

Amazing Grazing



LEVEL: Grades 4-6

SUBJECTS: Social Studies, Nutrition, Environmental Science

SKILLS: Analyzing, applying, comparing similarities and differences, concluding, critical thinking, evaluating, interpreting, mapping, map reading, observing, reading data, synthesizing, reasoning, solving problems, understanding cause and effect

MATERIALS

Newsprint or butcher paper, scrap paper, markers in assorted colors for each group of students, copies of each of the attached **Five Scenarios, Food Production Information** sheets, **Student Questions**, and **Map Samples** for each group.

VOCABULARY

alluvial soils, browsing, cecum, fallow rotation, forbs, forage, frost, frost-free days, grazing, growing season, herbivore, kaolin, legume, rotation, rumen, ruminant animals, silage

RELATED LESSONS

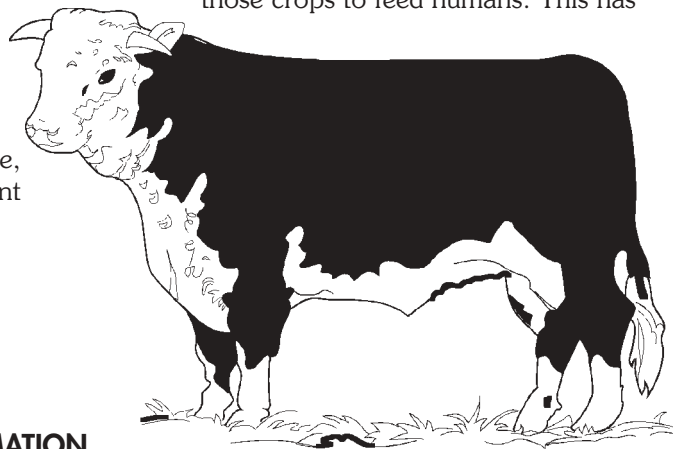
In Harmony
Cows or Condos?
By the Way

SUPPORTING INFORMATION

Basic human needs for food, clothing and shelter are met using products made from natural resources. Some of the natural resources used are renewable; others are non-renewable. The human population is expected to keep increasing rapidly through 2035 before leveling. Using both renewable and non-renewable resources wisely is critical to meeting human needs and sustaining the population. Essential is a comprehensive understanding of each human need and the resource base that is required to meet it. This lesson will focus on the human need for food, on the use of land, and on the availability of water and other

natural resources needed to produce that food. The decisions human populations will need to make in the future about land use are complex. Much of the following supporting information is provided to help develop that understanding.

Upon first examining the issue it would seem that the solution is simple—grow crops on all available land and use those crops to feed humans. This has



been proposed as a feasible option to feed the increasing population. If only it were that simple. According to the Food and Agricultural Organization (FAO) of the United Nations (UN), about half of the world's land surface is suitable only for rangeland and not for growing food crops. Although rangelands are unsuited for cultivation, they have a beneficial use for agriculture and wildlife. Most rangelands could not sustain a yearly crop without a huge expense or significant deterioration of the land. However, rangelands can sustain a grazing population of domesticated livestock to meet human needs,

BRIEF DESCRIPTION

Students learn about the efficient use of renewable resources to meet human need in this lesson. Five small groups of students build a food system to meet their needs, which is based upon the capability of their land resource, climate, topography, and economics. The lesson provides information that directs students to understand why grazing is an environmentally sound option in each scenario.

OBJECTIVES

The students will:

- identify products and by-products of ruminant animals that meet human needs;
- list and describe reasons why grazing can be an efficient and environmentally sound use of land and, in many cases, the only suitable use; and
- make their own land-use decisions.

ESTIMATED TEACHING TIME

Five sessions: 45 minutes each.

if well managed. To understand this issue, one should comprehend human nutritional needs, ruminant animals, animal nutrition, and the characteristics and limitations of rangelands. In addition, ruminants and ruminant-like animals are important to the proper management of other lands under agricultural cultivation. There are misconceptions about the use of lands for producing livestock and the impact of livestock on the environment.

Unlike plants, which can convert sunlight, minerals, gases and energy into food, humans must eat to absorb the nutrients they need to live. The nutrients humans need to consume are proteins, carbohydrates, vitamins, minerals, and a limited amount of fats and oils. We also need water, although it is not technically a nutrient. Protein is the nutrient most critical to sustaining human life. Proteins are made up of amino acids. Complete proteins are balanced in their amino acid composition. Humans need to consume complete proteins with balanced amino acids to build muscle, nerves, organ tissue, etc. Animal proteins are complete proteins. Plant proteins are incomplete, lacking (or low in) one or more amino acids. The amount and types of amino acids vary from plant to plant. Therefore, a balanced combination of foods from plants needs to be consumed to obtain complete proteins. Consuming plant foods in a complementary fashion to balance amino acid requirements is common. Mixing rice and beans or corn and beans are examples.

