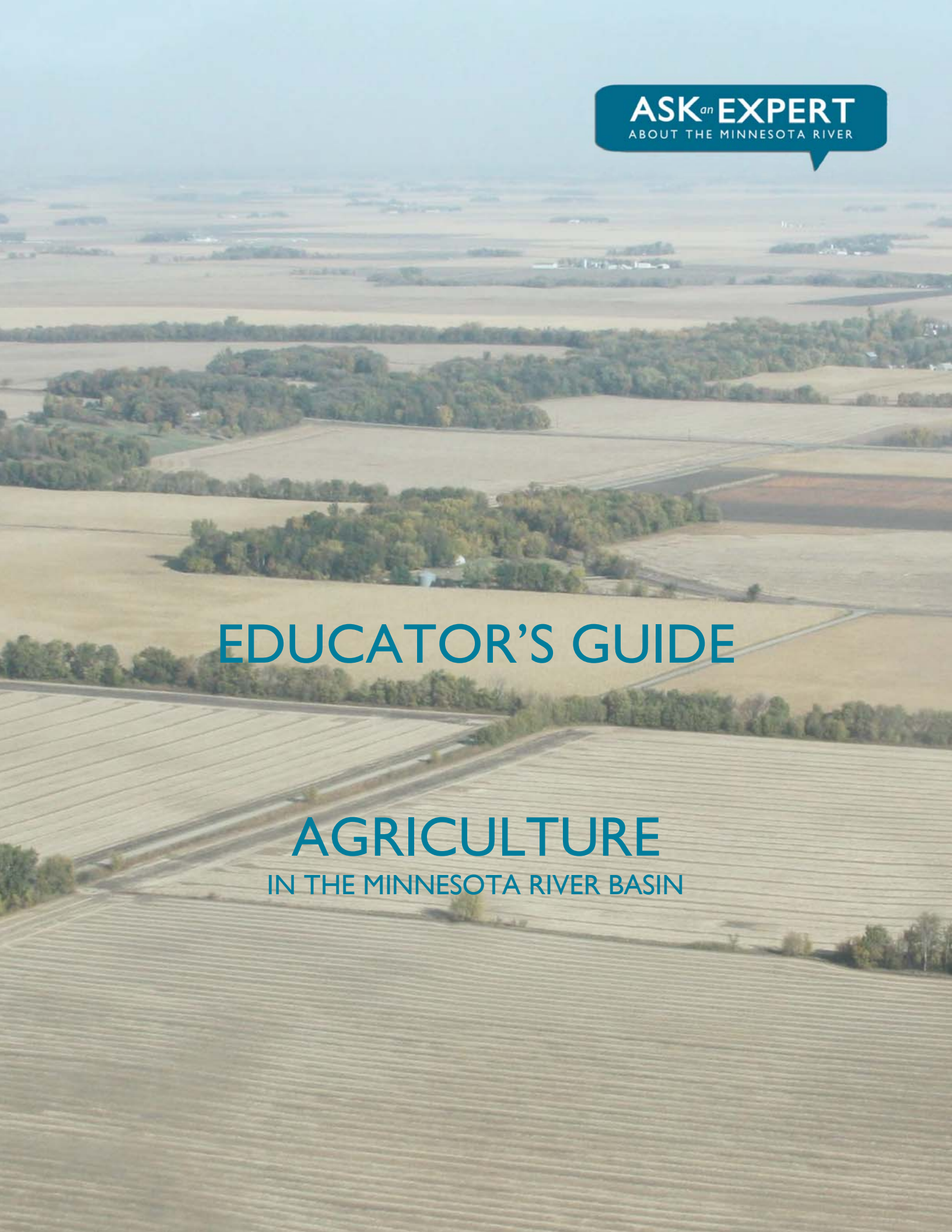

ASK an EXPERT
ABOUT THE MINNESOTA RIVER

EDUCATOR'S GUIDE

AGRICULTURE

IN THE MINNESOTA RIVER BASIN

TABLE OF CONTENTS

Ask an Expert: About the Mussel River is produced by the Water Resources Center (WRC) at Minnesota State University, Mankato. Created in 1987, the WRC serves as a regional center for environmental research and information exchange.

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Thanks to David Bergeson, Carmen Fernholz, Bruce Tiffany, and Tom Kalahar.

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ASK AN EXPERT INTRODUCTION

Ask an Expert: About the Minnesota River is an on-line field trip featuring scientists and experts answering questions on the health of the Minnesota River Basin. The intent behind this web-based program is to bring experts into the classroom through a series of videos designed to answer questions related to the Minnesota River and this Educator's Guide. A dramatically altered landscape has impacted the rivers and lakes of the Minnesota River Basin whether for recreation use, drinking water or the health of aquatic organisms. Today, the Minnesota River contributes a significant level of pollutants including sediment and nutrients downstream to the Mississippi River, Lake Pepin, and the Gulf of Mexico.

Water quality can be a complicated and confusing issue for students and the general public. *Ask an Expert: About the Minnesota River* strives to bridge that gap by focusing on a set of themes telling the story of how a dramatically changed landscape here in the Minnesota River Basin has resulted in water pollution problems.

The story of the Minnesota River Basin is one of sorrow, hope, and great patience. *Ask an Expert* uses videos, fact sheets, educational modules, and more to help clarify what is happening to this state and national significant resource. Experts answer questions on a diverse array of issues organized by 20 major themes.

> **Landscape History** recalls how glaciers formed the basin and the Dakota lived on a vast prairie-wetland landscape dotted by shallow lakes and "big woods."
>
> **Landscape Today** is dominated by agricultural production primarily growing corn and soybeans intermixed with urban areas.
>
> **Water Quality** is a term used to measure the level of pollutants (sediment, nutrients, bacteria, etc.) in our rivers and lakes.
>
> **Bio indicators** like fish, mussels, macroinvertebrates, etc.) shed light on the current health of the system and how much it has been impacted by water pollution and landscape change.
>
> **Making A Difference** explores efforts by government agencies and citizens to improve water quality in our rivers and lakes.

Ultimately, *Ask an Expert: About the Minnesota River* highlights the dedicated scientists and citizens working hard to better understand human impacts on the river system and how all of us can make a difference today and for future generations.

For more information on *Ask an Expert: About the Minnesota River*, go to http://mrbdc.mnsu.edu/learn

ASK AN EXPERT THEMES

Ask an Expert: About the Minnesota River captures scientists and citizens in the field answering questions about the health of the Minnesota River. This online field trip incorporates video of the experts answering questions related to a particular theme. Images, graphics, charts, and maps along with fact sheets, field guides, power point presentations, 360 panoramas, and website will be used along with the videos to tell this story.

For more information on *Ask an Expert: About the Minnesota River*, go to http://mrbdc.mnsu.edu/learn

Landscape History

- Geology
- Prairie
- Wetlands

Landscape Today

- Agriculture

Water Quality

- Monitoring
- Impaired Waters
- Sediment
- Nitrogen
- Phosphorus
- Downstream Impacts
- Hydrology

Bio Indicators

- Fish
- Mussels
- Macroinvertebrates

Making a Difference

- Pollution Problems
- Clean up Solutions
- Case Studies

EDUCATOR'S GUIDE OVERVIEW

This educator's guide is designed to directly link high school students with scientist and citizen experts studying what is happening on the health of the Minnesota River Basin through lesson plans, videos, and fact sheets by concentrating on these goals:

- What happens on the landscape has a direct impact on the rivers and lakes including water quality and the living resources.
- These impacts are being studied by scientists and citizens throughout the Minnesota River Basin to identify how it affects the resource and what can be done to improve it.
- Conservation efforts are being implemented on both a small and large scale to improve, protect and restore our rivers and lakes. This will benefit the living resources and the public's ability to effectively address the consequences of how we manage the landscape.

