

Siesta Software Solutions Lesson Plan

Teacher: Rich McKinney

Class: AP/IB Geography

Course Unit: Environmental Sustainability

Lesson Title: Water Utilization and Trends in the United States (Two Days)

LESSON OVERVIEW

Summary of the task, challenge, investigation, career-related scenario, problem, or community link.

Students will examine how water issues contributed to the collapse of the Anasazi civilization in the 12th century. They will then research key issues involved in water utilization in the United States. Finally, they will compare the problems of the Anasazi to problems currently being experienced in different regions of the United States and predict which regions of the United States might potentially face a similar fate in the future.

NATIONAL GEOGRAPHIC STANDARDS

From <http://www.nationalgeographic.com/xpeditions/standards/matrix.html>

- 5 - That People Create Regions to Interpret Earth's Complexity
- 7 - The Physical Processes That Shape the Patterns of Earth's Surface
- 11 - The Patterns and Networks of Economic Interdependence on Earth's Surface
- 14 - How Human Actions Modify the Physical Environment
- 17 - How to Apply Geography to Interpret the Past
- 18 - How to Apply Geography to Interpret the Present and Plan for the Future

OBJECTIVES

Students will:

- 1) Identify how water is utilized in different regions of the United States.
- 2) Examine areas of the United States that experience physical and/or economic water scarcity.
- 3) Describe how human and environmental factors impact water scarcity
- 4) Predict the consequences of current water utilization by examining how water scarcity impacted past societies.

ASSESSMENT/EVALUATION

Students show evidence of proficiency through a variety of assessments.

Aligned with the Lesson Objective
Formative & Summative
Performance-Based

Students will complete questions regarding the collapse of the Anasazi. (Obj. 4)

Students will create a PowerPoint that demonstrates what they learned during the research. (Obj. 1, 2, 3)

Students will complete an annotated map while listening to the reports of other groups. (Obj. 1, 2, 3, 4)

Students will write a 5 paragraph persuasive essay with the following prompt, "Predict which region of the United States is most likely to experience a similar fate as the Anasazi." (Obj. 4)

MATERIALS

Aligned with the Lesson Objective
Rigorous & Relevant

"The Mysterious Disappearance of the Anasazi" worksheet
Computer/Smartboard/PowerPoint
"Water Utilization on a Regional Scale" research assignment sheet
Annotated Maps worksheet

ACTIVATING STRATEGY	Motivator/Hook An Essential Question encourages students to put forth more effort when faced with a complex, open-ended, challenging, meaningful and authentic questions.
<p>I begin the lesson by asking students to consider the following question, “Is water a basic human right or a commodity that can bought and sold?” I tell students that they have to demonstrate their answer by moving to a specific spot in the room. I then ask some devils-advocate questions to each group to challenge them to really consider the implications of the side they chose. Students are allowed to change sides as I ask questions if their opinion changes.</p>	
INSTRUCTION	Step-by-Step Procedures-Sequence Discover/Explain – Direct Instruction Modeling Expectations – “I Do” Questioning/Encourages Higher Order Thinking Grouping Strategies Differentiated Instructional Strategies to Provide Intervention & Extension
<p>Day 1: Students will read and complete questions #1 and #2 on the Anasazi worksheet. Teacher will lead a discussion of key terms, points of interest, and broad concepts of studying water. Teacher will explain research project and discuss why we are approaching the research on a regional scale. Students will research their specific region in the library.</p> <p>Day 2: Students will present their research findings in a PowerPoint format. Students will annotate regional maps as they listen to other groups’ presentations. Students will complete question #3 on the Anasazi worksheet. Students will write their persuasive essay.</p>	
CLOSURE	Reflection/Wrap-up
<p>We began the lesson by considering whether water was a basic human right or a commodity. Now we will look at what we learned about specific areas of the United States where water scarcity could make this question very relevant. Students will be asked to describe how their opinions have either strengthened or changed during the lesson.</p>	

CROSS-CURRICULAR CONNECTIONS	How does this lesson connect to what students are learning in other courses?
<p>This lesson will develop skills that students are learning in Language arts by challenging them to write a persuasive essay.</p> <p>This lesson will enhance knowledge that students have learned in history by exploring the collapse of the Anasazi.</p> <p>This lesson will promote thinking about environmental science issues regarding the hydrological cycle.</p>	

The Mysterious Disappearance of the Anasazi

Read the following account of the Anasazi and complete the questions on the back.

