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Farm Wars: Old MacDonald versus the Factory Farm

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Narrative

Many teachers of Mathematics are faced with a dilemma in the classroom: How do I make this lesson relevant and interesting? Students are constantly bemoaning the importance of one mathematical concept or another, and why they need to know it. Numeracy is as important as literacy, but generation after generation dread Math because they do not connect its usefulness to everyday life. This has been my personal goal from the time I decided to become a teacher.

Food is so much more than something you grab at the drive-thru. The manner in which it is produced has everything to do with the seminar topic of *Energy, Environment, and Health* . The intent of this unit is to utilize Math to examine and explain the costs, tangible and intangible, associated with the production of food. And what could possibly be more relevant to a teenager than food?

Even the White House has been promoting local farming. Food co-ops, farmers' markets and even backyard gardening have all been a part of Michelle Obama's agenda. Not everything we buy can be produced locally, but many of the things we enjoy are available just down the road!

If the way to a teen's heart is through his stomach, perhaps the way to get him to think differently is through his wallet. Math students need to understand that Algebra is the mathematical explanation of everyday life. By presenting students with a mathematical vantage point, perhaps the movement toward community supported agriculture will rise again and a new generation of citizens might actually enjoy math class!

Introduction

"Old MacDonald had a farm..." a familiar childhood song to see how many animals farmer McDonald had. Considering the current industry of food production, an updated version of the same song would only have one verse that would have to incorporate corn somehow. According to a recent two-year study by the Pew Charitable Trusts and Johns Hopkins Bloomberg School of Public Health:

"Not long ago, the bulk of fruit, grain, vegetables, meat and dairy products consumed by the American people were produced on small family farms. These farms once defined both the physical and the social character of the US countryside. However, the steady urbanization of the US population has resulted in an American populace that is increasingly disassociated from the production system that supplies its food. [1]

So what changed? Technology. Farmers saw technology as a way to make their farms more efficient. However, there was a problem: technology can be expensive. In the past, one farmer might have a plow, another an oxen and another would have a storage facility and they would all work together on the harvest. Advances in technology enabled farmers to be a bit more independent. As a result, farmers had to produce at maximum output to make up for the costs. This was fine when demand was high, but when the demand for their goods decreased, they still had to produce at the same high level. Ultimately, farmers decided to consolidate their resources to become more efficient. This unintentionally led to dominant firms controlling smaller ones, even to putting some of them out of business.

But technology isn't all bad, is it? Technological advances in agriculture have afforded us many advantages such as cheaper foods, exotic foods, genetically altered foods, strawberries in December and foods that even pests won't eat. However, these advances have also exposed us to illnesses and diseases and environmental damage that did not exist in farmer MacDonald's time.

"While increasing the speed of production, the intensive confinement production system creates a number of problems. These include contributing to the increase in the pool of antibiotic-resistant bacteria because of the overuse of antibiotics; air quality problems; the contamination of rivers, streams, and coastal waters with concentrated animal waste; animal welfare problems, mainly as a result of the extremely close quarters in which the animals are housed; and significant shifts in the social structure and economy of many farming regions throughout the country." [2]

The government takes a census of the farming industry every 5 years with the next census scheduled for 2012. This gives us the opportunity to make many more calculations with regard to changes in farming since 2007. Therefore, the data that is used in this exercise is dated but still relevant.

The amount of energy that is involved in the production of food is incredible. For example, in agriculture, the following are some of the contributing factors, or energy inputs in kcal/ha, to the production of fruits and vegetables:

· Labor

· Machinery

· Diesel

· Gasoline

· Nitrogen

· Phosphorus

· Potassium

· Insecticides

· Herbicides

· Fungicides

· Electricity

· Transportation (Organic Center p. 11-12)

For example, using the energy inputs listed above, to produce 46,000 kg of oranges requires a total of 22,921,000 kcal/ha which makes the ratio of kcal output/kcal input 1.02:1. To produce 55,000 kg of apples requires 30,660,000 kcal/ha with a ratio of 0.61:1. From this, we can conclude that the amount of energy needed to produce apples is less than that needed to produce oranges. (Pimentel and Pimentel 2008) [3]

In some cases, the ratio of the amount of food produced to the energy input is less than 1. Using various resources and websites, the students can investigate the specific energy input for a variety of fruits and vegetables and calculate the ratios of energy input to product yield (output).

