

WATER CONSERVATION

Water and Food

Irrigation Challenge Quiz Handout

1. How much water does it take to produce your favorite foods? Rank the following foods, from least to most water consumed, in terms of the gallons of water needed to produce one pound. For extra credit, rank how many gallons each uses.
 - A. Lettuce
 - B. Pork
 - C. Chicken
 - D. Apples
 - E. Beef

2. While the statistics on how much water it takes to produce a pound of meat vary wildly—from 420 to 5,000 gallons per pound—all numbers seem prodigious. This is largely because it takes approximately ten pounds of grain to make one pound of meat. Americans have always been a leading consumer of meat, but since 1950, per capita consumption of meat has evolved. In light of this, which of the following statements are true?
 - A. We consumed more than four times the chicken in 2007 than we did in 1950.
 - B. U.S. beef consumption has fallen 25 percent since 1970.
 - C. Altogether, the U.S. consumes less meat now than it did during the “steak and potato” years during the 1950s and 1960s.
 - D. The rise of vegetarianism since the late ‘90s meant a sharp drop off in U.S. meat consumption.



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3. Lester Brown, president of the Earth Policy Institute, compares the standard, omnivorous American diet to that of a sport utility vehicle (SUV), and the vegetarian diet to that of an efficient Toyota Prius hybrid compact. In terms of carbon and water footprints, explain what he means. Provide a short answer:

4. Your task: Explain a positive and negative component to each of the five facts listed below. Among others, consider issues of water, employment, fossil fuels, and diet.

California:

- A. Grows half the country's vegetables, but receives less than 10 inches of rain per year in its growing regions.
- B. Uses 54 percent of its irrigation water to produce 17 percent of its agricultural revenue.
- C. Irrigates over ten million acres of its land.
- D. Grows more than 200 crops, and produces more than 90 percent of the following crops grown in the U.S.: artichokes, processed tomatoes, almonds, apricots, dates, figs, grapes, kiwi, nectarines, olives, pistachios, and walnuts.

5. Eighty percent of water in the U.S. is in the East, yet 80 percent of water use in the U.S. occurs in the West. Can you name three factors that allow the West to be such a dominant agricultural region in spite of this?

6. There are 7 states that draw on the Colorado River:

- A. How many can you name?
- B. In a short answer, explain whether this river is able to meet the needs of the people who depend upon it.

7. What is the Ogallala Aquifer? Explain at least two concerns about its future.



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8. Which of the following answers show a symptom of subsidence due to water withdrawal?

- A. Houses that sit on land that was once permanently frozen, but now is thawing, are starting to sink and lean over.
- B. Oceanside houses that once sold for more than \$5 million are going down in price as people fear rising water levels.
- C. A miles-long crack in the land, ranging from 1 to 100 feet in width, developed near land that had been heavily pumped for groundwater.
- D. A large area of land keeps sinking about an inch every year. It's in an area where water is being heavily pumped for gas and oil refining.
- E. Both C and D
- F. Both A and C

9. Which of the following offer(s) justification for U.S. government farm subsidies?

- A. Without subsidies, many farmers would be out of work.
- B. Without subsidies, U.S. agricultural production would be less stable, forcing us to be at the mercy of foreign markets.
- C. Without subsidies, the already diminishing career of farming would attract even fewer farmers and farm workers.
- D. Without subsidies, consumers would pay considerably more for their groceries.
- E. All are True
- F. None are True



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Answer Key: Irrigation Challenge Quiz

1. How much water does it take to produce your favorite foods? Rank the following foods, from least to most water consumed, in terms of the gallons of water needed to produce one pound. For extra credit, rank how many gallons each uses.

- A. Lettuce
- B. Pork
- C. Chicken
- D. Apples
- E. Beef

Answer:

- 1. A. Lettuce: 23 gallons to produce 1 pound
- 2. D. Apples: 49 gallons to produce 1 pound
- 3. C. Chicken: 815 gallons to produce 1 pound
- 4. B. Pork: 1630 gallons to produce 1 pound
- 5. E. Beef: 5214 gallons to produce 1 pound

2. While the statistics on how much water it takes to produce a pound of meat vary wildly—from 420 to 5,000 gallons per pound—all numbers seem prodigious. This is largely because it takes approximately ten pounds of grain to make one pound of meat. Americans have always been a leading consumer of meat, but since 1950, per capita consumption of meat has evolved. In light of this, which of the following statements are true?