Today, the ruins of skyscrapers erected by native Americans, the Anasazi, can still be found in the south west of the United States - in the four corner area of Arizona, New Mexico, Colorado, Utah. The skyscrapers were up to 6-storey buildings, with up to 600 rooms.

The Anasazi build-up began around AD600 with the arrival of the Mexican crops of corn, squash and beans in that relatively dry area. It's very striking today to drive through an area where today either nobody is living at all, or nobody's living by agriculture and realize that this used to be a densely populated agricultural environment.

The Anasazi were ingenious at managing to survive in that environment, with low fluctuating, unpredictable rainfall, and with nutrient-poor soils. The population built up. They fed themselves with agriculture, in some cases irrigation agriculture, channeled very carefully to flood out over the fields. They cut down trees for construction and firewood. In each area they would develop environmental problems by cutting down trees and exhausting soil nutrients, but they dealt with those problems by abandoning their sites after a few decades and moving on to a new site.

It's possible to reconstruct Anasazi history in great detail for two reasons. Firstly, tree rings; from tree-rings on the roof beams you can identify precisely what year - 1116, not 1115 AD - the tree in that roof was cut down. And secondly, those cute little rodents, the pack rats, that run around gathering bits of vegetation in their nests and then abandoning their nests after 50 years. A pack rat midden is basically a time capsule of the vegetation growing within 50 yards of a pack rat midden over a period of 50 years.

Julio Betancourt was near an Anasazi ruin and happened to see a pack rat midden. He was astonished to see in it the needles of pinion pine and juniper, in what is now a treeless environment. So Julio wondered whether that was an old midden. He took it back, radio carbon-dated it, and lo and behold it was something like AD 800. So the pack-rat middens are time capsules of local vegetation allowing us to reconstruct what happened.

What happened is that the Anasazi deforested the area around their settlements until they were having to go further and further away for their fuel and their construction timber. At the end they were getting their logs from the tops of mountains up to 75 miles away and about 4,000 feet above the Anasazi settlements. These logs had to be dragged back by people with no transport or pack animals. So deforestation spread. That was the one environmental problem.

The other environmental problem was the cutting of arroyos. When water flow is channeled, for example in irrigation ditches, then large flows such as the run off in desert rains dig a trench within the channel. This trench digs deeper and deeper with time, and today we can see examples of arroyos up to 30 feet deep. If the water level drops down in the arroyos today then that's not a problem for farmers, because we've got pumps. But the Anasazi did not have pumps, and so when the irrigation ditches became incised by arroyo cutting and when the water level in the ditches dropped down below the field levels, they could no longer do irrigation agriculture.