According to the Organic Center report, *Impacts of Organic Farming on the Efficiency of Energy Use in Agriculture* , the US food system uses 19% of the total fossil energy burned: 7% of that for agricultural production; 7% for packaging; and 5% by the consumer. [4] Since smaller organic farms are less reliant on pesticides and large petroleum-consuming machinery, the benefits to the environment and the community are difficult to quantify, but significantly greater than the alternative.

Another major contributing factor to the production of food is water. One of the exercises involves the different amounts of water, in gallons, that are used to produce a serving size of certain foods. Students will be asked to build a sandwich using the given ingredients and then calculate the amount of water used to produce that one sandwich. [5] The results are eye-opening!

Industrial Farm Animal Production has also affected how meat, poultry and dairy are produced in this country. "Over the past 50 years, the production of farm animals for food has shifted from the traditional, extensive, decentralized family farm system to a more concentrated system with fewer producers, in which large numbers of animals are confined in enormous operations." [6] For example, although the number of swine raised in this country today is about the same as in the 1950's, the number of farms and farm workers has declined to very few, larger farms where hundreds of animals are kept indoors and in cages that restrict their movement. As a result of the inhumane conditions under which these animals are contained, they are injected with antibiotics to prevent disease and accelerate their growth. This practice began in the 1940's and has contributed to the "growing pool of antimicrobial resistance in the environment." [7] As a result, there has been an increase in infectious diseases that are multi-drug resistant.

But what about Connecticut? It is the third smallest state in the US. According to the USDA 2007 Census of Agriculture, there are approximately 3.18 million acres of land in Connecticut. A little over 405,500 acres is dedicated farmland accounting for 13% of the total area of Connecticut. The average size of the small and medium family farm in Connecticut is 82 acres compared to the national average of 418 acres. Connecticut's agriculture is very diverse. As one might expect, milk and dairy products and poultry and eggs comprise a good portion, 21%, of agricultural sales. However, nursery, greenhouse, floriculture and sod make up nearly 50% and tobacco 10% of sales of agricultural products in Connecticut.

What are the benefits of consuming agricultural products produced in Connecticut? According to the University of Connecticut's *Economic Impacts of Connecticut's Agricultural Industry* , "the agricultural industry has a critical, significant impact on the economy of Connecticut in output, jobs, and the quality of life: $3.5 billion in output, 20,000 jobs, and significant social benefits and ecosystem services." [8] All residents of Connecticut benefit from the local farming industry, including those that do not purchase locally grown products. Some benefits would be environmental. Hypothetically, if people purchased produce grown locally, it would decrease the amount of tractor-trailer traffic on I-95 and I-84. People would purchase from farmers' markets, vegetable stands and food cooperatives. The purchase of these items would increase the dollars that are spent within the state and not go to mass producers out of state.

Purpose

The purpose of this unit is to enable students to realize and illustrate how math is a useful tool in making everyday decisions. It should elevate their awareness about how something as simple as the purchase of groceries has global implications and ramifications. Our students are not just consumers; they need to be educated consumers because we are training them for the future. They will be empowered to form their own opinions about whether it is better to purchase goods produced within a day's drive of their home or a product that is manufactured in a place with no windows. The lesson can be expanded to include such things as soil degradation around the world and calculate the percentage of land on earth that is still fertile enough to grow crops and sustain livestock.

Using mostly Algebra, students will be calculating distances food has to travel from farm to table, costs of production, graphing to determine break-even points, and other methods to help determine which type of agricultural practice is the most beneficial to the environment, economic impact to the community, uses the least amount of energy and is better for their health. Corporations have spent millions of dollars convincing the consumer that bigger is better. Students will gain an understanding of the facts based on their own research and calculations without the influence of a slick marketing campaign. Because businesses and large farming conglomerates have lobbyists in Washington, even the information we receive from the government is somewhat less than reliable. Knowledge is power and empowering students so that they can make more informed choices will undoubtedly have an effect on the food purchases and consumption within their household if only by a small percentage.