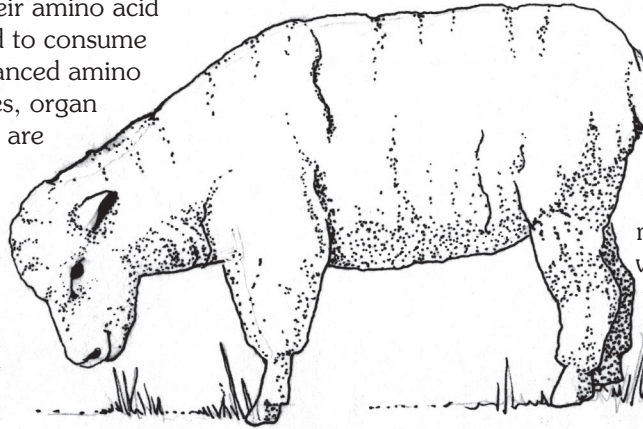
Many herbivores (plant eaters) graze or browse. These grazers are either ruminant animals or ruminant-like animals. Ruminants and ruminant-like animals have complex digestive systems that include a fermentation vat. In these fermentation vats, microorganisms digest plant cellulose. In a ruminant, this fermentation vat is one of four stomach compartments known as the rumen. In ruminant-like animals, this vat is often part of the large intestine known as the cecum (caecum). To simplify and avoid confusion, the term “grazing animals” will be used for both ruminants and ruminant-like animals in this lesson.

These types of digestive systems allow animals such as cattle, deer, rabbits, beavers, guinea pigs, goats, elk, water buffalo, sheep, koala bears, zebras, and giraffes to graze pastures, range and grasslands or browse trees and shrubs. Most importantly, unlike humans, these animals can convert the inedible plant fiber into high

quality protein (meat, milk and fibers) because they can digest plant cellulose. Cellulose is the most abundant component of plants. As such, it is the most abundant organic compound on Earth. Cellulose is the tough, fibrous component that gives a plant’s cell walls their rigidity. Cellulose is very difficult for humans to digest; therefore, humans are not grazers. Ruminants can digest 30 to 80 percent of the cellulose they consume.

Humans and other simple-stomached animals such as pigs, cats, dogs, turkeys, raccoons, bears, robins, eagles and tigers cannot live solely by grazing or browsing. Simple-stomached animals need to consume easily digested and complete plant and animal proteins and/or carbohydrates from meat, milk, seeds, fruits or vegetables.

Scientists observe that grazing and browsing by grazing animals have occurred since dinosaurs roamed the earth.



Many grazing-land plants evolved over thousands of years in cycles of migrating grazing herds. These herds would consume the plant material and move on. This would give the plants a rest period for regrowth. Grasslands also experience periodic fires. These fires would clear away debris and fertilize the soil, perhaps even improving its

pH. Well managed grazing of rangelands, grasslands and pastures, which follows this pattern, is the most sustainable form of agriculture known. This is one reason that grasslands and grazing animals exist across the globe. Also, grazing animals are important to meet the protein needs of an expanding human population.

Rangelands (lands on which the native vegetation is predominantly grasses, grasslike plants, forbs or shrubs and is managed as a natural ecosystem) comprise nearly half the world’s land surfaces. Half of the landmass of the United States also is classified as rangeland by the Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture (USDA). According to the NRCS National Resources Inventory, another 50 million acres are in permanent pastures, which are planted in high quality grass and/or legumes.

In the United States, and many other countries, most of the land grazed by cattle, sheep and goats cannot or should not be used for crop production. In hilly and mountainous areas, the slope of the land is usually too

steep or the soils are too rocky or too shallow, and/or the growing season is too short or too uncertain. In other areas, the soils are sandy (containing little organic matter or ability to hold nutrients and water), temperatures are too extreme, and water is unavailable or too expensive for irrigation to produce crops. In lands unsuitable for crops, grazing animals may keep brush and other plants under control and reduce fuel available for wildfires. Low-lying, wet areas, which may be too wet for growing crops or periodically unavailable for that purpose may be entirely suitable for well-managed grazing. Experts are learning that well-managed grazing is beneficial for both the lands being grazed and the wildlife they support.

Grazing animals also can be important to help prevent soil erosion. Land suitable for crop production is often strip-cropped either on level land or on the contour of a hill. Planting alternate strips of row crops and forages effectively reduces wind and water erosion. This also maintains soil quality by adding organic matter and nutrients to the soil. Then, those forages are fed to grazing animals that convert plant material into products such as meat, milk, leather, and wool. If that option were not available, fewer farmers would be able to keep a portion of their land in these strips of forages to care for the valuable, limited soil resource. Grazing animals may harvest plant stubble after a crop has been harvested. This increases the nutrient value by converting the stubble to manure while producing animal protein.

One of the newest uses for a ruminant animal can be seen in many of our urban areas. Goats are being used as a very effective, relatively low cost method of weed control. Denver's defunct Stapleton Airport is being grazed by a herd of goats on contract. The herd of goats is trucked in, fenced in with portable fencing, and moved to another location when its job is done, perhaps along a bike path, ski trail, highway or park. The goats are very effective weed-control managers. Likewise, a herd of sheep from New Hampshire is grazing on kudzu (a noxious weed) in Florida in the summer.