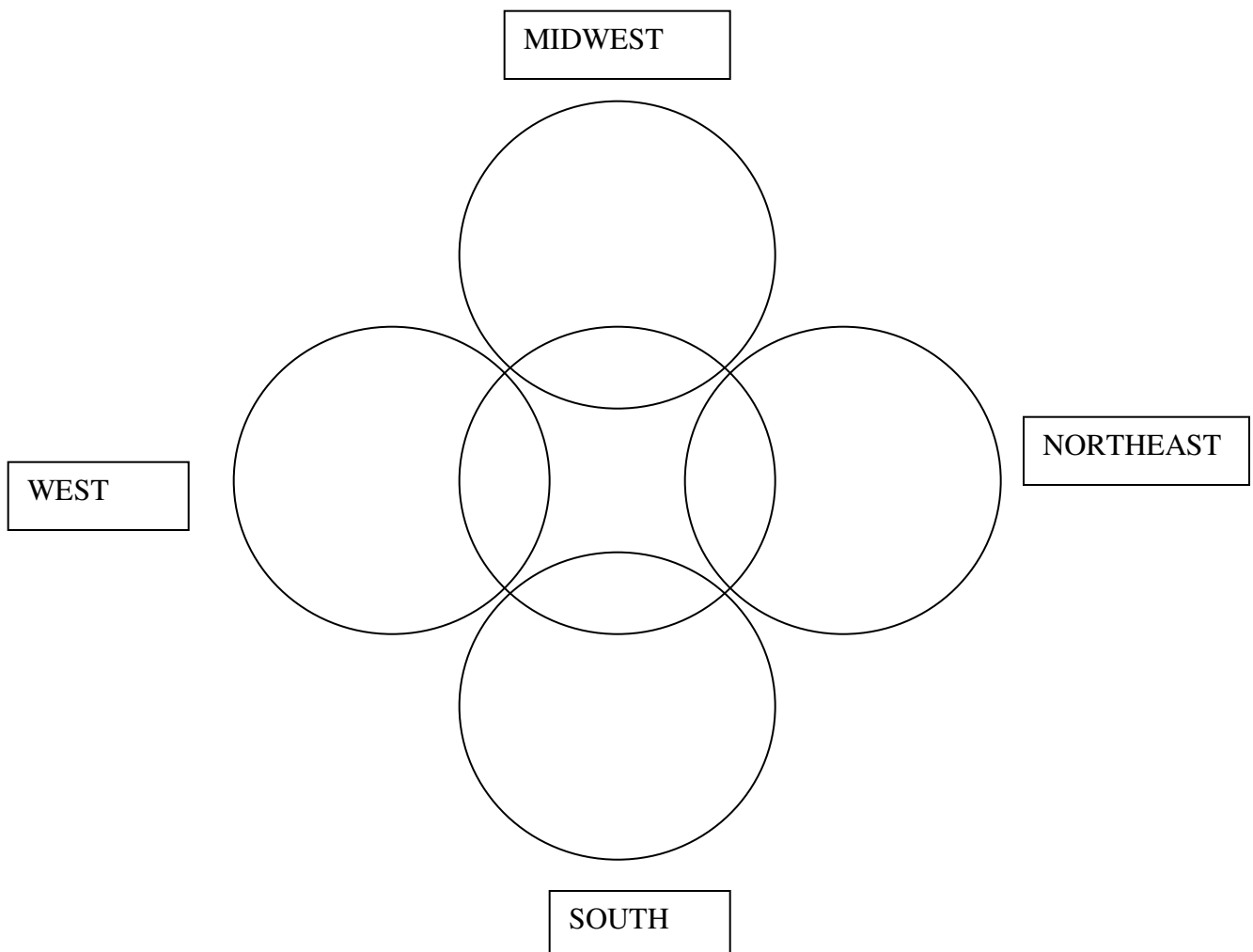
For a while the Anasazi got away with these inadvertent environmental impacts. There were droughts around 1040 and droughts around 1090, but at both times the Anasazi hadn't yet filled up the landscape, so they could move to other parts of the landscape not yet exploited. And the population continued to grow.

Then in Chaco Canyon when a drought arrived in 1117 there was no more unexploited landscape. At that point, Chaco Canyon was a complex society. Lots of stuff was getting imported into Chaco - stone tools, pottery, turquoise, probably food was being imported into Chaco. Archaeologists can't detect any material that went out of the Chaco Valley, and whenever you see a city into which material stuff is moving and no material stuff is leaving, you suspect that the city has political or religious control in return for which the peasants in the periphery are supplying their imported goods.

When the drought came in 1117 it was a couple of decades before the end. Pueblo Benito was a big, six story, unwallled plaza, until about 20 years before the end, when a high wall went up around the plaza. And when you see a rich place without a wall, you can safely infer that the rich place was on good terms with its poor neighbors, and when you see a wall going up around the rich place, you can infer that there was now trouble with the neighbors. So probably what was happening was that towards the end, in the drought, as the landscape is filled up, the people out on the periphery were no longer satisfied because the people in the religious and political centre were no longer delivering the goods. The prayers to the gods were not bringing rain, there was stuff to redistribute and they began making trouble. Chaco Canyon was eventually abandoned. The Anasazi had committed themselves irreversibly to a complex society, and once that society collapsed, they couldn't rebuild it because again they deforested their environment.