Because it varies so widely from country to country, the focus of this unit will be on US production and, more specifically, Connecticut. I want the students to look at what they eat and research from where it originated. After the information is collected, students will evaluate whether it can be obtained in New Haven County, within a 50 mile radius of New Haven County, the State of Connecticut, the Northeastern US, the continental

US and beyond in that order. Because consumers are so detached from the production of food, the added purpose of the unit is to enlighten students' consciousness to what they are putting in their mouths and how their eating habits affect the world beyond New Haven. Most students can tell you what they like or don't like to eat, but few can tell you from where it comes or what it took to produce that chicken nugget, regardless of the conditions the chicken experienced before being slaughtered.

Students will be asked to compare and contrast production costs of a local farm, possibly one they have visited on a field trip, or cooperative and the costs related to food at a chain supermarket. They will explore the cost of the item from farm to register as well as the price of the item to the consumer.

If the unit is done in the fall, it is possible to thread the lesson over the course of the school year. For example, in New England and other parts of the US, it is apple-picking season. A class trip to the local orchard is a great way to build unity in the class and start a relationship with a local farmer. Once the seasons change, apples are still available year-round, but most are imported from outside the US. Students can compare and contrast the cost, quality and taste of the apples picked locally with that of the imports during the winter months.

Students can also calculate the percentage of soil and the gradual stages of soil degradation. The effect of industrialized farming has implications around the world beyond providing food for the masses. In the same way, local farming is limited in what it can provide for the community. As the demand for housing increases, land becomes expensive and some farmers, especially here in Connecticut, are forced to choose between the demand for their produce and the demand for their land.

Lesson Plan

Goal: Using the information obtained from their food journal, students will transfer it to a graph and record what they consume, how much they consume and how often.

Objective: Students will be able to organize data in tables

Materials

· Computer

· Spreadsheet program

· Food journal

Instructional Strategies (Marzano)

· Summarizing and Note Taking

· Reinforcing Effort and Providing Recognition

· Nonlinguistic Representations

· Cooperative Learning

· Homework and Practice

Teacher Notes

Using a spreadsheet program, students will organize their food journals. They will be able to compose graphs from the information to show how much they eat of certain foods during the course of the day. Students may need to be guided determine which things go on which axis and organize their information. Once the students have assembled their spreadsheets and made their pie charts, they can present them to the class and compare charts with each other.

Lesson Plan

Materials:

· LED Projector

· Computer with internet access

Objective: Students will be able to interpret, sketch, and analyze graphs from situations.

On the news and on the internet, graphs are used as a simple way to communicate large amounts of data. Being able to read a graph, interpret what it represents and analyze the information is crucial in so many areas.

Bellwork: Ask each student to write a brief paragraph of their journey to school, from door to door. (As the students are writing their assignment, draw Q1 of the coordinate plane on the board without any numbers. Label the y-axis "distance" and the x-axis "time")

· Select a few students at random and ask them to read their story. Choose a different colour for each student and "draw" their story on the board. Do not explain what you are doing. As you are drawing more and more students' stories, some in the class might start to see a pattern. The line is steeper when the student took the bus and flat when they were waiting for the bus, why?

· Now ask the students to draw a graph on the same paper as their story and hand it in to assess their understanding.

Classwork: Explain to the students that graphs are not always confined to lines and grids. There are many different ways in which data may be presented outside of the traditional. Yet, we are still able to "read" the graph and draw conclusions based on what we see.

· Go to the website: www.factoryfarmmap.org

· Using the initial setting, ask the students what they can infer by looking at the map.

· Before moving to specific categories, ask the students to predict what they think the map will look like when you select the category. Most people don't really consider where their food comes from. This map provides a

somewhat graphic depiction of the concentration of factory farms and what regions of the country are affected. The beauty of this map is that you can do it for every state in the Union.

· Does Connecticut have any large concentrations of the products listed? Click on Connecticut. Ask the students what products they think might be relevant to our state. Which counties are affected?

Homework: Have students search the internet to find a graph that is similar to the ones used in class. Each student should come back with a story based on the graph they selected. If the students are having difficulty finding a website, Google Images is a great place to start!

Project Lesson Plan

If at all possible, do this lesson as close to the beginning of school as possible. The data collected in this unit will be used throughout the year as a reference used for various future lessons.

Materials:

· Journal

Objective: Students will be able to collect data and analyze the results.

Students are going to record everything they consume, food and beverage, over the course of a weekend. (You may want to do a similar project for one day to get the students used to keeping track of what they consume) If possible, have them record how much of each thing they ate. For prepared foods, like a Happy Meal, have them list what the meal consisted of.

When the students have their lists complete, they need to break everything down. For example, if they ate mac n' cheese, they should list wheat, cheese and milk for the pasta and cheese sauce. The Happy meal can be listed as beef, wheat, potatoes and soda (you can break this down using another lesson or in science class). Chances are, most kids don't think about where their food comes from or what is in it.

Once the students have reduced their food to basic ingredients, have them list the frequency of certain foods. What patterns do they see? How much of their food is "natural" versus processed? Use the table below as an example for them to see how much water it took to produce a typical meal.

Food (typical serving size)	Water Used to Produce One Serving	Grains and Soybeans Used to Produce One Serving
Lettuce (1 cup)	3 gallons	none
Tomato (1 small)	8 gallons	none
Broccoli (1/2 cup)	11 gallons	none
Whole-wheat bread - 2 slices (.8 oz each slice)	15 gallons	.065 lbs
White bread - 2 slices (.8 oz each slice)	21 gallons	.065 lbs
Eggs - 1 egg (2.1 oz)	63 gallons	.375 lbs
Chicken with skin and bones - 4 oz	165 gallons	.75 lbs
Hamburger patty - 4 oz	616 gallons	4 lbs

Data derived from USDA, Economic Research Service, Beltsville, Md. As cited in Frances Moore Lappé, Diet for a Small Planet, Ballantine Books, 1982, p. 70 and from "Water Inputs in California Food Production," a 1991 study for the Water Education Foundation, Sacramento, CA. Water-use data include all water for raising feed, raising animals or plants, and processing; data are for food production in California only.

There are many other sources that would be great to see how much fuel is used to produce the same amount of food or how many steps it takes for the food to get from the farm to the plate.

Students can use their data to show the percentage of what they consume. Have the students list the amounts of food they consume in order. They can compare it to "My Plate" to see if they are getting what the government considers a healthy meal. How far did their food have to travel? Did the pork in their hot dog come all the way from Iowa? Did that strawberry come from Lyman Orchards, California or South America? How much of what they consumed actually came from Connecticut? How could they increase the percentage of food they consume to come from within a 50-mile radius?

The data the students collect can be used over the course of the entire school year. Also, you can have the students update their journal with newer data every month or term. This way, the students can see if their eating habits change over time. Perhaps student diets will change the more informed they become. The percentage of imported food might increase over the winter months when some fruits and vegetables are not available locally. The students can recalculate their findings and compare them to the Fall when classes started.

Project Lesson Plan – Field Trip/Data collection

New Haven has a farmers' market that meets in various parts of the city on different days of the week. Almost every type of food that is available at the grocery store can be found at the farmers' market.

Students should be prepped regarding the proper way to ask questions and speak to merchants. They should have had a class exercise where they have prepared questions ahead of time to ask the different farmers and the grocery store employees.

The purpose of this project is for students to get an idea of what is available locally, how much it costs to produce, and how much it is to purchase. This information will be used to compare and contrast similar items that are available at the local grocery chain store. Students should find out how far the farmer had to travel to

get their products to New Haven. When was the food harvested? How was it produced? How long did it take from the time it was harvested to the market? The questions should deal with expenses, costs, distance traveled, time, land use, crop yield, and other quantifiable things associated with food production.

Arrangements can be made ahead of time to meet with the grocery chain. They are often very welcoming of local students because their parents may shop there. Stop & Shop is very generous and give behind-the-scene tours with their department heads and they are quite knowledgeable about food origins and some of the same information that the local farmers will provide.

The data collected from this lesson can be used throughout the school year for basically every unit. Simply extract the information you need to satisfy the unit you are teaching.

Student Resources

· Weber, Karl (editor *) Food Inc.: A Participant Guide: How Industrial Food is Making Us Sicker, Fatter, and Poorer-And What You Can Do About It*

· Bellman, Allan E. and Sadie Chavis Bragg, Randall I. Charles, William G. Handlin, Sr., Dan Kennedy (2004). *Algebra 1* . Upper Saddle River, NJ: Prentice-Hall.

Teacher Resources

· *Food Inc.* , Dir. Robert Kenner. 2009. DVD. Magnolia Pictures Participant Media

· Anderson, Cathy, ed. *Environmetal Action: Food Choices* . New York: Dale Seymour, 1998

· Bendrick , Lou. *Eat Where You Live: How to Find and Enjoy Local and Sustainable Produce No Matter Where You Live,* PublicAffairs, 2002.

· Brownell, Kelly. Food Fight. McGraw Hill. 2004.

· Kessler , David. A Question Of Intent: A Great American Battle With A Deadly Industry, PublicAffairs, 2002.

· Kessler, David. The End of Overeating: Taking control of the Insatiable American Appetite. Rodale, 2009.

· Pollan, Michael. *The Omnivore's Dilemma: A Natural History of Four Meals* . New York: Penguin, 2006

· " 'Locally grown' food sounds great, but what does it mean?" USA Today 27 Oct. 2008

o http://www.usatoday.com/money/economy/2008-10-27-local-grown-farms-produce_N.htm

· Mayor, Leah, "Zero Waste Total Impact: Transforming School Lunch" online posting. 31 March 2011. *Huffington Post*

o http://www.huffingtonpost.com/leah-mayor/sustainable-school-food-green_b_842816.html

· United States Department of Agriculture. *Cooperatives in a Changing Global Food System* . Washington: GPO, 1997

· LocallyGrown.net – resource listing farmers' markets throughout North America

· http://www.localharvest.org/

o Organic farms and CSAs (Community Supported Agriculture)

· http://environment.about.com/od/greenlivingdesign/a/locally_grown.htm

o How Does Eating Locally Grown Food Help the Environment?

· http://www.youtube.com/watch?v=S5rd2_d4HWc&feature=related

o CNN Reports Swine Flu : Inhumane Factory Farming Root Cause

· http://www.organic-center.org/reportfiles/ENERGY_SSR.pdf

o *Impacts of Organic Farming on the Efficiency of Energy Use in Agriculture*

· http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Fact_Sheets/farm_numbers.pdf

o USDA 2007 Census of Agriculture

· A Report of the Pew Commission on Industrial Farm Animal Production

Appendix

Alignment with the NCTM standards requires that the mathematics curriculum should make mathematics more accessible and relevant to students. These developed concepts and skills should be integrated throughout all subject areas. The following standards are addressed within this curriculum unit:

· Understand patterns, relations, and functions

· Represent and analyze mathematical situations and structures using algebraic symbols

· Use mathematical models to represent and understand quantitative relationships

· Analyze change in various contexts

· Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

· Develop and evaluate inferences and predictions that are based on data

The state of Connecticut is also adopting a new set of standards known as the Common Core Sate Standards for Mathematics. The following standards are addressed within this curriculum unit:

· Create equations that describe numbers or relationships.

o A.CED. 1, 2, 3, 4

· Understand solving equations as a process of reasoning and explain the reasoning.

o A.REI.1

· Solve systems of equations.

o A.REI.6

· Represent and solve equations and inequalities graphically.

o A.REI.11, 12

· Analyze functions using different representations.

o F.IF.9

· Construct and compare linear models and solve problems.

o F.LE.1, 3

· Interpret linear models.

o S.ID.7, 8, 9

· Write expressions in equivalent forms to solve problems.

o A.SSE.3

· Create equations that describe numbers or relationships.

o A.CED.1, 2

Endnotes

1 (The Pew Commission on Industrial Farm Animal Production 2009)
2 (The Pew Commission on Industrial Farm Animal Production 2009, 3)
3 (Pimentel and Pimentel 2008, 122)
4 (Impacts of Organic Farming on the Efficiency of Energy Use in Agriculture n.d., 2)
5 (Anderson 1998, 22)
6 (The Pew Commission on Industrial Farm Animal Production 2009, 5)
7 (The Pew Commission on Industrial Farm Animal Production 2009, 5)
8 (University of Connecticut - The Department of Agriculture and Resource Economics 2010, 5)