UBPL 101: MAP APPRECIATION

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Objective:

The students will design a city to see how their decisions effect other communities and the land around them. The students will examine various maps and make observations to gain perspective on human's interaction with the natural ecosystem. The students will use scientific understanding to plan and analyze their land use decisions.

Grade Level:

6th-12th Grade

Preparation:

One map and student worksheet per group of four students.

Materials:

-Map PDF
-Markers
-PDF worksheets

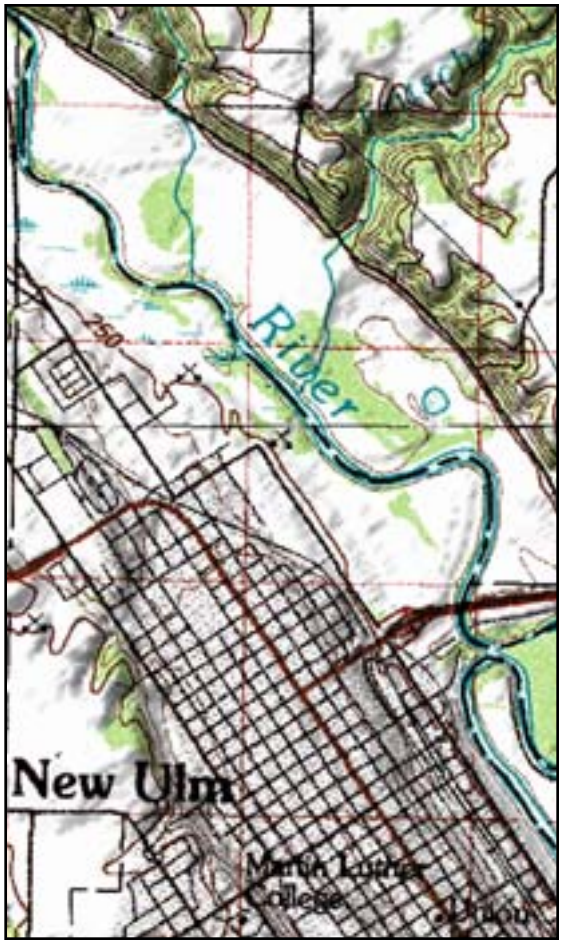
Time:

Two class periods
One block period

TEACHER INFO

Overview:

In this activity the students will begin by looking at a series of maps, including three-dimensional maps. As a class they will brainstorm ways the natural world may interact with humans and vice-versa. The students will come up with a list of necessary features of a city or town and will then make decisions where to set up the infrastructure and other features of a city or town. The primary focus of the activity is the interaction between humans and their surroundings and how to best plan for potential problems that may arise. The activity will conclude with each group combining their maps with all the other groups to form a much larger "invented" community and examine the impacts to those down stream.



Students will have an opportunity to create a "new" city from the ground up after discussing the somewhat complicated relationship humans have with their surroundings.

Procedure:

Begin the activity by giving the students a few minutes to examine a three-dimensional map of an urban area. Make a list of a few natural features for the students to notice as they look at the maps (see side bar). This lesson is designed to consider the natural features and not ignore them.

After a few minutes of looking at the maps, ask the students a series of questions to help get them thinking about the interaction of humans and the world around them. Familiarize yourself with the background interpretation for Minneapolis and St. Paul in this packet. It is not just the city that should be discussed, but the land that it rests on.

-Rivers
-Mountains
-Hills
-Canyons
-Wetlands
-Flat Ground
-Uneven Ground
-Lakes
-Floodplains
-Forests
-Bluffs

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Why are cities where they are, and what are the decisions that went into their creation? *Tired of walking, water, hot springs, nice trees, good view, cross roads, opportunities for trade, resources, rivers, ports, lakes.*
Why were Minneapolis and St. Paul settled at their present locations? *Rivers and a host of other reasons.*
What was the first non-native settlement? *Ft. Snelling.*
Where was it located? *Confluence of Minnesota and Mississippi Rivers*
Why is that important?
Why was the Minnesota River Valley so Important for the American Indians? *Fertile, water, sacred, transportation....*
Why? *Location, location, location*

If you look at most cities in the world their proximity to water is a common characteristic. Brainstorm a list of cities in the world and it will become evident that water plays an important role. Challenge them to come up with a city that is not located by water. Why?
Why is water important to the growth of a city? (See side bar)

- -Irrigation
- -Transportation
- -Drinking
- -Commerce
- -Industry
- -Power
- -Milling
- -Aesthetics

Water is obviously an important resource for many reasons. If water is so important it seems that a person ought to do as much as they can to keep it in good health. In most cases, water in our rivers is cleaner than it was thirty years ago as a result of pollution control. In 1969, the Cuyahoga River in Ohio caught fire as a result of all the pollution. Luckily, things have changed for the better, but there are still serious issues regarding pollution.