Grazing animals also consume other food or feed inedible to humans and fiber processing by-products (e.g. cottonseed) that were formerly waste products. Grazing animals convert materials that humans cannot eat (or digest) into high quality protein.

Citrus pulp, sugar beet pulp, cottonseed and brewer grains are a few examples of waste products from the processing of food, fiber or beverages that are fed to ruminants. This benefits humans by producing food, reducing waste sent to landfills, reducing the cost of producing food and fiber, and providing innumerable by-products such as pharmaceuticals, leather, and industrial products.

To meet current and future human needs for protein, the limited land resources that are available need to be well managed. Grazing or the production of forage crops for grazing animals is an environmentally sound option that makes good use of lands not suitable for cultivation. This benefits humans by providing protein for food and fiber for clothing.

Furthermore, the land is often improved in well-managed grazing. Grazing stimulates the spread and growth of a healthy variety of grasses, stabilizes soil, improves wildlife habitat, and controls the spread of wildfires by minimizing large stocks of fuel.

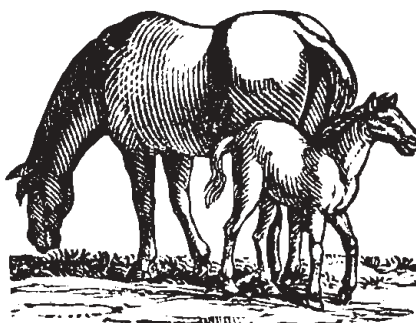
GETTING STARTED

This lesson should follow the lessons "By the Way," and "In Harmony," and can be used in conjunction with the lesson "Less Elbowroom." If "By the Way" has been completed, it will only be necessary to review Session One and Session Two with the students to refresh their memories. Make copies of the **Five Scenarios, Map Samples, Student Questions** page, and **Food Production Information** sheets - one for each cooperative group.

PROCEDURE

SESSION ONE

1. Review with the students (by brainstorming) what qualifies as a human need and how those needs are met. Make and post a listing of those needs or a listing of needs versus wants.
 - A. Ask the students:
 - What are basic human needs? (*food, clothing, shelter, water, living space, air*)
 - What are secondary human needs? (*medicine, communications, sanitation, socialization*)
 - B. Expand this list by identifying exact components of each category and sources of



each. The lessons “From Sea to Shining Sea” and “Lunchtime Favorites” can help.

work, glue, recreation, sport, food in other countries)

- D. Share those elements from the Supporting Information that students need as appropriate.

FOOD

Fruits

- Apples:** New York, Washington, Michigan, California
Oranges: Florida, Texas, California
Strawberries: California, Florida, (many states in summer)

Vegetables

- Potatoes:** Idaho, Washington, Maine
Lettuce: Arizona, California
Tomatoes: Florida, California, Mexico

Meats

- Hamburger (Beef):** Texas, Kansas, Nebraska, Colorado, (almost all states)
Ham (Pork): Iowa, North Carolina, Minnesota, Nebraska, Indiana

BEVERAGES

Tea

- Herbal:** Colorado, Connecticut, (most states)

Green and Black:

- Sri Lanka, Indonesia
California, Wisconsin, New York, Pennsylvania, (most states with water and forages available and close to population centers)
Most countries in the humid tropics

Milk

Cola

Any items listed, which do not have a clear source, could be researched in the library.

2. Ask these questions and post the answers:
- What is a herbivore? (*plant eater*)
Carnivore? (*meat eater*)
Omnivore? (*animal which eats both plants and meat*)
 - Which herbivores graze? Can you as a human graze and live by just grazing? (See Supporting Information.)
 - What products do we get from grazers, which we have domesticated to meet our needs and wants? (Cattle - *hamburger, steak, roasts, leather, gelatin, glue, medicines, milk, dairy products*; Sheep - *lamb, mutton, wool, medicines*; Goats - *meat, wool*; Horses -

SESSION TWO

- The students will now create their own communities and economic structure from the natural resource base they are given. The focus will be to meet their food needs. Divide the class into five groups. Give each group one of the five regional scenarios provided and the **Map Samples** sheet. Ask them to read their scenario out loud to learn their resources. Have each group note which scenario they have by number on their map.

- Review map samples. Have the groups design the basics of their regional map in pencil. Include large items such as location of mountains, lakes, oceans, rivers, hills, cities, towns etc. They need to plan carefully to be accurate.

Example 1: A river needs to flow downhill and flow to something. It could start in a hilly or mountainous area and end in a lake or ocean or another river.

Example 2: A deepwater port could be at the ocean or large lake such as in the Great Lakes.

Example 3: Cities need to have a source of a great deal of water. This could be streams, lakes, rivers, or ocean harbors.

- Next, have the students decide in each group what the food needs of their population are based upon their own preferences.



- What do they need to eat to have a healthy diet with variety?
- What do they want to have as treats and beverages?

Make sure they have fruits, vegetables, meats, dairy products, and grain products on their lists.

