed out the sand and the sand compacted.

*Application.* The compaction of the sand connects to the formation of the great lakes. The glaciers shaped the great lakes. The mass of the glacier hollowed, compacted, and scooped out the depressions for the great lakes. Indiana Dunes State Park shows students boundaries of the shrinking, scooped-out Lake Michigan. Students may also observe these results at Indiana and Sleeping Bear Dunes National Lakeshore. Visitors can walk around the succession dunes and shore lines. Commercial mining uses sand from the dunes as an aggregate material that can be mixed with cement for industrial purposes. People easily dredge the sand to from harbors in the region. The deep water ports allowed international trade by serving ocean-going freighters. Students may create elevation maps of the land and the surrounding dunes. They can apply contour lines to connect area of similar elevation and color code them.

## Kettle Lakes

*Model making and Discussion.* Have the students pack one-half of a paper cup with sand and fill the center with ice half buried in the sand. The students let the ice melt. The teacher asks the students about the shape of the lake. Students should respond that the kettle lakes have flat bottoms.

*Application.* When the glaciers stated to retreat, chunks of ice broke off the main body of the glaciers. As run-off containing till partially buried the blocks, the ice stared to melt. When the ice block melted, they left lakes dotting the terrain. Round steep-sided lakes called kettle lakes formed when isolated chunks of ice became separated and half submerged in till before melting to leave only their impression on the land. Much of northern Indian contains kettle lakes. They may be observed at Pokagon and Chain O'Lakes State Park. The lakes vary in size from small pools to large lakes.

Recreation and tourism are an important part of the economy. Kettle lakes serve as a place for people to fish, swim, and boat. The lakes served as a destination for many people who look forward to recreation on the lakes and relaxation on the shores.

Student may use maps for state or national properties to find symbols. Students can make symbols to add to the map, or change one of the symbols on the map to improve it.

## Glacier Waterfall

*Model Making and Discussion.* Students get a mixture of wet sand and water in their hand and drip it into a sand castle tower at the side of the dishpan. The students describe the shape the sand castle forms. Students respond that it is a half cone-the edge of the glaciers. When water melted off the top of the glacier, it ran over the side and carried the till with it.

*Application.* When the glacier melted, water ran off the top edge of the glacier; the till that the moving glacier collected gathered in the area under the waterfall. The half-cone-shaped hill grew to half the height of the glacier. Students should make the connection about how a waterfall creates a hill by stacking up glacier debris. The glacier covered the other half of the cone behind the side of the glacier. The glacier is not over there because it melted, but the half cone remains. Pokagon State Park has one of these features. The hiking trails takes a hiker up the unusually steep slope, and from the summit, the hiker returns along a much more gradual trail.

Students may make a relief map from paper mache, using Pokagon as a model. The students should use a fine tip marker to apply contour lines.

## Glacial Runoff

*Model Making and Discussion.* The students build up a ledge of wet sand across one-half of a dishpan to a depth of half of the height of the pan. The students point a cup of water in the

middle near the edge of the built-up side. The teacher asks the students to describe what happened. Students reported that erosion occurred or the water created a canyon and flowed into a delta.

*Application.* The glaciers even affected land they did not touch. When glacial run off hit soft rock like Mansfield Sandstone at Shades and Turkey Run State Parks, they carved the stone into cliffs and valleys. When the glaciers melted, the run-off carried gravel, and, and rock in the melted water across the land. Pine Hills Nature Preserve formed when glacial till-laden run-off cut away the rock to reveal narrow, double-sided cliffs called backbones. Portland Arch Nature Preserve formed when glacier till–laden runoff cut away the rock on each side leaving backbones before the water carved through the adjacent rock to form an arch. The rugged features demonstrate the power of glacier run-off just a few miles from the edge of the glacier. The deltas that were created by the glacier run-off sorted aggregate-valuable natural resources of sand and gravel—for future mining operations. Roads and buildings use these. Sediments such as clay also help construct modern conveniences.

Students can use an Indiana state high map to measure the distance between Shades and Turkey Run State Park by road. The students use the small red mile number, the mileage chars, and the scale of miles. The can also measure the distance between the two parks by river.

## Botanical Mystery

*Model Making and Discussion.* To conclude the model construction process, ask the students to design a model for the following situation. In groups of four, students may use ice, sand, and water to illustrate their two part solution. The presence of Northern Hemlock trees in Shades State Park presents a botanical mystery. Similar trees live in Canada. Why are these trees in

western Indiana? The two part answer explains how the trees got to the Shades State Park and why the trees stayed at the Shades State Park.

*Application.* The trees moved from Canada to Indiana when the glaciers moved in that direction, moderating and cooling the climate as the glacier advance. When the glacier retreated, most of the trees died, but some hung on in the shade-providing canyons. The moist steep-sided canyons trap relatively cool summer air and abundant water keeps the trees from getting to hot and dry out in the summer sun.

## Conclusions

Students use knowledge about glacial action to discover how the forces of nature changed their environment. To find out more about glacial action on land forms, student may manipulate ice and sand, use models for understanding the land, predict and question their experience, and respond with their observations. Additionally, students use models as a foundation that readies them for experience with text and serve as a mnemonic helping them to recall and interpret existing information and incorporating new information.

NOTES

1. Raymond W. Kulhavy, J. Brandon Lee, and Linda C. Caterino. “Conjoint Retention of Maps and Related Discourse.” *Contemporary Educational Psychology* 10 (1985): 28-37.

2. Raymond W. Kulhavy, William A. Stock, Michael P. Verdi, Kent A. Rittschof, and Wilhelmina Savenye. “Why Maps Improve Memory for Text: The Influence of Structural Information on Working Memory Operations.” *European Journal of Cognitive Psychology,* in press.

3. Jill H. Larkin, and Herbert A. Simon. “Why a Diagram is (Sometimes) Worth Ten Thousand Words.” *Cognitive Science* 11 (1987): 65-99.

4. Michael P. Verdi, Raymond W. Kulhavy, William A. Stock, Kent A Rittschof, and Janet T. Johnson. “Text Learning Using Scientific Diagrams: Implication for Classroom Use.” *Contemporary Education Psychology* 21 (1996): 487-99; Michael P. Verdi, Janet T. Johnson, William A. Stock, Raymond W. Kulhavy, and Polly Whitman-Ahern. “Organized Spatial Displays and Texts: Effects of Presentation Order and Display Type on Learning Outcomes.” *The Journal of Experimental Education* 65(4) (1997): 303-17.

5. National Council for the Social Studies. *Expectations of Excellence Curriculum Standards for Social Studies.* Washington, D.C.: Author (1994): 34.

6. Geography Education Standards Project. *Geography for Life.* Washington, D.C.: National Geographic Research and Exploration (1994): 113-16.