What are things you could do when you build your city to help protect the valuable water resources? Think about it another way.
How does pollution get into the water? (See side bar.)

- -Industry
- -Chemicals from lawns
- -Litter
- -Erosion of sediment
- -Removal of vegetation that holds sediment.
- -Storm drains
- -Car fluid leaks
- -Stream bank erosion
- -Agriculture Runoff
- -People
- -Animals

NCED is particularly concerned with how the Earth's surface interacts with water and moves from its source throughout the Earth system. This understanding is critical for making educated decisions regarding the land.

Look at the landforms present. They are in the process of change and in time the landforms you see now will look very different as a result of naturally occuring Earth-surface processes.

What are some forces at work that are eroding the land? *Wind, water, gravity, ice, chemical changes, human forces*

In this activity the students will use previous knowledge, their observations and classroom discussion to create a city grid that takes into account the land around it.

The students will receive a city charter for their map and lay a grid work for their city that addresses natural processes through various mitigation strategies. The students will be expected to interpret the Earth surfaces and decide on how to best to plan for a new community.

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What are some natural processes that may be of concern for a budding city? (See side bar)

It is important to stress that the focus should not be to build a cool city, but plan a city that takes into account its relationship with the land around it, thereby making it a cool city. The students should have general experience reading maps. Although three dimensional maps are easier to interpret the maps the students will be creating their cities on are flat maps with shading. As a class, brainstorm what natural events or factors may play a role in their planning. **Can any of them be planned for or mitigated?** *Challenge the students to plan their cities to account for factors that can be mitigated (mud slides, flooding damage), rather than trying to prevent an earthquake.*

-Drought
-Mud slides
-Tornados
-Fires
-Wind
-Dust
-Flooding
-Density
-Sprawl
-Hurricane
-Volcano
-Earthquakes
-Erosion
-Deposition
-Acid Rain
-Resources
-Heat
-Cold

What the students do not know is that all the maps connect to form a single river system. The conclusion of this activity will look at the cumulative effects downstream.

Conclusion:

Assemble the maps so they connect and form a single river system and the class can begin to think about how each community is connected.

If the maps are clear and easy to interpret the groups can hand there map to the group that is immediately downstream and let the downstream group determine how they will be affected.

Another idea is to let each group give a brief tour of their city. As a class, determine how the city impacts those below it.

Make sure the students understand that the effects downstream are not just caused by the layout of a city, also by the people that live there. Challenge the students to think of ways that they can keep water clean in their own yards and neighborhoods. Make sure to make connections between people, actions and the Earth's surface.

Assessment:

Have each group do a self-evaluation of how they functioned and worked together. Ask each student to evaluate their group performance on a piece of paper.

Was there equal participation by all group members?
Did everyone cooperate as a group?
Did everyone perform their group role?
If they could make one change to their city after knowing they are connected what would it be?

Have the students analyze their city and its impact on the land around it. Write a page summary with some of the following questions or make up you own.

Can you make a city without effecting those downstream?
What changes would you make to your city and how would those changes be beneficial for the land and those that are downstream?

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Grouping Procedure:

Divide the students into groups of four. Each group will be given a student worksheet and map. Point out the main river channel on each map and indicate the direction that the main channel is flowing. Give each group member a designated role. For example, the students could be divided into a reader, drawer, summarizer and teacher representative for asking questions. Quickly discuss how each of the group members will "act" according to their group role.

Maps:

Use a variety of traditional classroom maps for the students to make observations about cities. Contact NCED regarding the availability of 3-D maps to use for this activity (ncedmaps@umn.edu). **What symbols are used on the various maps?** Make a list for the students to follow..

It is possible to view NCED's map library online in 3-D and project the maps using a LCD projector. The viewable files have a zoom feature that give the optimal resolution for viewing the maps in 3-D. The zoom feature can be accessed by moving the mouse over the bottom right hand corner of the map.

The maps used for the student cities are manipulated gray-scale images that show the Earth's surface without vegetation. The maps are created from data collected from the Space Shuttle Missions. The white areas are higher and flatter while the darker shaded areas usually show a hilly or more varied topography. The maps are not in 3-D.

Consider laminating a class set of maps to be used during each period of the day. Have the students draw with erasable pens or have the students write on a transparency so they can project their city for the whole class to see. Add a transparency of the land to show how the city was built considering the features.

Indicate a proper scale for the maps. For instance, a pencil line is a small two-lane road and a fingernail is a large sports stadium. The students do not necessarily have to draw every building but they may simply want to zone areas as residential, business or industry. Also, let the students know that their city does not have to cover the entire map, but they should think about what will be present on the entire map. Are there roads, forests, agriculture or farms?