- C. Identify where the foods they select originated. Is the cereal made from corn, wheat, rice, barley? Does it have fruit in it?
- D. Divide the group in half. One half should design the food system (i) and the other should finish designing the region (ii).
- i. The United States produces more than 200 crops and raises livestock, fish and fowl in all shapes and sizes for food and the manufacture of clothing. Using the limited examples provided on the regional scenarios, ask the students to design a food system based upon their own preferences, land capability, population needs, economics, and natural resources. Use the list of questions provided to assist in the decision making.

- a. Compare what the food needs of your region are with what it is possible to produce with your resource base. Use the **Question Sheet** to help.

- b. Foods not included, such as rice, can be researched.

- c. Consideration for future generations should be made. Employ soil and water conservation methods.

- Is the soil erodible? How should it be cultivated? Or should it not be cultivated?
- If not cultivated, how can it be used to produce food?
- Do you have adequate water? How can water be conserved? What will it cost to bring in water? What are its

sources? How much water can be obtained?

- d. Create a listing of foods you produce, foods you need, and foods you might have a surplus of depending on your resources.

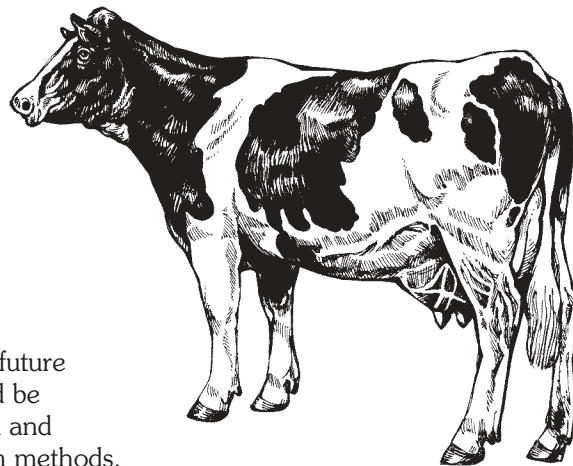
- ii. Have each group finish creating its own pictorial design of its region on newsprint or butcher paper including important topographical areas and a geography suitable to the description provided.

- a. Create a draft before using the large paper to create a final map, and get teacher approval. Each group also needs to consult with those planning the food system to decide how land can or cannot be used.

- b. Each group needs to design its own key. As they make these decisions have them consider these questions:

- Where would cities have been established? What do they need? (*water, transportation, industry, food, resources*)

- From a weather perspective, where does it make sense for rivers to flow or lakes to form? Which side of a mountain range will have little rainfall? (*Water-rich winds coming over a body of water from the west will precipitate out moisture as they rise over the mountains because they become cooler. The winds will be dry as they descend over the eastern face of the mountain because they have precipitated moisture out and they warm as they descend.*)



- c. Make sure you create symbols for the food, put it on the map where it would be grown, and include it in the map key.

SESSIONS THREE AND FOUR

1. Have the students continue to work on their projects until complete.
2. Once the group determines what it can and cannot produce, encourage them to negotiate and trade with other groups to meet their needs.

SESSION FIVE

1. When the mapping and food system is complete, have each group give a report on its region. Identify topographical features and what their region can produce.
 - What food needs to be produced in your region?
 - What food can be produced more efficiently elsewhere, with less impact on the environment?
 - What food can be produced most efficiently, with little impact on the environment in your area?
2. How does your region plan to meet the food needs that cannot be met by regional production? How can you purchase food? What food products can you sell to earn money to purchase others? How will they bargain with each other to exchange commodities to help each region meet their food needs and earn other resources they may need? How will they keep track of the bargains they have made and keep their trade agreements? Who will settle disputes?
3. Are grazing animals important in your region? How or why? If so, what kind of grazing animals are best suited i.e. browsers or grazers, dairy cattle, beef cattle, sheep, goats or horses?
4. Share with students that jointly these five regions can produce 25 percent more food than their populations need, if all land is used appropriately to provide food products. Ask:
 - What foods or beverages can these five regions not produce? (*Coffee, tea, cocoa, bananas, fresh fruits and vegetables if production is affected by the cold of winter or excessive heat of mid-summer*)
 - How can you obtain those commodities?
5. Ask the students to identify which area of the United States their scenario best represents: The Northeast, Southeast, Midwest, Northern Rocky Mountain area, Southwest, or Pacific states?
6. How does having a plentiful agriculture benefit a country's economy? What freedoms does this provide a people that another country does not have because they cannot meet the food needs of their population.



7. Ask each group to justify its decisions to the rest of the class.
 - Have you met the food needs of your population?
 - Are you growing crops or raising animals appropriate for your topography and climate? Have you chosen to raise grazing animals? Why?
 - What decisions have you made to minimize the impact of your food production system on the environment?
 - Does the rest of the class agree with your plan? What other options are there?

EVALUATION OPTIONS

1. Evaluate regional maps designed by students, the practicality of their food production plans, their cooperation in designing both as well as contributions to the project. The following may be used as a guideline:
 - Does the map depict the region as described?
 - Have the students met their food needs by growing and raising food appropriate for their topography, resource base and climate?
 - Do the students have a plan to trade for those items they are unable to produce? Are other groups willing to trade with them?
 - What are their thoughts about obtaining items that cannot be produced in anyone's region?
 - Grazing is a valid option in each scenario. Have the students selected this option? And, can they justify the decision? Are there lands that they have cultivated that would be better kept in grazing?