- A. We consumed more than four times the chicken in 2007 than we did in 1950.
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- C. Altogether, the U.S. consumes less meat now than it did during the “steak and potato” years during the 1950s and 1960s.
- D. The rise of vegetarianism since the late ‘90s meant a sharp drop off in U.S. meat consumption.

Answer:

- A and B are true.

3. Lester Brown, president of the Earth Policy Institute, compares the standard, omnivorous American diet to that of a sport utility vehicle (SUV), and the vegetarian diet to that of an efficient Toyota Prius hybrid compact. In terms of carbon and water footprints, explain what he means. Provide a short answer:

Answer:

- Eating less meat, we would significantly conserve fuel and water.

Moving “down the food chain” —or consuming less meat—reduces water use. In the United States, where the annual consumption of grain as food and animal feed averages 1,760 pounds per person, a modest reduction in the consumption of meat, milk, and eggs could easily cut grain use per person by 200 pounds, saving 1,000 tons of irrigation water annually per person. For 300 million Americans, such a reduction would cut grain use by 30 million tons and irrigation water use by 30 billion tons each year. Reducing the electricity required to pump this water would also result in enormous fuel savings, as would the reduction in importing grains and meat.

It’s staggering to realize the water pools up behind our food. Even a seemingly harmless bread and cheese sandwich takes a flood, with 156 gallons needed to produce a pound of wheat and 600 gallons needed to make a pound of cheese. Throw in a glass of milk and you’ve just added another 65 gallons! Meat, dairy, and processed foods require far more water use than fruits, vegetables, and whole grains to produce.



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With respect to per capita meat consumption, the U.S. takes the gold, but the podium is filling as developing countries, notably China, come to enjoy an increasingly meat-rich diet. According to the WorldWatch Institute, world meat production has grown nearly 500 percent since 1950.

4. Your task: Explain a positive and negative component to each of the five facts listed below. Among others, consider issues of water, employment, fossil fuels, and diet.

California:

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- B. Uses 54 percent of its irrigation water to produce 17 percent of its agricultural revenue.
- C. Irrigates over ten million acres of its land.
- D. Grows more than 200 crops, and produces more than 90 percent of the following crops grown in the U.S.: artichokes, processed tomatoes, almonds, apricots, dates, figs, grapes, kiwi, nectarines, olives, pistachios, and walnuts.

Suggested Answers:

- A. Positive: Annually, California farmers grow and sell about \$15 billion worth of vegetables and nuts. In some counties, agriculture employs up to 30 percent of the population.
Negative: That said, there have been increasing water shortages in the state and mandates for water conservation. With a population expected to swell from its current 37 million to between 44 and 48 million by 2025, California's agricultural future is open to debate.
(See Food and Water Debate Unit *for more on this topic.*)
- B. Positive: While California grows six crops that generate 54 percent of its state agricultural profits—lettuce, fresh tomatoes, tomatoes for processing, celery, carrots and broccoli—it also grows over 200 other crops whose nutritional benefits and diversity of taste extend beyond the simple math of profit and loss.



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Negative: That said, there have already been bitter legislative battles over water rights, and more efficient water use is necessary for the health of the people and the land.

- C. Positive: Thanks to its irrigation, California produces about half the nation's horticultural food by value. Its soil is usually rich in phosphorous, potassium and several micronutrients like calcium, iron, and magnesium, and its growing season affords two and sometimes even three rotations of crops. As more of its land has been irrigated over the past thirty years, there has been exponential growth in crop production and crop revenue.

Negative: During the summer of 2008, Governor Schwarzenegger declared a state of drought, the first since 1991, and water from already depleted areas was diverted to those even drier.

- D. Positive: California's crops are really the nation's crops, particularly in wintertime. Without them, there would be far less variety on the nation's plates. There may be areas of the country that receive more rain and so seem better suited for less water-intensive growth, but it's not simply a matter of lifting one crop and placing it elsewhere. California has achieved such productivity from a long era of experimentation and study.

Negative: Is it prudent to grow water-thirsty crops in Imperial Valley, where it rains, on average, three inches a year?

5. Eighty percent of water in the U.S. is in the East, yet 80 percent of water use in the U.S. occurs in the West. Can you name three factors that allow the West to be such a dominant agricultural region in spite of this?

Answer:

Factors include: transportation, fertilizer, cost of land, productivity of machinery, and government grants, loans, and subsidies.



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Transportation:

There are 143,361 total miles for freight railroads in North America. There are also nearly 50,000 miles of superhighway in this country, so our food supply is poised to move. Vast quantities of water are used to produce the oil and coal that power these conduits of commerce. It takes 65-90 gallons of water to refine one barrel of crude oil, and 2.2 billions gallons of water annually to cool a 500 megawatt coal power plant.

Fertilizer:

Without these chemical compounds, our food landscape would be entirely different and there would be far less reliance from the American West. In 1900, U.S. farmers applied 4 million tons of fertilizer to their crops. After the chemically dependent "Green Revolution" spread in the late 1960s, that number swelled to 32.5 million tons. Today, over 80 percent of all fertilizer goes to just three crops: corn, soybeans, and wheat, most of which is grown in the West. A single acre of corn, for instance, is grown with 270 pounds of fertilizer! Because they cannot be made without water, fertilizers have a sizeable water footprint themselves.

Land:

Our nation's history has seen some general constants: things head west, and when they do, they get bigger. So it is with farms. California grows half the country's vegetables on over 10 million irrigated acres with fewer than 10 inches of rain falling, on average, in its growing regions.

Machinery:

By 1950 there were more tractors than horses on farms in the U.S. In order to keep labor costs low and increase yields, farms need fleets of machinery that might include a stalk cutter, a cultivator, a two-row harvester, a self-propelled combine, advanced herbicide applicators, satellite technology, and global positioning systems. In 1890, one farmer, on average, tended 27.5 acres; one hundred years later, a single farmer tended an average of 740 acres. Considering the "water footprint" of the typical diesel tractor that burns 3.5 gallons an hour, this efficiency ratio relies



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heavily upon gasoline, and thus, water. With this capacity for large-scale farming come the relatively large-scale farms of the West.

Government Grants, Loans, and Subsidies:

To ensure a reliable and affordable supply of food, the federal government subsidizes farmers. According to the U.S. Department of Agriculture, 78 percent of the government's yearly farm subsidies go to only 10 percent of the growers. This taxpayer funding serves as a reservoir for Western farmers, securing them in times of flood, drought, heat wave, freeze, or labor crisis. Subsidies also help defray farmers' water bills. In some cases, farmers pay 5 percent of what their neighboring residents do for water.

6. There are 7 states that draw on the Colorado River:

A. How many can you name?

B. In a short answer, explain whether this river is able to meet the needs of the people who depend upon it.

Answer:

A. States that divert and use Colorado River water: Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming.

B. Much has been written over the contentious, vital, and limited flow of the Colorado River as it increasingly feeds growing cities, hydropower plants, and irrigation projects. The amount of water the river carries each year varies with snowmelt and rainfall; policy is set by pre-determined allotments of acre-feet of water to its numerous dependants—cotton growers, green lawn aficionados, hydropower plant operators, golf course superintendents, and car wash owners, to say nothing of the animals and plants that depend upon the river for their survival.

Since 1922, the river's average flow has been 13 million-acre-feet; from 1999 to 2003, it averaged just 7 million, with a drought-stricken, all-time low of 3 million in 2002. Freshwater has not reached the Colorado Delta, in southern California, since 1993, and without silt to maintain it, the delta is increasingly vulnerable to tidal



erosion. The great Lake Mead and Lake Powell, capable of storing four times the river's annual flow, are there to keep water for the non-rainy days ahead. But, after being full in 1999, Lake Powell was 3/5th empty in 2004; Lake Mead was not much better off. With current average conditions, it would take these reservoirs ten years to fill again, but given the global warning's anticipated effects on climate, they may not refill at all.

7. What is the Ogallala Aquifer? Explain at least two concerns about its future.

Answer:

The Ogallala Aquifer was formed from the erosion of the Rocky Mountains as rocks, mud, clay, and sand were saturated by snowmelt. Its 174,000 square miles stretch under most of Nebraska, western Kansas, eastern New Mexico, eastern Colorado and the Texas and Oklahoma panhandles. At its deepest, eastern portions, it is 300 feet; at its shallowest, western portions, it is just a few feet. For decades, the aquifer has provided one-third of the water used for agricultural irrigation in the U.S., largely for growing grain to feed cattle.

Concern A: Recharge Rate. With only 0.5 to—at best—3 inches per year going back into replenishing its supply, the aquifer does not look to be on a sustainable course.

Concern B: Grain Prices. As the Ogallala's levels are depleted, grain prices will rise, and this will have a large, direct effect in the local supermarkets.

Concern C: Livestock Industry: If the Ogallala region cannot grow as much grains to feed cattle, it will not be able to support its leading cattle industry.

Concern D: Conservation. Farmers in the region are too underpaid to concern themselves with conservation measures and there is little incentive for one farmer to conserve when another farmer in the next county fails to do so.

8. Which of the following answers show a symptom of subsidence due to water withdrawal?

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- A. Houses that sit on land that was once permanently frozen, but now is thawing, are starting to sink and lean over.
- B. Oceanside houses that once sold for more than \$5 million are going down in price as people fear rising water levels.
- C. A miles-long crack in the land, ranging from 1 to 100 feet in width, developed near land that had been heavily pumped for groundwater.
- D. A large area of land keeps sinking about an inch every year. It's in an area where water is being heavily pumped for gas and oil refining.

Answer:

- Both C and D are correct

When water that is holding up the ground is withdrawn in large quantities, the rocks and soil above can collapse. But unlike a small sinkhole, subsidence may be harder to see, as it occurs over large areas of land. Its effects are compounded when intense underground water pumping occurs above or next to heavily populated areas.

In heavily populated, heavily pumped areas, like the Tampa Bay area in Florida, or California's San Joaquin Valley, there is significant subsidence. According to the U.S. Geological Survey (USGS), 17,000 square miles of the U.S., an area roughly the size of Vermont and New Hampshire combined, have been directly affected by subsidence. More than 80 percent of this has occurred because of exploitation of underground water.

9. Which of the following offer(s) justification for U.S. government farm subsidies?

- A. Without subsidies, many farmers would be out of work.
- B. Without subsidies, U.S. agricultural production would be less stable, forcing us to be at the mercy of foreign markets.
- C. Without subsidies, the already diminishing career of farming would attract even fewer farmers and farm workers.
- D. Without subsidies, consumers would pay considerably more for their groceries.



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Answer:

- All offer justification for subsidies

A. True: Farm subsidies supplement the incomes of farmers and agribusinesses that grow staples like corn, rice, wheat, and soy. Against the uncertainties of weather, subsidies provide a surety that farmers will be paid and will be able to compete with foreign markets.

B. True: With emerging agrarian superpowers like Brazil, there is little doubt that if the U.S. slacks in production, other nations will step in to supply. But if the simple rules of economics apply, this would have the U.S. agricultural sector at the mercy of foreign markets. We know the strains of foreign dependence on oil; with something as vital as food, there could likely be more shuffling of global powers.

C. True: In 1790, 90 percent of the labor force were farmers, now, owing largely to technology, this number is less than 1 percent. The work can be hot, repetitive, straining, and dependent on expensive, sometimes erratic equipment. Beyond their questionable politics, subsidies do help keep farmers in business. Michael Pollan, who researched the corn industry for book *The Omnivore's Dilemma: A Natural History of Four Meals*, writes of subsidies, "...taken together, these federal payments account for nearly half the income of the average Iowa corn farmer, and represent roughly a quarter of the \$19 billion U.S. taxpayers spend each year to payments on farmers."

D. True: In 1960, Americans spent 17.5 percent of their income on food; in 2007, we spent 9.9 percent on food. In terms of cost per calorie, subsidies are helping. But this does not mean that subsidies, which helped to launch the career of high fructose corn syrup, allow people to eat *better*. In this same time period, health care spending went from 5.2 percent of national income to 16 percent.