How to Use the Educator's Guide

The goal of *Ask an Expert: About the Minnesota River* is to increase the public awareness about the health of the Minnesota River through video interviews of scientists and citizens working in the field. These experts answer questions related to their particular topic of study in an engaging manner that brings the students and public right into this world of scientific research. This Educator's Guide provides a step by step process of navigating through a particular theme involving videos, lesson plans, fact sheets/field guides, and much more.

I. Project Overview highlights each of the different themes selected to tell the story of the Minnesota River Basin through the eyes of our experts.

II. Theme Orientation will help guide the teacher and students in their use of the educator's guide and what each of the products offers for the classroom.

- Video Overview
- Key Terms
- Discussion Questions
- Fact Sheets and Field Guides

III. Lesson Plans are designed to give students a chance to learn about the particular theme through specific questions and hands-on activities.

IV. Additional Resources will allow students to conduct additional research on the various themes through websites, books, reports and more.

VIDEO SEGMENTS

AGRICULTURE VIDEOS

What are the greatest farming challenges in the Minnesota River Basin? (03:01 minutes)

What types of crops are grown in the Minnesota River Basin? (02:47 minutes)

What are the benefits of conservation tillage? (04:04 minutes)

What are the benefits of conservation practices? (03:08 minutes)

How is nutrient management handled in the Minnesota River Basin? (03:00 minutes)

What is the size of a typical farm operation in the Minnesota River Basin? (01:30 minutes)

What are the major costs for farming in the Minnesota River Basin? (06:19 minutes)

What is a typical farming cycle? (03:39 minutes)

What is the story of corn in the Minnesota River Basin? (02:50 minutes)

How has corn yield changed in the Minnesota River Basin? (03:10 minutes)

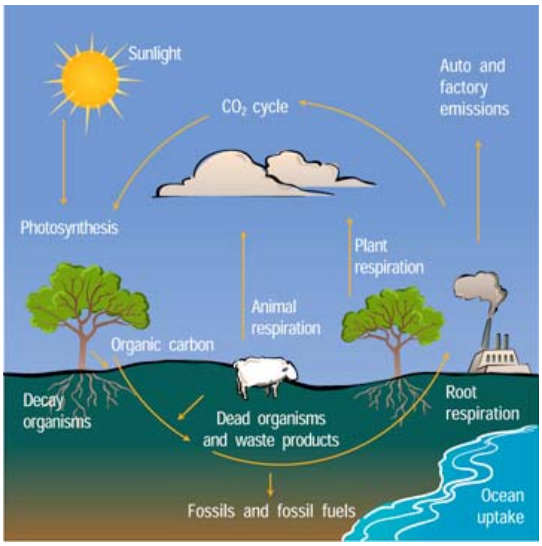
What are the greatest farming rewards in the Minnesota River Basin? (02:04 minutes)

KEY TERMS

Acre: a measure of land equal to an area a team of oxen could plow in one day-660 x 66 feet, 160 square rods; about the size of a football field.

Bushel: a volume of measurement of 1.25 cubic feet.

Carbon Cycle: the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth. It is one of the most important cycles of the Earth and allows for carbon to be recycled and reused throughout the biosphere and all of its organisms.



Cellulose: a carbohydrate; it's the chief constituent of the cell walls of plants and algae.

Combine: a machine that cuts the standing crop, threshes and separates seed from other plant tissue while moving across the field. Combine types include those pulled by a tractor and those that are self-propelled.

Crop Rotation: the sequence of crops over a period of consecutive years on the same land.

Disk Injection: Farmers use disks attached to tractors to inject manure in rows into their cropland for nutrient purposes.

Ethanol: It's an alcohol-based fuel made by fermenting and distilling starch crops such as corn.

Glaciation: Glaciers once covered the majority of Minnesota. When they retreated they left scars on the landscape that created many of the rivers, streams and lakes today.

Impaired Waters: A water body is considered impaired if the water quality in the stream or lake does not allow it to meet its designated use (such as swimming, fishing or monitoring).

Land Application: Applying animal manure to the surface of cropland instead of injecting the manure.

Photosynthesis: chemical process of converting light energy to chemical energy by storing it in the bonds of sugar. This process occurs in plants.

Run-off: When farm/crop fields have too much water and the soil is saturated, the excess water will run off into the nearest stream, ditch or surface water; often times carrying sediment and chemicals with it.

Sediment: Excess sediment that is saturated with water gets carried away with run-off into the nearest stream, ditch or surface water.

Sub-Drainage/Tile Drainage: agricultural practice that removes excess water from soil. To remove excess water, tile is installed under the ground so excess water can drain effectively off of the farm fields.

Switchgrass: dominant species of tall prairie grass. Warm season grass with purple stigmas at flowering time.

http://www.wildflower.org

Surface Drainage (ditches): commonly used surface drainage systems include shallow ditches, open channels and sloped banks. When excess water accumulates on crop fields, farmers dig ditches in order to drain the excess water from their crops.

TMDL: Total Maximum Daily Load; part of the Clean Water Act, states are required to develop lists of impaired waters. TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.

The terms in this glossary are adopted from the Minnesota Department of Agriculture website http://www.mda.state.mn.us and the University of Minnesota Extension program http://www.extension.umn.edu.

LESSON I: HISTORY OF AGRICULTURE IN THE MINNESOTA RIVER BASIN

Lesson Objective

Upon completion of this lesson, students will understand:

- Agricultural trends in the early 19th century and how they compare to modern trends
- How to interpret newspaper articles and analyze their material
- How these agricultural trends have affected farming in the Minnesota River Basin

Abstract

This lesson plan uses old and recent newspaper articles to compare/contrast agricultural and farming trends in the Minnesota River Basin. This plan can be used for a large class or individual study. Appended at the end of the procedure is a copy of the activity sheet AND Venn diagram to be used for this lesson.

Materials

Group folder for each group (4 folders)

Resources

For more information on Minnesota corn and other articles like the ones below please visit Minnesota Corn Media; this is a media webpage that includes links to Minnesota corn, soybean and farmer news. For archived *Minneapolis Morning Tribune* articles visit http://search.proquest.com/hnpminneapolistribune/advanced?accountid=12259. ProQuest is a historical database that includes archived articles for digitized newspapers. This site in particular is features digitized *Minneapolis Morning Tribune* articles.

Historic Newspapers; Minneapolis Morning Tribune (1867-1922):

- Editorial Article 6 Feb. 18, 1882
- This article is a critical review of the Minneapolis Tribune and what they have currently been writing about the farmers in Southern Minnesota. Based on the opinions of the reviewer have students take a critical look at the Minneapolis Tribune…are their sources credible? Are they a credible source? Are they biased, in which way (towards consumer, farmer, government, etc.).
- Minnesota Crop Report Aug 23, 1899 (Have the students scroll halfway down to where it says "Southern Section" and begin reading there.
- Big Crop in Southern Minnesota August 3, 1912
- Southern Minnesota Crops Promising July 8, 1914

Present Day Articles:

- Crop Input Prices to Surge in 2012 Oct. 18, 2011

- Southern Minnesota Farmers to Participate in Nutrient Management Initiative April 2011
- Oil is the Alternative to Ethanol
- Conservation on the Farm: A Way of Life December 28, 2011

Procedure

1. Separate the class into four groups.
2. Distribute to each group their own folder of resources, two articles and worksheets (folder can be found on the website). Make sure each group has at least 2 members (ideally 4).
3. Have two people in each group read the old article and distribute a worksheet to the pair. Have the other two people in the group read the new article and distribute a worksheet to them as well.
4. While they are reading, encourage them to look over their resources that are included in the folder. Help them understand the charts, and graphs if needed.
5. Once each pair has finished reading their article, have the 4 members meet to discuss each other's article and go over the worksheet. Encourage them to see the differences in each article. Do they have questions for each other?
6. Convene whole class. Have the students discuss the similarities and differences between the two articles their group discussed. Also discuss the resources. Make sure they understand that farming 100 years ago consisted of wheat as the main crop. Whereas today, the Basin is primarily corn and soybeans. Discuss this difference. Do they have any suggestions as to why crops have changed in southern Minnesota?

Follow-Up

Extra: for further evaluation have the students each write a one page paper discussing more thoroughly the activity sheet questions. You can also add other questions you think are important for students to understand. You could also have the students write a discussion paper of their own opinions pertaining to the article, the authors, trends, etc.

- Encourage students to do some extra research on the time period that their past article was written in: was there a famine, war, any national events that were happening at this time?
- Note: if you feel that these articles do not suffice for your class please feel free to substitute other articles found on the ProQuest database or other archived newspapers.

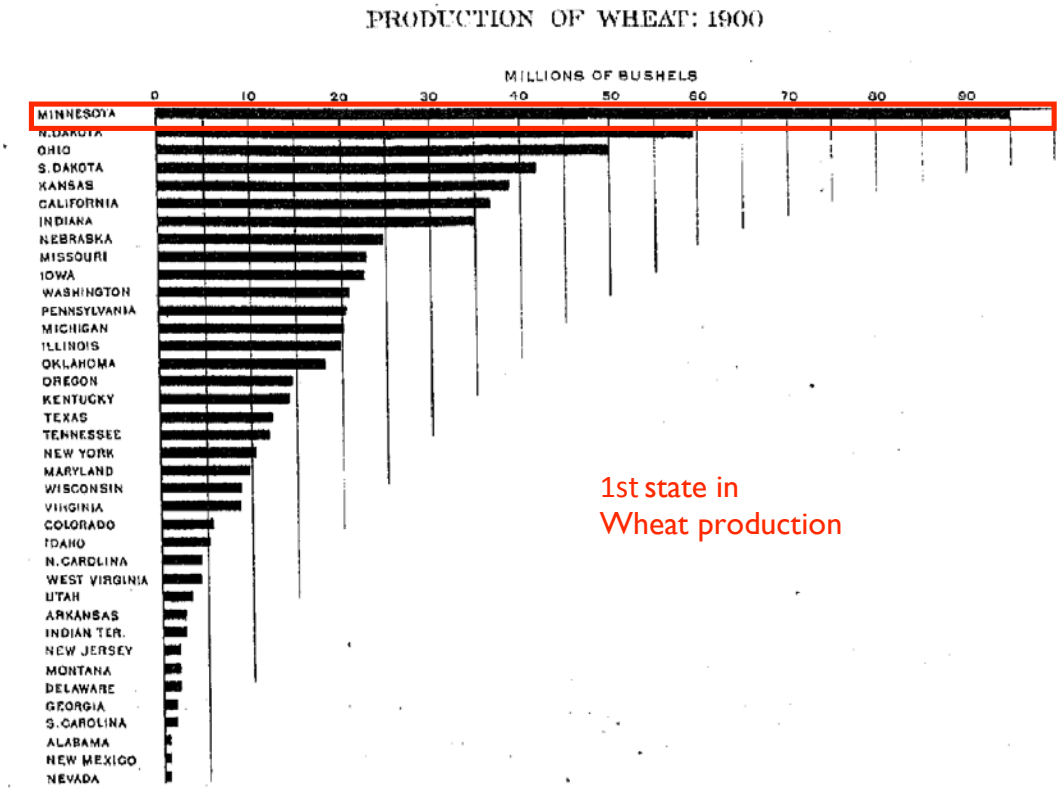
State Standards for 9th- 12th grade

- Social Studies
    - 9.1.1.1.3 Evaluate sources of information and various forms of political persuasion for validity, accuracy, ideology, emotional appeals, bias and prejudice.
    - 9.3.1.1.1 People use geographic representations and geospatial technologies to acquire, process and report information within a spatial context.

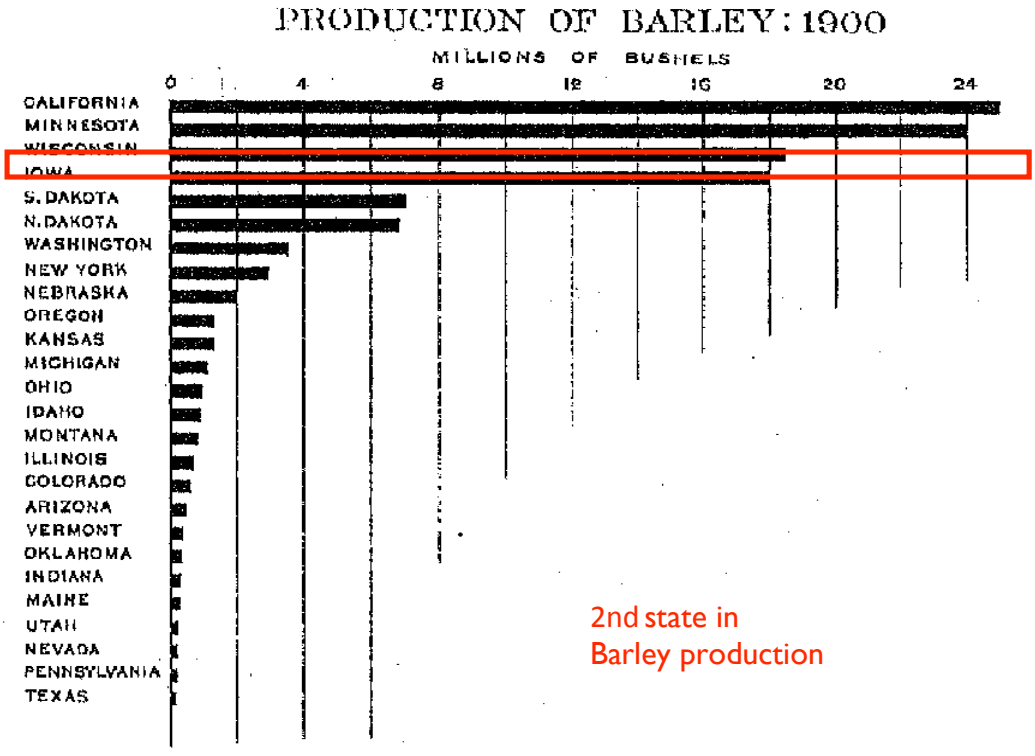
Performance expectations

1. Systematically employ processes of critical historical inquiry to reconstruct and reinterpret the past, such as using a variety of sources and checking their credibility, validating and weighing evidence for claims, and searching for causality;
2. Investigate, interpret and analyze multiple historical and contemporary viewpoints within and across cultures related to important events, recurring dilemmas and persistent issues while employing empathy, skepticism and critical judgments.

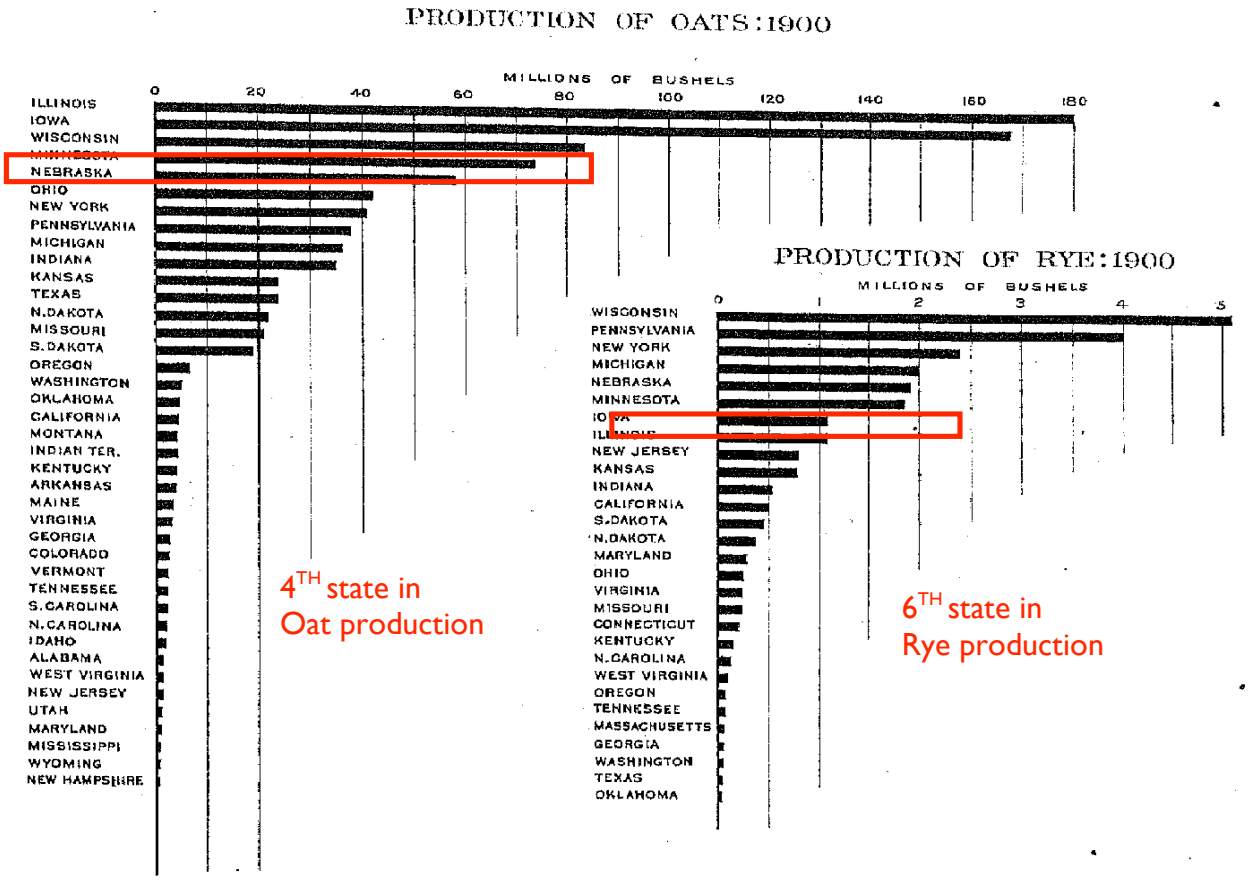
Lesson 1 Agricultural Trends Graphs.



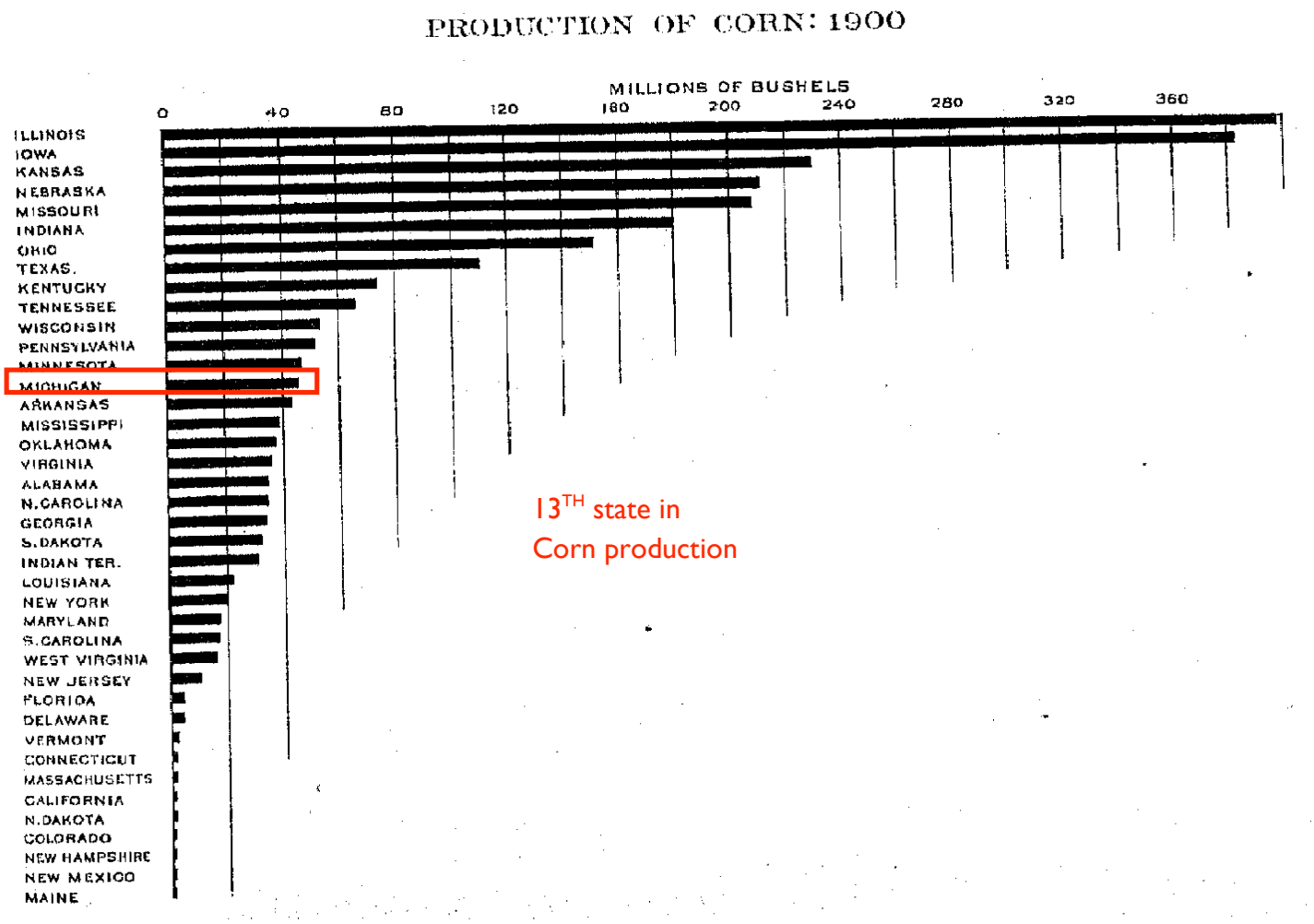
1st state in
Wheat production



2nd state in
Barley production

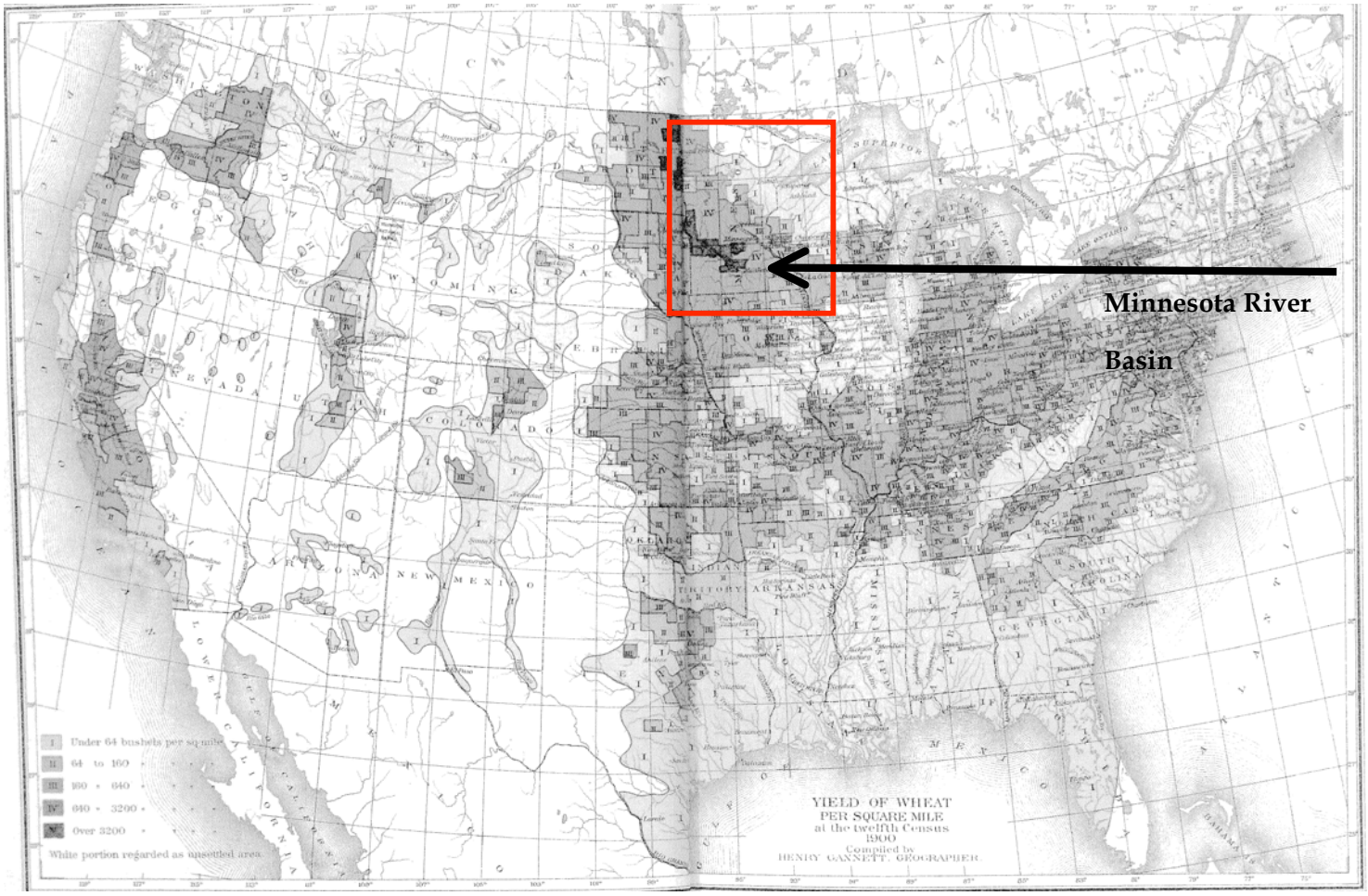


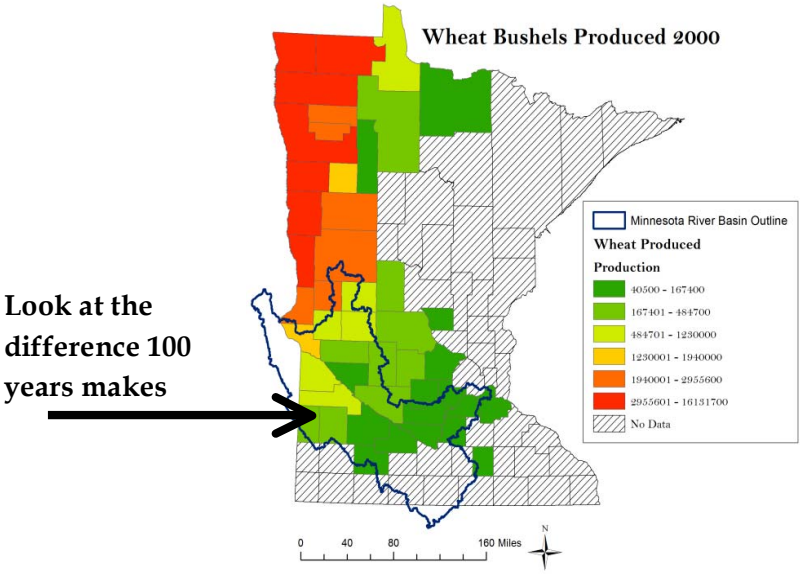
http://www.agcensus.usda.gov/Publications/Historical_Publications/1900/1900_Crops_Irrigation/33398096v6p2.pdf



13TH state in
Corn production

1900 Wheat yield





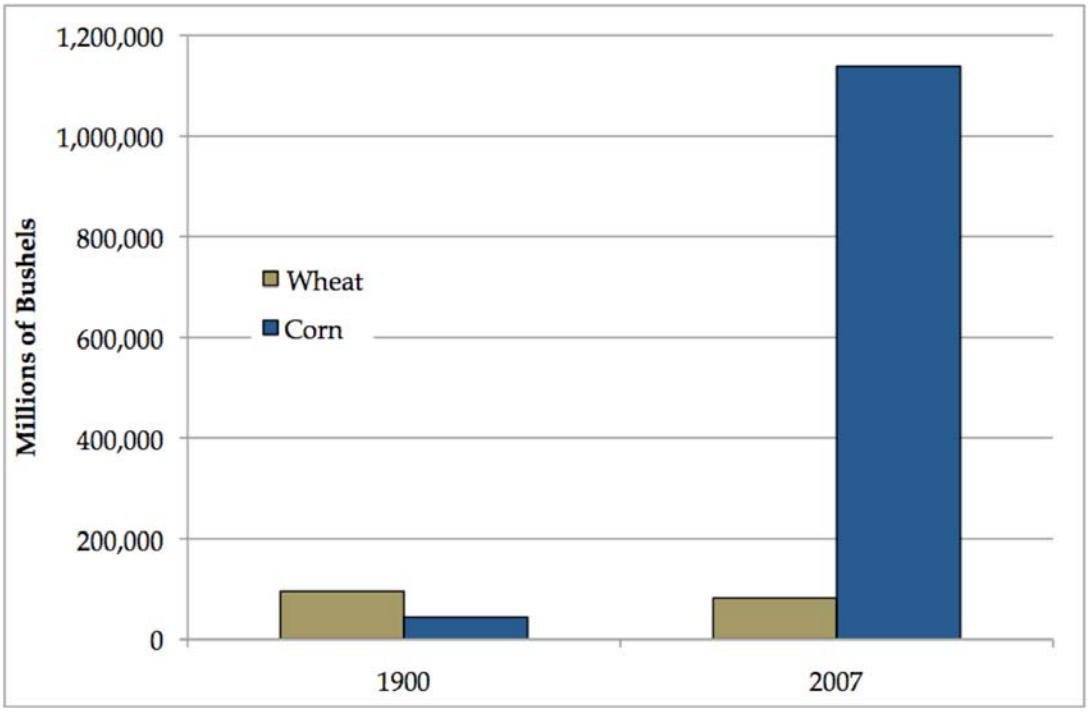
Look at the difference 100 years makes

Crop	1900 Ag Statistics	2007 Ag Statistics	% Change
Oats for Grain	72,000,000 Bushels	10,494,120 Bushels	85.4% Decrease
Barley for Grain	24,000,000 Bushels	5,800,659 Bushels	76% Decrease
Wheat Production	95,000,000 Bushels	82,488,109 Bushels	13.7% Decrease
Corn Production	44,000,000 Bushels	1,138,660,229 Bushels	2,487% Increase

Source: Minnesota agricultural statistics 2007, 1990

http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/Minnesota/st27_1_001_001.pdf

Wheat & Corn Production 100 years



Activity I Farming Calculations

Student Activity (source: Mathline)

How big is an acre? An old unit of measure is the rod. A rod is 16 ½ feet long. A square rod is a square plot of ground 16 ½ feet on a side. An acre is 160 square rods

Questions

1. How many feet are in one acre? _____

2. Calculate the area of the classroom. How many classrooms would it take to make an acre?

3. A football field is 160 feet wide and 100 yards from goal line to goal line. How does this area compare to an acre?

These days, an average farmer farms 330 acres of corn.

4. If our farm is 330 acres, how many square rods does this equal (remember 1 acre=160 square rods).

When planting corn, it is common for the rows to be 30 inches apart and the goal is to have a corn stalk every 4 inches.

5. Suppose you have an acre of field and plant rows that are 30 inches apart. What is the combined length of all the rows in the acre field?

6. If seeds are planted every 4 inches, how many seeds are needed for an acre field? How many seeds are needed to plant 330 acres?

7. In the fall, the farmer hopes to be able to harvest about 175 bushels per acre. A bushel of corn weighs about 56 lbs. How much would the corn from a 330 acre field weigh?

8. When farmers harvest their corn they pack it into semi-trucks for transporting. One semi-truck can hold 607 bushels (3 acres). The average farmer fills 110 semi-trucks, how many bushels is this?

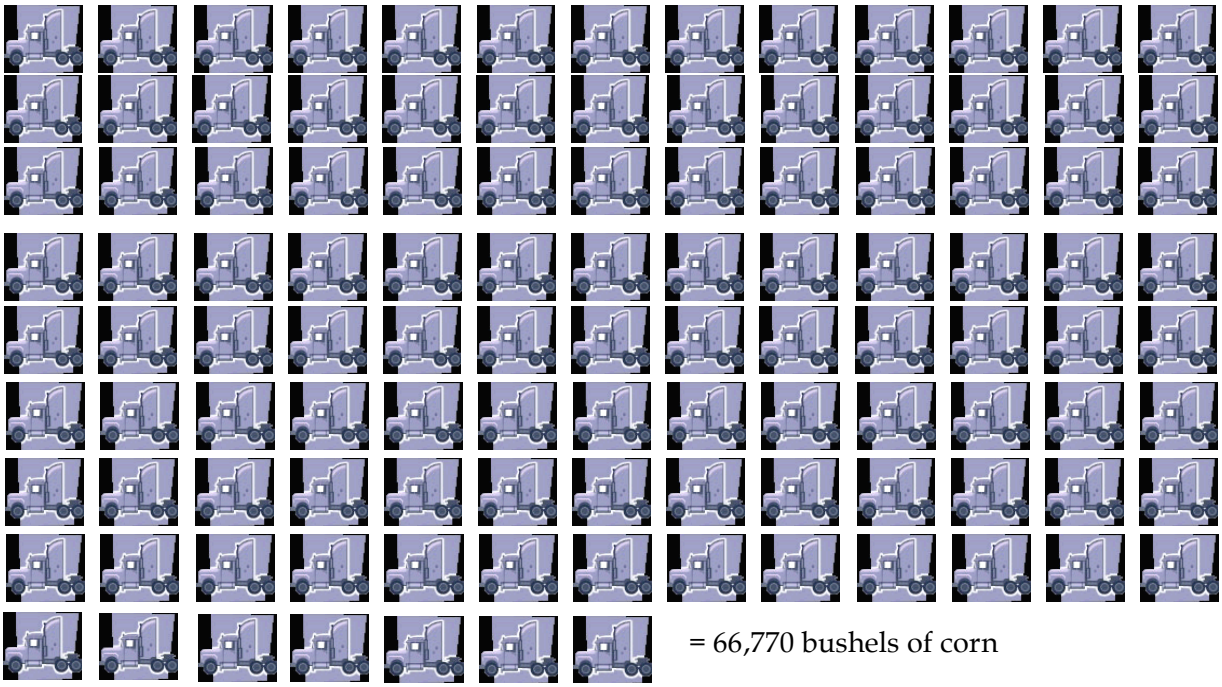
Activity Sheet Answers

1. 1 acre= 160 square rods = 160 x (16 ½ * 16 ½) square feet
2. Answers will vary.
3. 100 yards= 300 ft, so the area of a football field is 300 x 160=48,000 square feet. That is 1.1 acres, or a little larger than an acre.
4. 330 x 160 square rods=52,800
5. The combined length would be in the range of 17, 424 to 17,472 feet or 3.3 miles. If you use a square plot (209 feet by 209 feet) then you have 209ft x 12 inches/ft = 2508 inches.
6. Every 4 inches is 3 seeds per foot. 17,424 feet of row per acre x 3 seeds per foot is 52,272 seeds per acre. 52,272 seeds per acre x 330= 17,249,760 seeds for a 330 acre field.
7. One semi-truck = 607 bushels. 110 semi-trucks x 607 = 66,770 bushels.

How much corn does the average Minnesota farmer produce?

Today (2010), the average Minnesota farmers farm on 332 acres. When harvest comes, he has enough corn to fill 110 semi-trucks full of corn bushels. Altogether, that it 66,770 bushels!! That's a lot of corn!

 = 607 Bushels of Corn



= 66,770 bushels of corn

LESSON 2: AGRICULTURAL REGIONS IN MINNESOTA

Source: www.mda.state.mn.us (Minnesota Agriculture in the Classroom)

Abstract

Minnesota's vegetation regions offer distinct soils and growing patterns for different types of crops. These regions have influenced the development of cities and transportation systems throughout Minnesota.

Middle School appropriate; time: seven 50 minute class periods

- Part One: four to five fifty-minute class periods
- Part Two: one to two fifty-minute class periods
- Part Three: one to two fifty-minute class periods

About the maps:

The maps in this curriculum have been designed specifically to enable students to master the essential skills in the Minnesota Academic standards for Social Studies/Geography (layering and map info can be found at the end of this lesson plan).

PART ONE

Objectives

- To understand which counties in Minnesota are the biggest producers of five of Minnesota's crops by reviewing choropleth maps.
- To create a map showing the different regions of cropland in Minnesota and to label the parts of the map correctly

Materials

- One enlarged copy of Minnesota Counties (unnamed) (Map 33) for every pair of students. Note: Mount map on cardboard, tag board, or open file folder
- One enlarged copy (11" x 17") of each of the following black line master choropleth maps: Wheat (Map 1), Corn 2007 (Map 3), Soybeans 2007 (Map 5), Hay (Map 6), and Sugarbeets (Map 7)
- The following grains purchased at a local co-op or grocery store: 2 lbs. popcorn kernels, 1 c. soybeans, 2 c. wheat berries, and 1 box sugar cubes (It might be possible to obtain these grains by contacting the Agronomy Department at your local College or University).
- 6 bottles of glue

Activity

Set up five eye-level stations around the classroom. Place a different grain at each station along with the corresponding choropleth crop outline map, and a bottle of glue. Note: Prepare or have students glue the blank outline county maps to their cardboard, tag board or open file folder.

1. Show each grain to the class and have the students guess how the grain is used. Record correct guesses on an overhead or the board. Note: The popcorn is being used to represent corn for grain (Map 3)
2. Show one of the enlarged choropleth maps and explain why there are varying shades of color, e.g., dark shades represent more grain than light shades. Next, have students find which counties have a lot of the grain and which do not. Instruct the students (in pairs) to make a map of the regions in the state where each of the five grains are grown. First, have the students glue one grain (seed) to each of the counties that have the highest percentage of the corresponding crop. As they continue to work, students should glue a second grain onto the map legend and add the name of the crop.
3. After moving through each station, students should complete their maps by adding a compass rose, labeling neighboring states, labeling the province of Ontario (bordering Minnesota), adding a map title and their names.

Note: To condense Part One, use the Color Student Desk Map with the following four crops: wheat, hay, soybeans and corn; provide those four grains and a blank county outline map.

Evaluation

1. Instruct students to write five questions about their map that could be answered by a fellow student viewing their map.
2. Assess the completeness and accuracy of the student-made maps. Check that they have correctly identified the highest grain counties. Look for a map title, legend, labeling of neighboring states and province, and authors' names.

PART TWO

Objectives

- To compare the student-made maps to native vegetation, annual frost free days, landforms and annual precipitation maps to further understand why there are different crop regions in Minnesota.

Materials

Copies of the following maps for each of the pairs of students: Native Vegetation (Map 26), Landforms (Map 27), Annual Precipitation (Map 28) and Annual Frost Free Days (Map 29) or Color Student Desk Map for each pair of students

Student-made crop maps of counties showing which county has the highest percentage of the five Minnesota crops.

8" x 11" plain paper for student use

Activities

1. Ask the students if they have ever had their own garden; specifically have they grown any of the crops they placed on t heir maps. Together, list the needs of a garden in order to produce a good crop, i.e., good soil, warm weather, water, sun, etc. Explain that different crops do well with a variety of different growing conditions, i.e., oranges would not grow well in Minnesota because of the cold, but apples thrive in cooler climates.

2. Together, review the four maps on the Color Student Desk Map and determine what clues they give about the growing seasons in relation to different crops.
3. Working as partners, have each pair fold four pieces of plain paper in half and then in half again, dividing the paper into four equal sections. Pairs should write the name of a different Minnesota crop in each of the four sections. Next, after reviewing Maps 26, 27, 28 and 29, students should write three hypotheses in each of their four sections as to why the crop grows where it does in Minnesota. For example, sugarbeets grow in northwestern Minnesota because the soil is rich, and the combination of cool nights and warm days provide ideal growing conditions for beets to produce a high amount of sugar.
4. Each pair should share their hypothesis with another pair in the classroom.

Evaluation

1. Chart that has been created (students' folded papers) listing the different hypotheses about the growth of the crops.
2. Participation in the class discussion.

PART THREE

Objectives

- Using the student-made map of crops, identify where a particular crop should be processed and the route the crop should take to get to market.

Materials

- Student-made map of crops (from part one)
- Copies of Major Highways (map 30) and the Minnesota Reference Map on the Color Student Desk map for each pair of students
- Two blank outline maps of Minnesota, 8 ½ by 11 for each pair of students
- One transparency of each of the following: Meat Processing Plants (Map 25), Vegetable Canning and Freezing Sites (Map 23) Dairy Product Processing Sites (Map 24), Major Highways of Minnesota (Map 30), Railroads in Minnesota Map (Map 31) and Ethanol Production (Map 22)

Activities

1. Divide the class into six groups. Next, explain that students will be responsible for getting all of the crops to market. Discuss what happens to crops after they are grown and what must be done to them before they can be consumed or used. For example, preserving crops for later consumption or processing corn into ethanol. Decide together which crops might need to be canned, frozen, bagged or cleaned, etc.

2. Review the Minnesota Reference map showing major cities and major water features together. Discuss how the city locations and water features affects where food is prepared and where and why food must be transported. Assign a different crop to each of the six groups. Using their blank outline maps of Minnesota, each group should come to a consensus on the location of three sites for processing plants. Students should mark them on the map and in a legend. They should decide where the market should be located for their crops and also draw in highways and railroads to show the best way to

transport their crops to market. They should include symbols on their map legend to identify these features and also add a map title.

3. As each group finishes, give them the appropriate transparency map that shows the actual processing sites for their crops and Minnesota's major highways and railroads. Have students place the transparency on top of their paper map. Next, individually, students should write a description of how their map was the same and/or different than the transparency map. They should also write a sentence or two describing how well their small group worked together and finally, what they learned as an individual.

4. Facilitate a class discussion about the outcomes of this activity. What did the class learn? Why are the highways located where they are? How do the highways relate to major cities? The railroads? What difference would it make where these are located to the farmer?

Evaluation

1. Group maps of where they believe the sites should be and the transportation lines
2. Individual student description/reflection written at the end of the lesson

State Standards for 6th- 9th grade

- Geography
    - Standard 2. The student will identify and locate major physical and cultural features that played an important role in the history of Minnesota.
    - Standard 3. The student will identify and locate geographic features associated with the development of Minnesota.
    - Benchmark 1. Students will identify and compare and contrast the landforms, natural vegetation, climate, and systems of rivers and lakes of Minnesota with those of other parts of the United States.
    - The student will identify physical characteristics of places and use this knowledge to define regions, their relationships among regions, and their patterns of change.
    - Standard 1. The student will give examples that demonstrate how people are connected to each other and the environment.
    - The student will describe how humans influence the environment and in turn are influenced by it.

*****Suggestions for Layering the Black Line Maps*****

The black line maps were designed for use on overhead projectors and also for use by individual students. You may photocopy them for either purpose. Minnesota is the same size on all the black line maps. We encourage you to layer and mix and match the maps to fit the subject of the day. The following suggestions for layering or matching maps facilitate map comparison and lead students to discover geographic relationships. The maps listed in bold type on page 6 should serve as the main focus for each inquiry. Start with the maps in bold type and successively overlay other maps in pairs.

Layering that focuses on livestock:
Overlay **Milk Cows (Map 13)** with Dairy Product Processing Sites (Map 24), Major Highways (Map 30), and Railroads (Map 31). In general, begin with the map about milk (dairy) cows (or another livestock map) and describe the relationship to processing sites and to potential markets for the products.

Layering that focuses on crops:
Overlay **Corn 2007 (Map 3)** with Ethanol Production (Map 22), Hogs and Pigs (Map 16), Major Highways (Map 30), and Railroads (Map 31). Use the map about corn (or another crop map) to analyze the relationship of the crop to processing sites, to on-farm use within Minnesota, and to shipment outside of Minnesota.

Layering that focuses on the physical environment:
Overlay **Soybeans 2007 (Map 5)** with Native Vegetation (Map 26), Landforms (Map 27), Annual Precipitation (Map 28), and Annual Frost-Free Days (Map 29). Consider different crops in relation to variations in physical environment and climate in Minnesota. For example, note the characteristics of regions where crop production is low vs. regions where crop production is high.

Layering that focuses on population characteristic:
Overlay **Population Change (Map 21)** with Farmland (Map 19), and Major Highways (Map 30). Contrast the population characteristics of farming areas vs. large urban areas.

Layering that focuses on the Twin Cities as a market area and production area:
Overlay **Major Highways (Map 30)** with Nurseries (Map 9) and Farmland (Map 19). How does the concentration of people around St. Paul and Minneapolis affect two particular commodities and more generally the use of land for farming?

Layering that focuses on the pattern of cities in Minnesota:
Overlay **Major Highways (Map 30)** with Farmland (Map 19) and Railroads (Map 3).

LESSON 3: AGRICULTURE AND THE MINNESOTA RIVER

Minnesota Standards 9th to 12th grade

- Science Standards
  - II: Understand nature of matter including forms, properties and interactions. Explain causes and effects of Earth's atmospheric and hydrologic processes.

- Social Studies Standards
  - IV: Describe how humans influence and are influenced by the environment.

Introduction

Slide 1 – Ask an Expert

- This lesson is all about drainage systems and how they are implemented. While drainage is essential for crop farming it can also be hazardous to the Minnesota River if not controlled.

Slide 2 -Land in farms

- Agricultural activities account for more than 92% of the land use in the basin.
- The Minnesota River flows through some of the richest agricultural land in the state. Row crop agriculture is the predominant land use in the Basin. The Minnesota River Basin consists of 10,820,000 million acres and in 2001, 8.46 million acres of this land was agriculture (78%).
- The basin stands out statewide as a region with a higher percentage of land in farms.

Slide 3 - What is run-off

- Excess water, usually found on farm fields, that has nowhere to go but run-off into ditches, major water ways, and surface water holding ponds.
- Storm flow, base flow, snowmelt, subsurface/tile all contribute to run-off.
- When run-off is not controlled by agricultural tiling systems, contaminants such as sediment and harmful fertilizers can flow with the run-off water into streams and ultimately into the Minnesota River.

Slide 4 - Examples of sediment runoff

- In the 1930s, damaging practices in the use of land and water were recognized as impacting water quality.
- Prior to 1948, when the tile system was first introduced, many farmers used the Minnesota River as an unregulated drainage outlet.
- After heavy flooding and spring rains, farm fields were saturated with water.
- Without any means of proper drainage systems in place, the run-off which often carried large amounts of sediments slowly started to erode and widen the river banks.

Slide 5 - Examples of agricultural drainage

- From the 1970-1990s, high world demand for commodities led to overexpansion of fields, increased drainage, inflated land prices and huge crop surpluses.

- Large hog and cattle feedlots emerged as a way to make agriculture profitable but raised questions about their impact on the River.

Slide 6 - What is the Clean Water Act?

- The Clean Water Act established the basic structure for regulating discharge of pollutants into waters.
- It required all states to adopt water standards that protect the nation's waters.
- These standards define how much of a pollutant can be in a surface and/or ground water while still allowing it to meet its designed uses-drinking water, fishing, swimming and irrigation.
- Clean Water Act requires all states to:
    - Assign designated uses to waters and develop standards to protect those uses
    - Monitor and assess their waters
    - List waters that do not meet standards
    - Identify pollutant sources and reductions needed to achieve standards
    - Develop a plan to implement restoration activities

Slide 7 - Examples of how increasing farmland has altered the river's path

- Besides agricultural run-off, agricultural practices affect the Minnesota River in other ways.
- One is increasing farmland size and by doing this farmers and contractors are farming right up against the River which we can tell has altered the path of the River.

Slide 8 - Besides agriculture, what else is impacting the River?

- While initial development along the Minnesota River began 150 years ago with European settlement, rural development continues to grow adjacent to the River.
- The increase in housing and neighborhood developments and the number of people living in the basin greatly impact the quality of the River.
- Conservation is an important tool to reduce the impact of development and agricultural practices on or near the river.
- Conservation of the river can protect it from further contamination, band erosion, and human contamination.
- Show students the picture examples---making sure to note how close the housing development is to the river; ask them if they can see any consequences to this. The other picture is a car parked near a storm drain which leads to the river. Again, have students examine why this can cause contamination (leaking gasoline or oil and other chemicals from cars).

LESSON 3: AGRICULTURAL DRAINAGE RUN-OFF ACTIVITY

Materials

2 large glass containers
Masking tape
Permanent marker
Ruler

Introduction

Agriculture is an important sector in Minnesota's economy and the agriculture sector is the 2nd largest industry in Minnesota. Why is agriculture so important:

- It feeds use by providing grains, vegetables and livestock
- Clothes us by producing cotton, wool and leather
- Shelters us with timber for houses and with soybeans and corn products used in construction
- Keeps us clean by providing soap, toothpaste, cosmetics and detergent all made from corn, soybeans and cottonseed

Agriculture is very important to us Minnesotan's but the Minnesota is also important to us. Why is the Minnesota River important:

- Recreation: fishing, canoeing, paddling, camping
- Fish and wildlife
- It's a natural part of our ecosystem and we should try hard to keep it clean

Now that we know why agriculture and the Minnesota River is important to us, it is essential that we study the effects agricultural drainage can have on the river so we know how to problem solve

Water collection Procedure

- Fill one glass container of water from a stream/ditch/storm ditch that is adjacent a farm field (can either be a crop field of livestock farm)
- Once the glass jar is full try and keep it in the sun for 2-3 days
- Take the other glass container and fill it with water run-off that is not near a farm
- Again, keep it in the sun for 2-3 days
- After 2-3 have the class analyze the color, consistency, smell and overall quality of the water in both glass jars
- Have them fill out the work sheet below

Name:_____ Date:_____

1. Is there any color differences in the water between the two samples? If so, what is the color of the farm sample and the non-farm sample?

2. Is the water consistency different between the two samples? If yes, how so?

3. Which sample has the better water quality?

4. In your opinion, which sample of water would you feel more comfortable swimming in, canoeing in, etc? Why?

5. In your opinion, does either of these water samples' quality concern you? Why?