Vocabulary:

Sedimentation: The act or process of deposition sediment.
Deposition: The act of depositing, especially the laying down of matter by natural process.
Watershed: A region draining into a river, river system or other body of water.
Erosion: The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which means material is worn away from the earth's surface.
Reservoir: A natural or artificial pond or lake used for storage and regulation of water.
Biodiversity: The number and variety of organisms found within a specified geographic region.
River Mouth: The part of a stream or river that empties into a larger body of water.
Confluence: The point where two or more stream flow together.
Mitigate: To soften or reduce the effect

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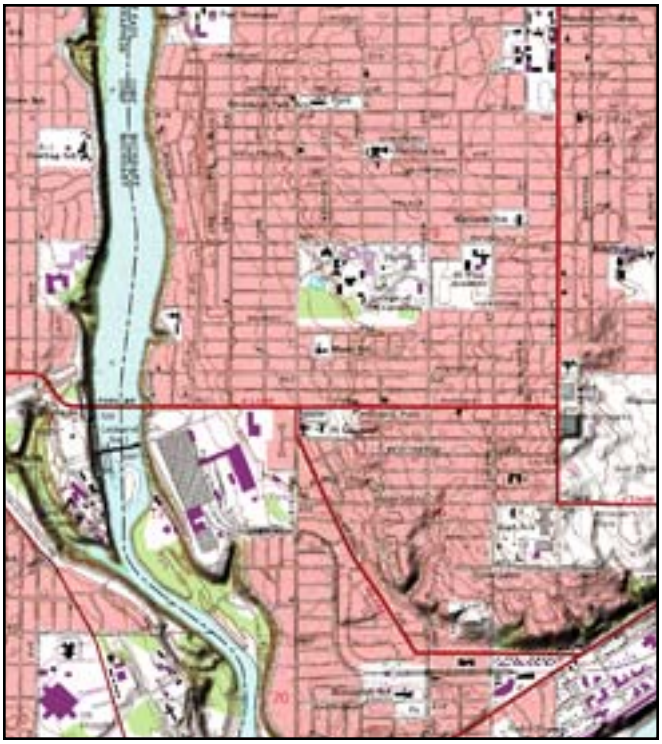

BACKGROUND MAP INTERPRETATION:

It is important to familiarize yourself with some of the main features on the maps you will be using for this activity. The following are some of the main features to keep in mind for this activity.

The location of Fort Snelling is at the confluence of the Minnesota and Mississippi Rivers. It was the first non-native settlement.

The city of Minneapolis prospered because of the presence of St. Anthony Falls. The water power was used for sawmills, flour mills and other industry. Ford Motor Co.'s plant is also located near a waterfall/dam in St. Paul.

Where is the best place to build an airport? MSP is located high and dry while the St. Paul airport is located in the river floodplain. It occasionally floods.

Compare the Mississippi River with the Minnesota River. The Mississippi is narrow and in a canyon, while the Minnesota River meanders over a broad river valley over a mile wide. Beginning approximately fourteen thousand years ago the Minnesota River valley drained the massive Glacial Lake Aggassiz that covered parts of the Dakotas, Minnesota, and Canada. The voluminous quantity of water flowing over a few thousand years helped carve the broad river valley and formed the steep bluffs along the Minnesota River Valley.

The "green" in the river bottom is vegetation that forms on the slowly shifting sediment deposits in the river. When the river floods, sediment is deposited on the banks and the slow accumulation of sediment is held in place by vegetation. As the river slowly changes course over time, these deposits will be redistributed throughout the floodplain.

The relatively smooth surface of South Minneapolis is a result of the last glacial advance. The Grantsburg Sublobe, an off shoot of the Des Moines Lobe, covered much of Minneapolis and St. Paul, but South and West St. Paul, Mendota Heights and other points south were at the glacial margin. Think of the Minnesota River as the approximate path that the Grantsburg Sublobe traveled. The margins of glaciers are often characterized by sediment deposits called moraines. Compare the two different areas of the map. The retreat of this glacier approximately thirteen thousand years ago is the primary cause for the landscape we see today.

Compare the location of downtown Minneapolis and St. Paul. Which downtown is more easily accessible from the river? St. Paul was settled first. Do you think there was a connection?

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Focus Questions:

"What are places or things that are present on the map?"

What symbols are used on the various maps?

"What do the cities have in common in terms of infrastructure?"

"What natural features does the land have and how is the city arranged around them?"

"Why are the Twin Cities where they are?"

"How do the cities benefit from the access to water?"

"How will aspects of one community effect another downstream?"

"What if an upstream community built a dam and restricted water flow downstream? How would that impact the other communities?"

"Where does water go after it leaves a toilet?"

"If there was a flood, how would the various communities be affected?"