Scenario 1: Hilly areas in forage production and a strip crop rotation to reduce soil erosion. Dairy cattle would be appropriate on pastures or confined and fed forages from corn and hay fields.

Scenario 2: The short growing season in the north with soils susceptible to wind erosion would benefit from forage production in a strip crop rotation or pastures and hay fields. Dairy cattle or beef cattle would be appropriate.

Scenario 3: Much of the land in Scenario 3 would best be kept in native rangeland or permanent

pastures. Beef cattle and sheep would be a good option.

Scenario 4: This region would benefit from lands kept in native rangeland or permanent pastures where irrigation is not possible. Beef cattle, sheep and goats would be a good option.

Scenario 5: Low lying areas where floods often occur may have no other use than wooded or cleared pasturelands. Both beef and dairy cattle as well as horses would be a good option here. It is probably too warm to raise sheep profitably.

It is possible to raise horses and goats almost anywhere.

2. Ask students to put their decision-making process in writing and explain their decisions.
3. Have the students describe foods and other products from grazing animals.

EXTENSIONS AND VARIATIONS

1. Continue the process with clothing needs, then shelter needs, then wants. Older students may want to consider other types of economic development around the rest of the resource base.
2. Make a class listing of which animals graze, which animals browse (eat trees and shrubs), and those animals which may do both.
3. Explore more about grazing and browsing animals. Have the students select a grazing or browsing animal, wild or domesticated, and research its digestive system and eating patterns.

CREDITS

National Resources Inventory (revised edition). Natural Resources Conservation Service, United States Department of Agriculture. 2001. <http://www.nrcs.usda.gov/NRI/>

World Soil Resources Report. Land and Water Development Division. Food and Agricultural Organization. United Nations. <http://www.fao.org>

ADDITIONAL RESOURCES

American Farmland Trust. National Office, 1200 18th Street, NW, Suite 800, Washington, DC 20036. (202) 331-7300. <http://www.farmland.org>

Caretaker's All. National Cattlemen's Beef Association. Customer Service Department, P O Box 670, Bloomingdale, IL 60108. (800) 368-3138 or fax (800) 368-3136. <http://www.teachfree.com>

Grazing - Facts for Your Files. National Cattlemen's Beef Association. Customer Service Department, P O Box 670, Bloomingdale, IL 60108. (800) 368-3138 or fax (800) 368-3136. <http://www.teachfree.com>

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Madsen, Chris. *Ranching for Nature.* Wild Outdoor World and Rocky Mountain Elk Foundation. Copies available from Wyoming Field Office of The Nature Conservancy, 258 Main Street, Suite 200, Lander, WY 82520. (307) 332-2971. <http://swcs.org>

National Resources Inventory (revised edition). Natural Resources Conservation Service, United States Department of Agriculture. 2001. <http://www.nrcs.usda.gov/NRI/>

Range of Wonders. (Booklet and accompanying Teacher's Guide) Soil and Water Conservation Society. 945 SW Ankeny Road. Ankeny, Iowa 50021. (515) 289-2331.

Things You Can Learn From a Cow and a Worm. National Cattlemen's Beef Association. Customer Service Department, P O Box 670, Bloomingdale, IL 60108. (800) 368-3138 or fax (800) 368-3136. <http://www.teachfree.com>

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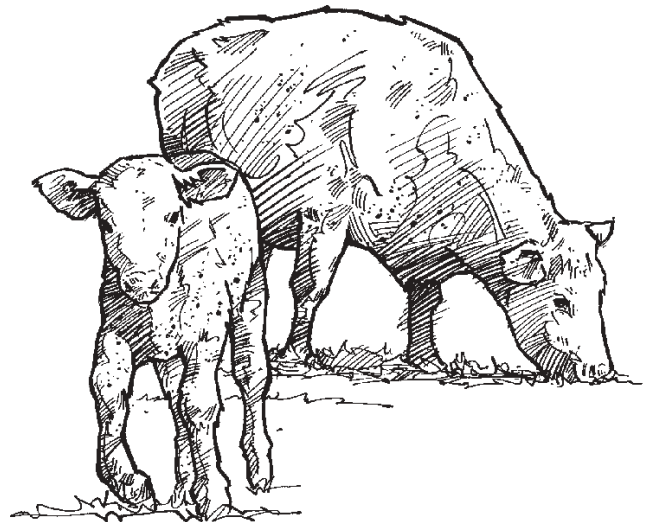
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EDUCATOR'S NOTES



SCENARIO 1

- Cities - Six large urban areas
- Population - 20 million of which 8 million are urban, 8 million are suburban, 3 million live in small towns, and 1 million are rural.
- Climate - Long winters, short growing season anywhere from 60 frost-free days to 120 frost-free days, frequent soft rains or abundant snow in winter. Storms and winds may come from any direction.
- Topography - Small mountains in one area of the region surrounded by extensive rolling hills.
 - Three large rivers surrounded by flat floodplains
 - Three deepwater ports (at least one ocean and one lake port)
 - Numerous other lakes and many ponds
- Soils - Fair to poor in mountains (these soils are highly erodible, thin and rocky).
 - Good to fair in hills (these soils are erodible on steep hills).
 - Excellent to good in valleys and ancient floodplains
 - Deep, excellent soils occur in the broad floodplains of the rivers
- Mining - Some coal deposits in mountains
 - Gravel, limestone and sand deposits in hilly areas
 - Iron ore deposits in mountains
 - Granite and marble

SCENARIO 2

- Cities - Three large urban areas scattered through region
- Population - 15 million of which 6 million are urban, 6 million are suburban, 3 million live in very small towns and rural areas
- Climate - Northern portion has long winters with short growing season and 60 frost-free days.
 - Southern portion has winters slightly shorter and a longer growing season of up to 150 days.
 - Eastern half of region is water rich.
 - Western half of this region may experience frequent summer droughts and require seasonal irrigation to produce crops.
 - Winds are from the west throughout the year.
- Topography - One large lake, three small lakes/large ponds
 - One large river, three small rivers
 - Relatively flat lands, but one border has mountains
- Soils - Good to excellent throughout with a very deep soil base, except for the mountains.
 - Half of the soils are susceptible to wind erosion when dry, if not covered by plants.
- Mining - Coal and clay deposits
 - Gems and precious metals in mountains

SCENARIO 3

- Cities - Two cities, four towns
- Population - 5 million and growing of which 3 million are urban, 1.5 million are suburban or in large towns and 500,000 are rural.
- Climate
 - Extreme temperatures most of the year throughout the region.
 - In the northern part of the region there are two months of warmer weather in the summer, but an uncertain growing season due to unexpected frosts, which can occur anytime.
 - Low rainfall, most precipitation comes in the form of winter snows.
 - 100 days frost free in southern hills and some valleys (this is less than one fourth of the region).
- Topography
 - Very high mountains in much of the region (80 percent), the rest is hilly.
 - Two rivers, one lake
- Soils
 - Poor, shallow soils, except in some mountain valleys.
- Mining
 - In mountainous areas, silver and gold deposits, semi-precious gems, coal deposits.

This region is experiencing growth due to winter ski areas, summer mountain biking, tourism and summer retirement homes.

SCENARIO 4

- Cities - Two large sprawling cities, with even larger suburbs.
- Population - 8 million of which 3 million are urban, 4 million are suburban, 900,000 live in small towns, and 100,000 are rural.
- Climate
 - Much of the region is in desert-like or desert areas.
 - Some mountains (20 percent with high valley areas between mountains).
 - Very low rainfall, most of which comes in the form of rapid, heavy cloudbursts except in the mountain areas which receive limited precipitation in the form of snows.
 - The growing season varies; 100 days in the highest mountains; and 280 days above freezing in other areas.
- Topography
 - Two rivers which run intermittently, but are dry at least four months of the year.
 - One lake in mountains, with an intermittent river that runs at least three to four months of the year.
- Soils
 - Two-thirds are very poor to fair, most fairly shallow and easily eroded.
 - One-third is excellent, deep alluvial soils, very productive, if irrigation is available.
- Mining
 - Precious and rare metals, uranium deposits

This is a growth area due to high tech industries and winter retirement homes.

SCENARIO 5

- Cities - Seven large cities with large suburbs.
- Populations - 30 million of which 10 million are urban, 15 million are suburban, 4 million are in towns and 1 million rural.
- Climate
 - Relatively warm throughout the year.
 - The northern half of this region has at least 280 frost-free days.
 - The central quarter has 280 to 300 frost free days, some years there is no frost, but usually at least two months of the year killing frosts can occur.
 - The southern quarter of the region has a yearlong growing season with a freeze every 50 to 100 years.
 - Rainfall is frequent and plentiful, occasionally large storms drop excessive amount of rain, which cause flooding in low-lying areas and severe wind damage.
 - Heavy thunderstorms, lightning, tornados and high winds are frequent.
- Topography
 - Half of the region is hilly, with a few mountains at the center of this area.
 - Five rivers
 - Many lakes and ponds
 - Many wetland areas or seasonally wet areas
 - Much oceanfront
 - Three deepwater ports
- Soils
 - The soils in this region are mixed.
 - Half of the soils are excellent sandy loam mixtures that drain well.
 - An eighth are very heavy clays found in and around lakes and river bottoms, very prone to flooding during heavy rains. (Some of these clays are used for pottery and kaolin mining can be found here as well.)
 - An eighth are muck soils found in low-lying areas, which were once swamps or still may be. (These are very productive, if drained and well managed.)
 - One-quarter of the soils may best be described as sand. (These are found surrounding ocean frontage areas in very wide bands. Not very productive for agriculture they are also highly erodible from both wind erosion and water erosion and should be kept covered.)
- Mining
 - Phosphate fertilizers
 - Potassium and other mineral deposits
 - Limestone and sand deposits

Food Production Information

GRAIN CROPS

Corn

Products

- Dent Corn - livestock feed, corn oil, corn starch, corn sweetener, corn flour (tacos, cornflakes, tortilla chips, etc.),
 - industrial products, adhesives, plastics
- Sweet Corn - corn on the cob, canned corn, frozen corn

Requirements

- Good to excellent soils
- Minimum 90 frost-free days
- Longer growing seasons increase yields dramatically.
- Can be grown in hilly terrain, if planted in contour strips with a rotation of other crops, including a hay or hay silage crop
- Can be grown in soils susceptible to wind erosion, if planted in strips perpendicular to prevailing winds, with a rotation of other crops including a hay or hay silage crop
- Adequate water needs to be available throughout growing season, but is particularly crucial during pollination and may require irrigation.
- No-till planting reduces erosion

Soybeans

Products

- Livestock feed, soybean oil, tofu, vitamins, industrial products

Requirements

- Good to excellent soils
- Minimum of 100 frost-free days
- Longer growing seasons increase yields dramatically
- Other growing requirements similar to corn
- No-till planting reduces erosion

Wheat

Products

- Flour for breads, pasta, pastries, bakery products
- Industrial products

Requirements

- Good to excellent soils
- Minimum growing season varies with winter or spring wheat
- Can be grown in hilly terrain, if planted on contour, may or may not be included in a strip crop or crop rotation depending upon soils, rainfall, etc.
- Can be grown in soils susceptible to wind erosion, if strip planted perpendicular to prevailing winds, with a rotation of other crops including a cover crop.
- Requires less water than corn, soybeans or vegetables. In water-poor areas wheat may be planted in a fallow rotation to allow soils to absorb water for two years and produce a crop the third year.

FORAGES

Corn

Products

- Corn silage (The whole corn plant above the roots is harvested, chopped up and fermented in an airtight container for livestock feed.)

Requirements

- Good soils
- Minimum 60 frost-free days, longer growing seasons increase yields dramatically.
- Can be grown in hilly terrain, if planted in contour strips with a rotation of other crops including a hay or hay silage crop.
- Can be grown in soils susceptible to wind erosion, if planted in strips perpendicular to prevailing winds with a hay or cover crop in alternating strips.
- Adequate water needs to be available throughout the growing season, but is particularly crucial during pollination and may require irrigation.
- No-till planting reduces erosion.

Grasses

Products

- Pasture, range, hay, hay silage, pelleted hay

Requirements

- Poor to excellent soils
- Grasses can grow in the best and worst of conditions. (Can withstand very low rainfall, very long, cold winters, hot dry summers, steep slopes and poor, thin soils, all the way to the other extreme of very high rainfall, hot humid conditions, in deep excellent soils.)
- Yields are dependent upon these factors, harsh conditions result in poor yields and visa versa. (Grasses also can be grain crops: corn, wheat, oats, rice, etc., but these need better soils to yield a crop that is economically viable.)

Legumes

Alfalfa, clovers, trefoil (Legumes can also be vegetable crops: beans and peas.)

Products

- Hay, hay silage, pelleted hay, pasture

Requirements

 Vary with each type, but in general:

- Fair to excellent soils
- Legumes are less hardy than grasses and cannot survive the extreme conditions that grasses can.
- Water needs to be adequate, but either drought or flooding conditions may kill plants.
- Temperatures are an influence, extreme frigid conditions or heat can reduce crop success or lead to failure.

FRUITS AND VEGETABLES

Vegetables

Products

- All types of fresh vegetable
- Processing products
- Convenience foods, french fries, pizza sauce, pickles, ketchup, flavoring, snack foods, salsa, canned and frozen vegetables, juices

Requirements

- Good to excellent soils, which are relatively level
- Plentiful water for both production and processing
- Minimum of 70 to 120 frost-free days
- Either close to markets or excellent transportation for fresh vegetables
- Labor intensive, particularly during planting and harvest (see some seed catalogs for individual crop information).

Fruits

Small fruits, vine fruits, tree fruits

Products

- All types of fresh fruits
- Processing products
- Desserts, sauces, jams and jellies, flavorings, beverages

Requirements

 Fruits have diverse needs, but in general:

- Good to excellent soils
- Plentiful water for production and processing
- Climates without extremes of either excessively cold or hot
- Labor intensive during harvest

Specifically

- Tree fruits and grapes are grown on gentle slopes.
- Many tree and vine fruits need a chilling period to initiate fruit set (apples, peaches, cherries, grapes, raspberries).
- The plants of tropical fruits cannot withstand freezing temperatures, but can withstand significantly higher temperatures, if adequate water is available.
- Grapes may be grown in areas where there are inadequate water supplies for any other type of fruit or vegetable production or where irrigation is not economically or environmentally sound.

ANIMALS

Beef Cattle Primary Product

- Beef, steak, hamburger, stew meat, hotdogs

Secondary Products

- Leather, gelatins, marshmallows, glues, soaps, industrial products, pharmaceuticals, machine oils

Requirements

- Range or pasture
- Grass and legumes, pelleted hay, corn, hay silage
- Grains as supplements
- Adequate water
- Can withstand temperature extremes

Dairy

Primary Products

- Fluid milk
- Processing of milk yields cheeses, butter, ice cream, yogurt, etc.

Secondary Products

- Beef, leather, gelatins, marshmallows, glues, soaps, industrial products, pharmaceuticals, machine oils

Requirements

- Large amounts of water
- Pasture, hay, silages
- Grains
- Can utilize some food processing by-products
- Milk can be transported limited distances in its raw state; however, it needs relatively close processing and a nearby large market population in its fluid state.
- In its cultured and processed state, milk may be distributed over a wide geographic distance.

Hogs

Primary Products

- Pork, bacon, ham and sausage

Secondary Products

- Medicines, leather, industrial products, soaps

Requirements

- Plentiful supply of grains
- Plentiful supply of water for drinking and cooling
- Waste management is an issue; if raised in large numbers, make sure buildings are well away from streams, rivers, and lakes or a buffer zone is in place.

ANIMALS (Continued)

Poultry

Primary Products

- Eggs, chicken, turkey

Secondary Products

- Mayonnaise and vaccines (eggs), down (chickens and turkeys), chicken feet for export

Requirements

- Plentiful supply of grains
- Plentiful supply of water
- Waste management is an issue; if raised in large numbers, make sure buildings are well away from streams, rivers and lakes or a buffer zone is in place.
- Chickens have a difficult time maintaining their body temperature in extremes of hot or cold; they need heat to be maintained in the winter if raised in cold climates and cooled in summer, if raised in hot climates. (This is usually done by ventilation not air conditioning or heating and uses a great deal of energy.)
- Protection from predators and parasites is critical.

STUDENT QUESTIONS FOR DETERMINING FOOD PRODUCTION

Directions: Use these questions to help you determine whether or not your region can produce the food of your choice. One student should ask these questions. Select a food from the list your group made. If the answer is no to any question, you cannot produce this product in your region or may not produce enough for your total population.

- I.** What is this food made from, crop or animal? (If it is a plant, go to the plant list; if it is an animal, go to the animal list. If you don't know, find out for homework and move on to the next item for now.)

A. Plants

1. What soil type does it need?
2. Does your region have any of this soil type? How much? Where?
3. What type of growing season does this crop need?
4. Does your region have the growing season needed? How much of the region? Where?
5. Can this crop withstand frosts?
6. If the crop can withstand frosts, can it withstand a hard freeze?
7. How much water does this crop need?
8. Does your region have enough water to meet its needs? Does it rain frequently? Is the rain soft and gentle?
9. Is irrigation possible in your region? What access to water is there? Is the water good for irrigation?
10. If you can grow this crop, can it be produced throughout the whole region? Will you need to choose between producing this crop and another due to limitations? Which one will you choose?
11. Do you need to be concerned about soil erosion in your region? How will this limit what and how much you produce? What will you do to protect the environment?

B. Animals

1. What type of feed does this animal need?
2. Can your region produce any of this type of feed? How much? Where? (Go through the plant list of questions for each feed needed.)
3. What type of temperature or climate does this animal need? Does this cause limitations for your region?
4. How much water does this animal need? Is water available yearlong? What access to water is there?
5. Is there an animal that is similar, but has lower water requirements?
6. Can this animal withstand temperature extremes? Does this match with your region?
7. Are there any limitations such as a ready market? Can it be transported a long distance for processing or sale? Do you have a large population as consumers?
8. If you can raise this animal, can it be produced throughout the whole region? Will you need to choose between producing this animal and another due to limitations? Which one will you choose?
9. Do you need to be concerned about soil erosion in your region? How will this limit what and how much you produce? What will you do to protect the environment?
10. To have fresh milk, every region needs to produce it relatively close to the consumer. Can you produce milk in your region? Have you set aside the needed land to grow the crops dairy cattle need? Have you set aside the water needed for those cattle?

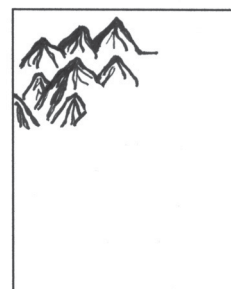
- II.** Which foods can your region not produce and/or which foods should be produced elsewhere?

MAP SAMPLES

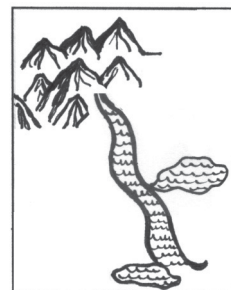
- Using this paper, draw a map of your region using the descriptions provided. Make the first drawing in pencil so that corrections are easily made.



- In the northern part of your region there are mountains.



- There is a river and two small lakes in your region.



- Near the smaller lake there is a city.



- Half of the group needs to make a map key for the food that can be grown in your area.

MAP KEY

<p>Corn </p> <p>Milk and Dairy Products </p>	<p>Wheat </p> <p>Beef </p> <p>Apples </p>
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