In the Anasazi case we have the interaction of environmental impact and climate change.

1. In your own words, explain why the Anasazi were able to flourish in an area where almost no people choose to live today.
2. Provide three possible explanations for why the Anasazi civilization collapsed. These three will likely be connected.
3. After conducting your research on water utilization in the United States and hearing from the other groups, complete the four-way Venn Diagram below as you consider which regions of the United States are in danger of following the Anasazi. The center circle is for the Anasazi.



Water Utilization on a Regional Scale

How Much Water...

How much water does it take to process a quarter pound of hamburger?

Approximately one gallon

How much water does it take to produce one ton of steel?

62,600 gallons

How much water is used to produce a single day's supply of U.S. newsprint?

300 million gallons

What is the total amount of water used to manufacture a new car, including new tires?

39,090 gallons per car

How much water must a dairy cow drink to produce one gallon of milk?

Four gallons

How much water is used during the growing/production of a chicken?

400 gallons

How much water is used during the growing/production of almonds?

12 gallons

How much water is used during the growing/production of french fries?

6 gallons

How much water is used during the growing/production of a single orange?

13.8 gallons

How much water is used during the growing/production of a watermelon?

100 gallons

How much water is used during the growing/production of a loaf of bread?

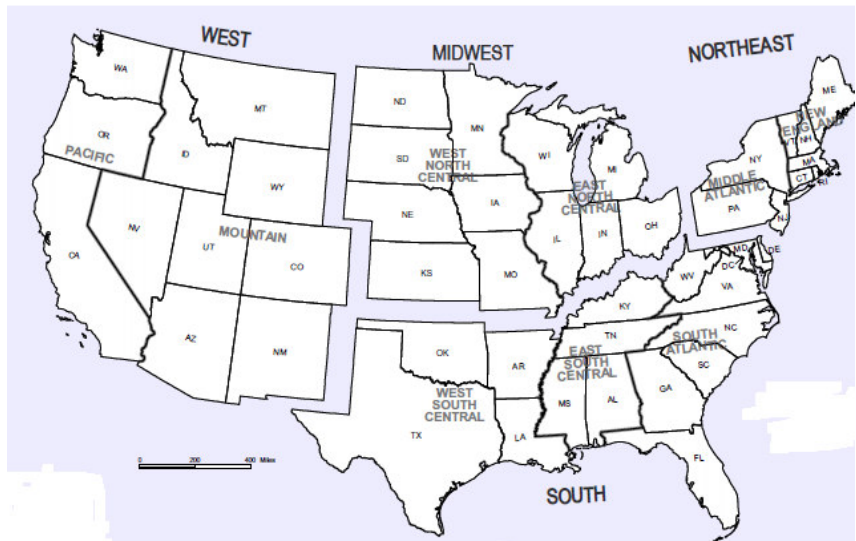
150 gallons

How much water is used during the production of an egg?

120 gallons

Four Main Categories of Water Usage

- **Domestic:** Water used for residential, commercial, industrial, and public uses such as street cleaning, fire fighting, municipal parks, and public swimming pools.
- **Power Plants:** Power plants use 136 billion gallons of fresh water per day during the production of energy from fossil fuels, nuclear, or geothermal sources.
- **Agricultural:** Water used to irrigate farm crops, for livestock, dairies, feedlots, fish farms, and other farm needs.
- **Industrial & Mining:** Water used for cooling in factories and washing and rinsing in manufacturing processes.



Your Task is to prepare a regional water analysis based on your research of the assigned region (West, Midwest, South, Northeast). Your analysis must address each of the following questions:

1. How is water utilized in your region? (use the chart at top)
2. Has this region experienced either type of water scarcity?
3. What environmental factors influence the way water is utilized?
4. What human factors influence the way water is utilized?
5. Do all parts of the population have access to clean drinking water? (think urban vs rural, or state vs state)
6. Does the population rely on public utilities or other means of getting their water? (wells, springs, rainwater collection, etc)
7. What are the natural water sources that this region can take advantage of in meeting its water needs?
8. Are there any disturbing trends that imply the potential for major water problems in the future?
9. Have state or local governments attempted to correct these trends with legislation?

Regional Water Utilization



West Notes

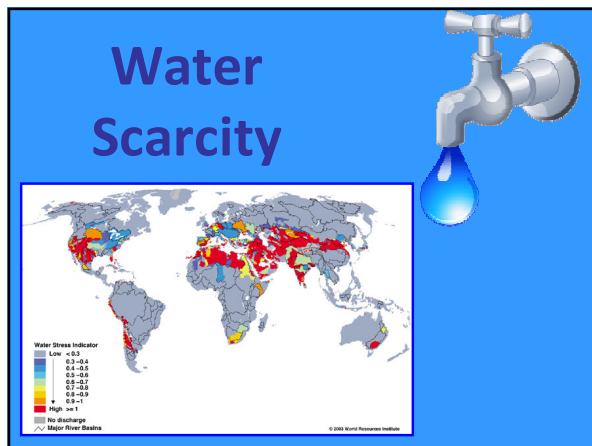
Midwest Notes



Northeast Notes



South Notes



Which products require the most water to make?

- T-shirt
- Loaf of bread
- Sheet of paper
- Car
- To-Go Latte
- Gallon of Paint
- 1-lb of beef

Write them in your rank order and then estimate how many gallons are required.

1. Car - 39,090 gallons (it's unclear if that includes the tires—each tire takes 518 gallons to make.)
2. Beef - 2500-5000 gallons per pound
3. Cotton T-Shirt - 714 gallons
4. Bread - 150 gallons
5. To-Go Latte- 53 gallons (plus, that sugar, and then there's that plastic lid, which has to be created and distributed over hundreds of miles. And doesn't plastic require a pretty vast amount of water and oil to produce?)
6. Gallon of Paint - 13 gallons
7. Sheet of paper- 2.6 gallons

- Water and change Identify the ways in which water is utilized at the regional scale. Examine the environmental and human factors affecting patterns and trends in physical water scarcity and economic water scarcity. Examine the factors affecting access to safe drinking water.

The fine folks in the IB Geography dept. would like you to know

This is a picture of Lake Meade, which supplies 95% of the water for Las Vegas. It is estimated to run dry in the next 10 years.

We Study Water Because It Is...

- A global health issue
 - 1.6 million people/yr die from waterborne illness
- An economic issue
 - Necessary to reduce poverty, make food & energy
- A women's and children's issue
 - Often their duty to find & carry in developing countries
- A national and global security issue
 - Water wars!

And, it is an ENVIRONMENTAL issue

- Lower water tables
- Lower river flows
- Shrinking lakes & wetlands
- Poor water quality
- Decrease in fish population
- Species extinctions
- Degradation of ecosystem

Some Interesting Facts



Water scarcity occurs even in areas where there is plenty of rainfall or freshwater.

Water scarcity affects one in three people on every continent of the globe.



So What is Water Scarcity?

- An inadequate supply of water based on:
 - Water availability
 - Population growth
 - Demand for water
 - Affordability of supplies and infrastructure
- There are two distinct types of water scarcity:
 - *Physical Water Scarcity* & *Economic Water Scarcity*

WATER DISTRIBUTION

Where in the world is our water?

71% of Earth's surface is covered in water



Saltwater in the oceans = 97.5%



Remember, we cannot use this water for drinking or for most industrial uses!

Ice Caps and Glaciers = 1.72%

That's 68.9% of the FW

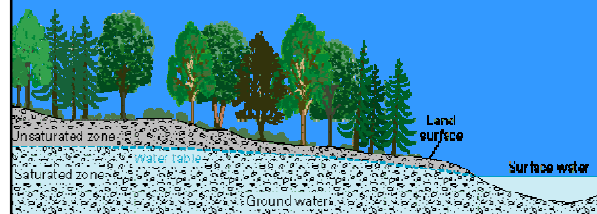


Remember, we cannot use this water either—it's frozen!



Ground Water = 0.75%

That's 29.9% of the FW



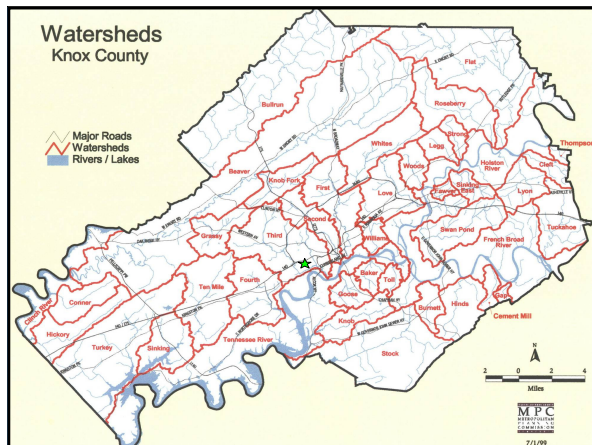
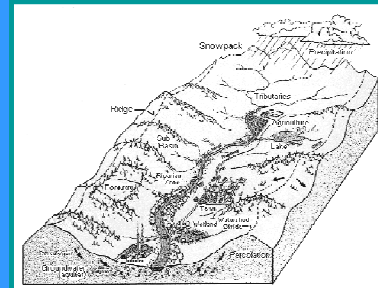
Surface water = 0.0075%

That's 0.3% of the FW



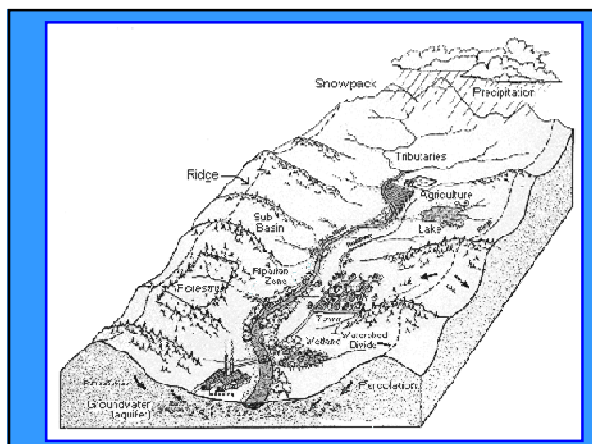
What is a Watershed?

An area of land that drains into a body of water such as a stream, river, or lake



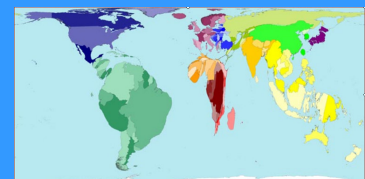
Watersheds are nested

Third Creek
Tennessee River
Mississippi River
Gulf of Mexico



How much of that is readily available?

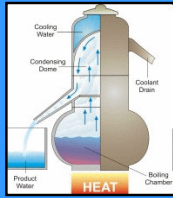
- Of the total, only 0.024%
- Liquid freshwater
 - accessible groundwater
 - Lakes, rivers, streams



This shows where the freshwater is distributed

This Leads to Physical Water Scarcity

- Water consumption exceeds 60% of the usable supply
- Countries like Saudi Arabia and Kuwait try to offset this in a supply/demand fashion:
 - They import food to reduce water demand for agriculture
 - They invest in desalination plants to increase the supply



These were bombed by Saddam Hussein in Gulf War

Other than sabotage, what other problem can you anticipate?

We discussed the supply side of physical scarcity, now let's examine the consumption side.

How much water am I using?

Place in order of water used & estimate amounts

Housing

- Dishwashing
- Baths
- Faucets
- Laundry
- Toilet
- Shower

Table 1. Water use inside the home

[American Water Works Association, written commun., 1997]

Use	Gallons per capita per day	Percent
Toilet	27	35
Laundry	17	22
Showers	14	18
Faucets	10	13
Baths	8	10
Dishwashing	2	2
TOTAL	78	100

Does this seem to reflect your home?

Estimated Use of Water in the United States in 2000

[Abstract](#) | [Introduction](#) | [Total](#) | [Public supply](#) | [Domestic](#) | [Irrigation](#) | [Livestock](#) | [Aquaculture](#) | [Industrial](#) | [Mining](#) | [Thermoelectric](#) | [Trends](#) | [References](#) | [Glossary](#)

Figure 14. Trends in total water withdrawals by water-use category, 1950-2000.

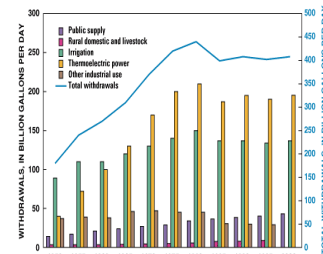
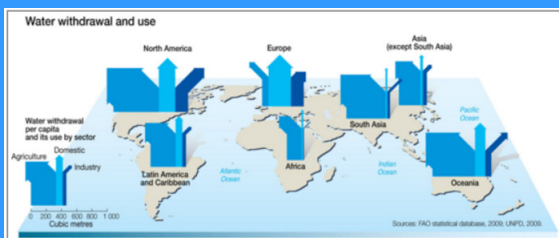
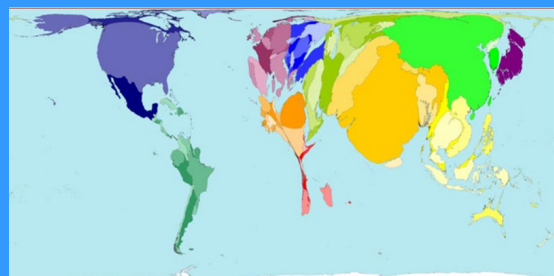


Figure 14. Trends in total water withdrawals by water-use category, 1950-2000.

Comparing Agriculture, Domestic, and Industrial Water Use Globally



Where is Freshwater Consumed?



How does this compare to the map we saw that showed where the freshwater is found?

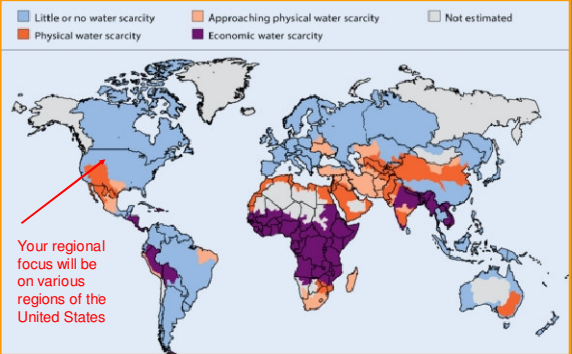
Economic Water Scarcity



- Sufficient water exists locally, but there is a lack of storage and transport facilities
- Countries in sub-Saharan Africa need to attract capital to begin large and expensive water development projects



Our Project - Study Water Utilization on a Regional Basis



So How Do We Use Water in the U.S.?



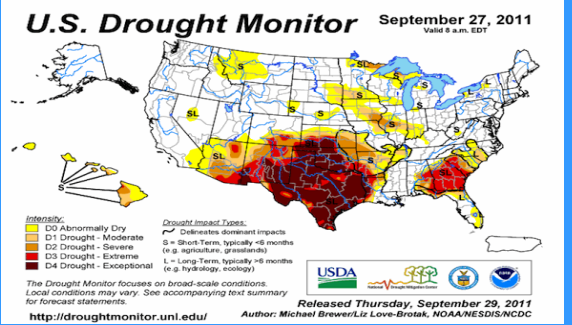
By 2020, California will face a shortfall of fresh water as great as the amount that all of its cities and towns together are consuming today.

To grow a ton of wheat uses 1,000 tons of water. The US is the largest exporter of wheat to the world. When we export a ton of our wheat, we are effectively including 1,000 tons of water in the bargain.

In the US, 21 percent of irrigation is achieved by pumping groundwater at rates that exceed the water supplies ability to recharge.

There are 66 golf courses in Palm Springs. On average, they each consume over a million gallons of water per day.

U.S. Ongoing Drought Map



U.S. Water Shortage Map