"How might the land be different if the glaciers hadn't advanced as far south as the Twin Cities."

"What earth-surface processes shaped the land around your city?"

Can you make a city without effecting those downstream?
What changes would you make to your city and how would those changes be beneficial

Wild Card Variations

Introduce a flood through the river channel. Tell the students that everything below a certain contour interval has been flooded. What will they do next?

Have one of the communities plan their city without restraint and without regard for the land around them and compare the differences. Have this be one of the last of the downstream communities.

Have one of the communities build a dam across the river if none decide to do it by themselves. How will this impact the communities downstream.

Resources:

Ojankangas, Richard W., University of Minnesota Press, 1982

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National Science Foundation

Science Content Standards: 5-8

Earth and Space Science

CONTENT STANDARD D:

STRUCTURE OF THE EARTH SYSTEM

- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.
- Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.
- Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.
- Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.
- Living organisms have played many roles in the earth system, including affecting the composition of the atmosphere, producing some types of rocks, and contributing to the weathering of rocks.

EARTH'S HISTORY

- The earth processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth history is also influenced by occasional catastrophes, such as the impact of an asteroid or comet.

Science and Technology

CONTENT STANDARD E:

- Scientific inquiry and technological design have similarities and differences. Scientists propose explanations for questions about

the natural world, and engineers propose solutions relating to human problems, needs, and aspirations. Technological solutions are temporary; technologies exist within nature and so they cannot contravene physical or biological principles; technological solutions have side effects; and technologies cost, carry risks, and provide benefits. Many different people in different cultures have made and continue to make contributions to science and technology.

- Science and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.
- Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Engineers often build in back-up systems to provide safety. Risk is part of living in a highly technological world. Reducing risk often results in new technology.
- Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials, or effects of weather and friction; other constraints limit choices in the design, for example, environmental protection, human safety, and aesthetics.
- Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted, others cannot.

Science in Personal and Social Perspectives

CONTENT STANDARD F:

POPULATIONS, RESOURCES, AND ENVIRONMENTS

- When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.
- Causes of environmental degradation and resource depletion vary from region to region and from country to country.

NATURAL HAZARDS

- Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats,

damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, storms, and even possible impacts of asteroids. Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.

- Natural hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.

RISKS AND BENEFITS

- Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.
- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).
- Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits.
- Important personal and social decisions are made based on perceptions of benefits and risks.

SCIENCE AND TECHNOLOGY IN SOCIETY

- Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental.
- Societal challenges often inspire questions for scientific research, and social priorities often influence research priorities through the availability of funding for research.
- Technology influences society through its products and processes. Technology influences the quality of life and the ways people act

and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

- Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.
- Scientists and engineers work in many different settings, including colleges and universities, businesses and industries, specific research institutes, and government agencies.
- Scientists and engineers have ethical codes requiring that human subjects involved with research be fully informed about risks and benefits associated with the research before the individuals choose to participate. This ethic extends to potential risks to communities and property. In short, prior knowledge and consent are required for research involving human subjects or potential damage to property.
- Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.

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UBPL 101: Student Worksheet

Group Members: (Role)

_____

_____

_____

_____

The city of _____ is hereby chartered on this fine day of _____. You are the select few that will be given the opportunity to build your community from the ground up. You are to make responsible decisions that your citizens will be proud at your community's sesquicentennial 150 years from now. Remember, all decisions are to be deliberate and take into account the land that your city is built on.

Use what you know from looking at maps and begin deciding what your city needs. The more in depth you go into planning and making connections the longer your list will be. Please follow your group roles and make sure you participate.

When you are beginning to plan your city think of a single pen line as a small two land road and your thumbnail as a large building or stadium.

The map above has parks, industry, recreation, houses, roads, bridges, a dam, hospitals, a river lock, and commercial areas all in proximity to a river.

The following is a list of things to get you started.

Government Buildings (Courts, Capitol, City Hall)
Schools (Elementary, Middle, High, Universities)
Power source (Dams, Nuclear, Coal, Wind, Gas, Solar)
Industry (What resources will it need? Ore, Trees, Water)
Roads, Bridges, Rail lines, Bike Lanes
Residential Areas, Commercial Areas
Industrial Areas
Water Treatment Plant
Recreation (Parks, Stadiums, Arts, Malls)
Airport
Fire, Police, Hospitals
Other?

UBPL 101: Student Worksheet

Be prepared to discuss your city from the perspective of the land that it sits on. The focus should not be why you decided to put a mall where you did, although you may want to take this into account, but rather, why your city is where it is based on insights of natural processes. For example, you may have lots of parks along the river to help improve water quality. The vegetation will help prevent erosion and filter pollutants. Are you building in a floodplain? Consider floods, erosion, and other factors and how the human component of the your city will deal with them.

Notes: