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The Science and Technology of Food: The Food Unit

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Teachers' Introduction

In the Science, Technology and Society seminar, each teacher prepared a unit on the science and technology of a basic human issue. This unit is on food.

There are two introductions to this unit. The first introduction gives noncontent information to teachers; the second introduction describes the content covered. With this division, all material following the teachers' introduction can become a student text. The student text provides material for classroom work on reading as well as for class discussions and assignments.

The material presented in this unit is suitable for use in consumer and applied math, natural science, home economics and social studies classes. It could provide the foundation curriculum for from four to eight weeks of work. This time frame will allow for activities such as going through the seven guidelines the U.S. Department of Agriculture (USDA) puts out on food and nutrition, extra lessons on metric measurement, looking at the parts of plants and different foods under a microscope, and measuring the growth of two plants-one fertilized and one not fertilized.

The Teachers Institute packet that goes with this unit will include a copy of the unit, a copy of the USDA's seven guidelines, a set of six pocket microscopes and a copy of the answers, suggested answers and comments for the questions and activities.

The appendix gives teaching schedule and lesson plans.

The Food Unit

I. Introduction

This unit is on food. Food is one of our most important human needs. Not only does life depend on it, but the quality of the food we eat effects the quality of our lives. The purpose of this unit is to help us become better food consumers. The method for doing so is to develop our understanding of food issues by working with and

discussing information in four areas: the world food situation, food production, food storage and transportation, and becoming better food consumers.

The world food situation section looks at some of the significant differences between developed and developing countries, what world food security means, and some aspects of hunger and malnutrition.

The food production section aims primarily at developing a sense of how a plant grows, that the carbon, nitrogen and water processes cycle and the energy process flows primarily to earth and away from it. Soil condition, fertilizers, pesticides, erosion, seeds, water and energy are important agricultural issues.

The part on food storage and transportation stresses that grains are the world's most important food because they are easy to store and transport, can be grown with relatively little labor, have a high yield for work involved, and have high nutritional value. Wheat, rice and corn are the most important of the grains and together they provide the basic food for most of the world. This section further states that perishable foods have a variety of storage and transportation needs and that almost all U.S. domestic foods both dry and perishable are transported by truck.

The part on becoming better consumers considers two approaches, the U.S. Department of Agriculture's (USDA's) seven nutritional guidelines and an international approach, in trying to find suitable guidelines for food selection, preparation and consumption. As consumers, whatever we buy we encourage the production of that item. Each food item we buy has nutritional, environmental, and political effects.

II. The World Food Situation

i. Developed and Developing Countries: Science andTechnology.

In the world today we have developed countries such as those in North America, Europe, Japan, Oceanic and USSR, and developing countries such as those in Africa, Asia, and Latin America. One of the major differences between the two groups is that the developed nations have a high level of science and technology.

Science can be defined as the systematized arrangement of facts about the physical world as they are currently understood. Technology can be defined as the sum of the ways a group uses knowledge from the sciences and arts to provide for their material needs. The combined use of a high level of scientific and technological knowledge has a profound effect on the daily lives of people; this is illustrated in the following table that compares developed and developing countries.

The Gap Between Developed and Developing Countries [1]

Comparing	Developing countries	Developed countries
Per capita GNP, $	500	5,500
Number of people per doctor	3,490	680
Deaths per 1,000 live births	120	20
Life Expectancy in years	52	71

Grams of Protein per day per person	54	97
Literacy, %	43	97

2. World Food Security.\

World food security means the assurance of adequate daily food consumption at the national, village and family level even in years of bad harvest. To accomplish this would require that each country become as food sufficient as possible and that we maintain a food reserve of 17 to 18 percent of the total annual world consumption. [2] This reserve would help keep

This is what we want, world food security; what we have is a large number of people who are hungry and malnourished.

3. Hunger and Malnutrition.

How extensive is the problem of hunger and malnutrition? There are about 5 billion people on Earth, more than 1 billion people are chronically hungry and 35,000 people die each day from hunger. That is 24 of us 18 of whom are children die from hunger each minute. [3]

What do we mean by hunger? Hunger is an urgent need or desire for food. It can exist as chronic undernutrition, malnutrition, malabsorptive hunger, seasonal hunger and famine. [4]

What do we mean by malnutrition? Malnutrition is any faulty or insufficient dietary condition. Specifically, it is a condition resulting when an individual's diet has a relative deficiency or relative excess of specific nutrients vital to good health. [4] There are many reasons for malnutrition, personal difficulties in metabolism, lack of knowledge as to adequate food selection, inadequate preparation and consumption patterns, a shortage of food and lack of means to obtain food. [5]

4. Why We Have Hunger and Malnutrition.

Personal difficulty in metabolism is a medical problem possibly caused by hereditary or disease factors. Lack of knowledge as to adequate food selection and inadequate preparation and consumption patterns are educational problems and the target of this unit, Shortage of food and lack of means to obtain it are political issues.

5. The Hunger Project and The World Food Council,

The Hunger Project [6], and international organization of over 3 million people who are committed to ending hunger by the year 2000, state that we have more than enough food to feed all the people on earth.

> If all the food produced on earth each year were divided equally among all the people of the earth, every person would receive about 2.3 kilograms (five pounds) of food per day more than three times the minimum amount needed to support life. The grain alone would provide everyone with the equivalent of two loaves of bread a day. The food *currently* raised each year is more than enough to adequately feed the 6.1 billion people anticipated by the year 2000. [7]

The World Food Council [8] of the United Nations, the organization that monitors food problems and acts as a

political catalyst by providing a forum for discussion of policy and proposals, states that several delegations believe that hunger and malnutrition are due to international financial and trade crisis and an inequitable economic order. [9]

III. Food Production

Understanding how food is produced will help us to better understand the nutritional as well as the environmental and political aspects of food. To talk about food production means to talk about growing plants. All our food comes from plants, or animals that eat plants, or animals that eat animals that eat plants. [10] Some work is being done in aquaculture, but our main food supply comes from land products and that is the focus here.

1. How a plant grows.

As a plant grows it takes water and nutrients from the soil, takes carbon dioxide from the air and uses the sun's energy to chemically combine these ingredients to make the carbohydrates (sugar and starch), protein and fat molecules in its structure. During this process, called photosynthesis, oxygen is released into the air. The process of how a plant grows is represented by the following illustration.

(figure available in print format)

The carbon in the carbon dioxide that plants take in from the air becomes part of the chemical structure of the plant's carbohydrate, protein and fat molecules. When animals eat plant food, some of it is used as energy and some is stored. As animals use food energy in their living activities, they breath out carbon in the form of carbon dioxide, thus it is returning to the air. The animals breathe in oxygen and breathe out carbon dioxide.

Plants take in carbon dioxide and breathe out oxygen. Carbon dioxide is also continually being released into the air from decaying waste of plants and animals. This process is called the carbon cycle and is represented by the following illustration.

(figure available in print format)

The energy that the plant receives from the sun does the work of photosynthesis. The result of photosynthesis is that energy is stored in the plant material and can be recovered by burning plants such as wood or using plant food for animal energy.

Energy does not cycle like carbon, it primarily flows to earth and back out into the atmosphere. Solar energy arrives on earth in the form of visible light or ultra violet rays. Three of the things that could happen to solar energy as it comes to earth are: it could hit a pavement and be reflected back into the atmosphere as infrared rays, be absorbed by a plant and cause photosynthesis, or strike water and provide the heat for water evaporation. Most energy eventually flows away from earth in the form of heat: it does not cycle. Examples of energy flow are illustrated below.

(figure available in print format)

2. Land.

A plant needs land in which to grow. Three major land concerns are maintenance of active soil, use of fertilizers and pesticides, and control of erosion.

a. *Soil* . Active soil is essential for growing good food. A clear description of what soil is as follows.

> The soil is an ever changing natural body that covers a large portion of the earth's land surface. It teems with life. One gram of soil may contain several billion bacteria. Also found in the soil are roots of higher plants, algae, small mammals (e.g., squirrels, gophers, woodchucks, mice, moles), worms, insects, snails and many more.
>
> A soil in one place may differ from a soil in another place. And a soil in an area will change with the passage of time. [11]

All soil, regardless of the place or time, consists of these four major components: mineral particles (sand, silt, and clay), organic matter (partially decayed plant and animal waste), water and air. When a soil contains the proper proportion of these four components, it can supply plants with many of their life sustaining requirements.

Soil composition is complex; this can be seen by the two tables below. The first table lists the nutrients most plants need to grow, and therefore good soil needs to have most of these. The second table illustrates what some farmers consider to be the composition of a good growing soil.

Nutrients Essential for the Growth and Development of Most Plants [12]

Nutrients needed *in substantial amounts*	Nutrients needed in much smaller amounts
Carbon	Iron
Oxygen	Boron
Hydrogen	Copper
Nitrogen	Zinc
Phosphorous	Molybdenum
Potassium	Manganese
Sulfur	Chlorine
Magnesium	
Calcium	

Composition of Good Growing Soil [13]

Component	Percentage of soil by Volume
mineral particles	45%
organic matter	5%
water	25%
air	25%

b. *Fertilizers and pesticides* . As plants grow they take the sixteen nutrients they need from the soil. Once plants are grown and harvested, the nutrients they took are gone from the soil forever, If nutrients are not restored to the soil, it will become depleted and no longer have the nutrients needed to produce food crops. There are two basic methods to replacing lost nutrients, organic and inorganic methods,

The organic method uses organic fertilizers, a balance of plants and animals, and legume rotation. Organic

fertilizers are made from the decomposition of plant and animal wastes. A balance of plants and animals refer to the use of a field first for crops and then for grazing animals. This type of rotation allows the soil to rest and become enriched by incorporating the animal manure.

Legume rotation replaces nitrogen in the soil. Nitrogen is the most difficult of the nutrients to replace. Though it is found in abundance in the air, most plants cannot use nitrogen in that form. Legume plants, however, can. In legume rotation s field is planted alternately with legume and non-legume plants. Legumes include such plants as beans, peas, alfalfa, and clover. Non-legumes include grain crops, fruits, vegetables, and other plants. Legumes take nitrogen from the air and deposit it through their roots into the soil as a water soluble compound. The non-legume plants are able to use the water soluble form. Thus legumes put nitrogen into the soil; non-legumes take it from the soil. Further, as plant and animal waste decomposes, nitrogen is again released into the air. This entire process is called the nitrogen cycle and it is illustrated below.

(figure available in print format)

The inorganic method of replacing nutrients in the soil uses chemically produced compounds called inorganic fertilizers. Currently most U.S. farmers use inorganic fertilizers.

The proponents of organic fertilizers believe that (1) using the natural nutrients of organic matter from plant and animal waste and some crops grown for that purpose (green manure) produces richer soil and healthier plants and (2) this method requires significantly less fuel energy. Opponents of organic fertilizers say it (1) requires too much labor and (2) doesn’t produce as much food.

Proponents of inorganic fertilizers hold that it (1) is easier to apply, (2) produces high crop-yields, and (3) helps to produce low cost food. Critics of inorganic fertilizers say (1) they take a lot of fuel energy to produce and (2) cause contamination of drinking wells and lakes.

Opponents of organic farming, a method that uses organic fertilizers and alternatives to pesticides and herbicides (see below), believe that it is not practical. Some farms, however, do well using organic farming methods. One study done on organic farming results showed that organic farms used about 1/3 as much energy and the farmers enjoyed essentially the same income as the inorganic farmers. [14]

Pesticides and herbicides are chemical compounds used to protect crops from insects, disease or weeds. Their use is more controversial than the use of fertilizers. On the positive side they protect crops from insects, disease and weeds thus allowing for greater production of food. On the negative side they are poisons that can seep into the land and contaminate drinking wells and lakes, get into the leaves, roots and fruit of plants and then into the bodies of people who eat them. They also kill off useful insects, and the continual use of pesticides have caused some insects to develop immunity to them so that more and more pesticide is needed to do the job.

There are traditional and new developing methods of dealing with pests that do not require pesticides and herbicides. Some of these are as follows: growing healthy plants in healthy soil, one organically fertilized, makes it more resistant to pests and disease; planting a variety of crops instead of only one kind prevents an entire wipeout should a blight strike one type of crop; planting various combinations of plants that have a protective effect on each other in that one plant has a repelling effect on a pest that would otherwise go after one of the plants planted with it; and finally, using sophisticated biological technologies involving predator releases, microbial disease, biodegradable botanical sprays, resistant varieties, and mechanical and pheromone traps. [15] To use such methods takes more skill and work than spraying a field with poison.

However, it takes time to learn these skills, labor is expensive, and farmers must deal with the economic realities.

c. *Erosion* . The last land issue to be covered is erosion. It is not enough to develop and maintain active soil, you also have to protect it from being washed or blown away. About 5 billion tons of top soil, approximately 12 tons per acre, are lost annually from U.S. croplands. About three-quarters of the erosion is from water and one quarter from wind. [16]

Just as the top soil is being continually eroded away, it is also continually being formed. The problem is that the rate it is being formed is about 1.5 tons per acre per year and the rate it's being eroded is 12 tons per acre per year.

The conservation of topsoil is a major problem. Erosion is almost nonexistent in well-covered woodland, slow in land covered with trees and grass, and fast in fields that are cropped each year and not covered. Some of the factors that determine the severity of soil erosion are soil type, soil depth, slope of the land, length of slope, amount of organic matter present, cultivation practices, crops grown, rotation schedule, and duration and intensity of wind or rainfall. Worldwide soil erosion is worse than in the U.S. In developing countries it is estimated at twice as much. [17]

3. Seeds.

There are different kinds of seeds for each species of plant. Each kind of seeds had different qualities like some will do well in a moist climate but not in a dry one, or Certain seeds will produce plants that are resistant to specific insects. Throughout the world continual research is being done to try to find seeds that best meet the needs of each area.

4. Water.

In addition to seeds, soil and fertilizers, plants need water. The earth has a lot of water that flows and cycles about it. The amount of water on earth is constant. We do not get more and we do not lose it. The water cycle basically goes as follows: Heat from the sun's energy evaporates water from oceans and other surfaces; the moisture gathers in the atmosphere forming clouds. As the clouds become saturated, they drop the moisture in the form of rain or snow. As the rain or snow falls to earth any number of things could happen to it including being absorbed by the soil, running off the land into streams, or penetrating the soil to become part of an underground water flow. Eventually it will find its way into a stream, evaporate it once gain. The cycle will continue to repeat. The following illustration represents the water (hydrologic) cycle.

(figure available in print format)

Some land receives an abundance of water, but other land must be irrigated to make it arable. Throughout the history of agriculture and throughout the world today, farmers are trying to find improved ways of watering crops. As an example of the amount of land needing irrigation, in the U.S. in 1984 there were 175,134,000 acres of cropland planted and 44,731 acres had to be irrigated.

5. Energy.

Along with land, fertilizers, seeds and water, plants need energy to help them grow. The most important source of energy is the sun's energy mentioned above. But labor and fuel energy are also significant.

Different agricultural methods require vastly different amounts and types of energy. For instance, traditional dryland Asian rice culture uses about one calorie of energy (in the form of human labor) to produce about twenty calories of rice. Modern U.S. corn production requires about one calorie (mostly in the form of tractor fuel, fertilizer and heat for drying) to produce one calorie of corn. At the high extreme, feedlot beef production and modern deep sea fishing require from ten to twenty calories of energy to yield one calorie of food. [19]

Energy used to produce food usually does not stop with growing it. Most foods are processed, transported, and stored before we get them. The following table shows the percentage breakdown of the energy required to produce a 1-kilogram loaf of white bread and deliver it to a retail store in the United Kingdom. It is interesting to notice that slightly less than one-fifth (19.4%) of the energy used to produce the loaf of bread was used in the actual production of wheat. Slightly over four-fifths (80.6%) of the energy required was not related to farm cost of growing the basic food, wheat, but primarily for processing (57%), packaging (10.3%) and transportation (9,8%). The retail store used 3.4% of the energy.

Energy Needed to Produce and Deliver a 1 Kg Loaf of Bread [19]

Growing Wheat	19..4%	Confection	64.3%
tractors, etc.	5.3%	direct fuel and power	30.2%
fertilizers	11.1%	other items	17.3%
drying, spraying	3.0%	packaging	9.0%
		transport	7.8%
Milling Wheat	12.9%	*Retail Stores*	3.4%
direct fuel and power	7.4%	retail stores	3.4%
other	2.1%		
packaging (1.3%) and			
transport (2.0%)	3.3%		

IV. Food Storage and Transportation

Food must be stored to last between harvests and for being transported. Food in storage needs to be protected from being spoiled by microorganisms, being eaten by animals, losing nutritional value or losing its attractiveness.

The usual methods of preserving foods for storage are by drying, canning, freezing, refrigerating, fermentation, pickling, preserving as a sugar concentrate, with chemical additives, smoking, salting, and irradiation.

Drying is the most widely used and perhaps the oldest method. There is, however, competition between all methods of food preservation, and this competition is being settled by the consumer. The result of all this, according to one food expert, is that:

> . . . foods best preserved by freezing are generally frozen. Those foods highly acceptable as canned products continue as highly successful consumer goods. The economic struggle for survival between fresh, canned, dried and frozen foods in a free market evidences itself in better foods at lower prices for the consumer. [20]

Grains are humankinds main food supply and have been so down through the centuries. Grains, being the dry seeds of certain plants, are easy to store and transport, can be grown with relative little labor, and have a high yield for work involved and have high nutritional value.

There are seven grains: millet, rice, wheat, barley, rye, oats and corn. Of these, wheat, rice and corn are the most important since together they provide the basic food for most of the world. The following table shows the world production of these grains for one year (1979). It also lists the world's major producers of each.

The World's Main Food Crops (1979) [21]

Wheat		Rice		Corn	
I441 mmt		376 mmt		363 mmt	
USSR	27%	China	35%	U.S.	49%
U.S.	11%	India	29%	China	9%
China	10%	Indonesia	7%	Brazil	4%
India	7%	Bangladesh	5%	Romania	3%
France	5%	Thailand	4%	S. Africa	3%
Canada	5%	Japan	4%	S. Argentina	3%
Australia	4%	Burma	3%	Mexico	2.5%
Turkey	4%	Viet Nam	2%	France	2.5%
other	27%	other	18%	USSR	2%
				other	22%

These three main grain crops provide the basic food for most of the world, whether directly consumed or converted into meat and dairy products. (mmt = million metric tons)

Grains are stored in enormous steel silos as well as in village huts, sacks, piles of grains, piles of sacks, storerooms and warehouses. Our storage methods need to be improved for, according to the World Food and Agricultural Organization, each year up to 20% of the worlds grain, about 250 mmt, is destroyed by pests, rot, and other problems following the harvest.

This information is not as remotely related to the food we eat as it might first appear. Consider all the boxes of cereal, breads, rolls and buns, crackers, cookies, cakes, pies and pancakes you've eaten in your life, without grains they'd all disappear. Next consider all the beef, chicken and pork you have eaten they would have to go too since today almost all food animals are fed grains.

Without the animals you would not have the eggs, cheeses and milk either. Beers and liquors would go too because they are produced from grains. The point is that grains are our most important food crop. The quality and amount available will effect the quality of our food and the prices we may pay for many, if not most, of our food.

Grains and other dry foods are easily stored and transported. Other more perishable foods like fruit, vegetables, meat and dairy products need various methods of preservation depending on the individual need of each food.

Grains form the greatest bulk of dry commodities for transportation. Looking at the U.S. system, grains for domestic use are almost entirely moved by truck. Grains for export are moved either by barge, such as those

from major corn and soybean production areas along the Mississippi River system, or train, such as those from the major wheat production areas of the South Central Great Plains and the Northern Great Plains.

U.S. domestic perishable foods are primarily transported by truck. In general domestic perishable foods make little use of railways and almost no use of water transportation. Air transportation is used for such items as strawberries where the products are extremely perishable and transit time must be short.

For an idea of the volume we are talking about and a comparison of the domestic movement of food, in 1982 the U.S. moved about 172 mmt of perishables and 187.3 mmt of grains. [23]

V. Becoming Better Food Consumers

Earlier in this unit malnutrition was defined. It is important to realize that malnutrition isn't just something "out there" effecting other people or in the poorer countries, it is very much a part of our lives and is being recognized as contributing to many of the health problems we have from tooth decay and emotional instability to high blood pressure and cancer. What guidelines should we use in the selecting, preparing and consuming of food? We will look at two approaches to this question: the specific U.S, Department of Agriculture's (USDA's) seven guidelines and an international approach presented by Dr. Rudolph Ballentine in his book *Diet and Nutrition* . Our focus is primarily on the nutritional aspects of food; we will mention, however, that there are important environmental and political aspects of the choices we make,

USDA's Seven Guidelines.

Each of the USDA's seven guidelines is 4-12 pages long and gives facts, suggestions and recipes to help us choose and prepare foods to meet our nutritional needs. Each of the guidelines is listed below with a summary of the main ideas in each.

Guideline 1: Eat a Variety of Foods.

Since no one food provides all the vitamins, minerals, protein, fat, carbohydrates and water we need in the amounts we need them, it is important to eat several types of food each day to get the nutrients we need.

To help describe a varied diet, foods are grouped by the nutrients they contain. The major groups used here are the following:

1. Breads, cereals, and other grain products.

2. Fruits

3. Vegetables

4. Meat, poultry, fish, eggs, dry beans & peas

5. Milk, cheese, and yogurt

A varied diet includes foods from each of these groups every day. It should have different foods within groups, too. [24]

Guideline 2: Maintain Desirable Weight.

Reduce the number of calories you eat, get the most nutritional value for the calories consumed, and increase exercise.

Obesity is harmful to your health and may shorten your life. It increases risk of high blood pressure, diabetes, heart disease, and many other medical problems. [2]

Guideline 3: Avoid Too Much Fat, Saturated Fat, and Cholesterol.

Most nutritional authorities recommend that the U.S. population as a whole should reduce daily intake of fat, saturated fat and cholesterol. Why? Because diets high in fat, saturated fat and cholesterol increase the risk of heart disease and give you calories without significant nutrient value.

The way to lower fat intake includes the following:

1. selecting lower fat dairy products

2. selecting lean meats

3. using lowfat preparation methods

4. reducing amounts of fats added at the table [26]

Guideline 4: Eat Foods with Adequate Starch and Fiber.

Why eat starch and fiber? Because they provide energy, provide vitamins and minerals, mostly are low in fat, and they taste good. Fiber helps the digestive system work properly. [27]

Guideline 5: Avoid Too Much Sugar.

Why?

The major problem related to eating too much sugar is tooth decay. Tooth decay, however, is more than a matter of HOW MUCH sugar you eat. Both the FORM in which you eat sugar and HOW OFTEN you eat it are important. Sticky or chewy sugary foods that stay on the teeth longer cause more problems than other sweets. Sugary foods eaten between meals are more likely to cause tooth decay than those eaten only at mealtime. [28]

Guideline 6: Avoid Too Much Sodium.

Why cut down on sodium? Because about one out of four Americans has elevated blood pressure and sodium can contribute to causing high blood pressure and aggravating it once it exists.

How do you cut down on sodium? You do it in three places: in the supermarket read the nutritional and ingredient labels on what you buy; in the kitchen learn to use less salt in cooking; and at the table taste your food before you salt it, and then, if you must salt, use one shake instead of two. [29]

Guideline 7: If You Drink Alcoholic Beverages, Do So in Moderation.

Key ideas: abstinence or moderation is the best policy when it comes to alcoholic beverages, If you drink, don't drive. If you're pregnant, don't drink. [30]

An International Approach.

Another approach to finding guidelines in food consumption is presented by Rudolph Ballentine, M.D. He studies the diets of cultures from different parts of the world that had developed diets that maintained health and longevity,

When Ballentine looked at what is considered healthful, wholesome, everyday food by the traditional cooks in various cultures around the world, many similarities emerged. As he looked further, he saw that these healthful diets all had the same five food groups represented. The five groups are grains, legumes, vegetables, raw foods, and a B12 group. This is what he found.

> Whole grains constitute the bulk of most of these diets and are consumed in the largest quantities. The ever-present legume, which is taken approximately half that quantity, complements the grains, and together they provide the proper proportions of the eight essential amino acids, This grain/ legume combination is the core of the meal, but the vegetables give it flavor and vitality. The amount of fresh vegetables which are consumed varies according to availability, but in those areas where they can be obtained, they are usually included in sizable quantities. Generally, this means that they are taken in larger portions than the legume but smaller portions than the grains.
>
> . . . In addition to this basic trio of grain, legume and vegetable, most traditional diets contain varying quantities of a fourth food group of foods which includes dairy products, meat, eggs, fish, fowl and certain fermented bean preparations (such as tofu and miso). This food group might be referred to as the B12 group since all the foods included in it contain this vitamin whereas foods in the outer three groups do not. . . . A small daily serving of raw foods constitutes the fifth food group found in traditional diets. [31]

(figure available in print format)

Illustration showing the proportions for the 5 traditional food groups. [31]

Four examples of menus based on the 5 traditional food groups follow. [32]

Mexican Tostadas

Grain	tortilla
Vegetables	tomato, onion
Legume	.refried pinto or kidney beans
Raw	lettuce
B12	cheese

Middle East Falafel

Grain	pita, bulbar
Vegetables	onions, tomato, parsley, green leaves
Legume	humus sesame seeds, garbanzo beans
Raw	sprig of mint, fruit

B12	yogurt sauce

Casserole and Salad

Grain	whole wheat pasta
Vegetables	onion, zucchini, tomato
Legume	sprouts, seeds, nuts and beans in salad
Raw	green salad of romaine lettuce
B12	cheese and/or meat

French Country Meal

Grain	good French bread
Vegetables	tomato, zucchini
Legume	lentils
Raw	salad greens
B12	meat

Foods in proper proportions from the 5 traditional food groups give a good balance of protein, carbohydrates and fat. The chart below lists some comparison diets. The vegetarian diet referred to does not contain meat or dairy products but gets its protein from whole foods, beans, peas, grains, vegetables and fruit. Ballentine and others believe that if you eat your caloric allowance, about 2000 calories a day for women and 2500 calories per day for men, in wholesome foods mentioned above, you cannot help but get all the protein you need,

Percentage of Calories of Protein, Carbohydrate and Fat [33]

Diet	Protein	Carbohydrate	Fat
Preferred Ratio	20	60	20
Modern American	13	43	44
Typical Teenager	8	51	41
Vegetarian	18	61	21
Non-Vegetarian	20	57	23

An essential criterion for improving nutrition is the selection of healthful foods, but this is not easy in today's supermarkets. Ballentine describes the modern supermarket as follows.

> In recent decades, our supermarkets have become vast emporia, housing the by-products of the millions which are spent on advertising and packaging. They contain long aisles lined with brilliantly designed items that dazzle the eye with their colors and the mind with clever slogans that imply a wholesomeness they don't possess, that appeal to the desire for youth and excitement, that tempt one with promises of pleasure and convenience, or that tug at nostalgic memories of happier times when food was country-fresh and Momemade-simple. *The most basic guideline for finding one's way through this labyrinth is to focus on obtaining foods which are as close as possible to their whole natural state . This means steering clear of those foods whose natural integrity has been disturbed* . (Underlining added.) [34]

Ballentine suggests that if you want to improve your nutrition, gradually substitute for unhealthy foods others which are more healthful. A good first step is to reduce the use of refined sugar by having fruit juice instead of soft drinks, fruit instead of other sweets, and use honey or raw sugar instead of refined sugar if you must use a sweetener. Secondly, omit refined white flour and white flour products from the diet and replace with more Whole grain flour and whole grain products. The third major change in diet would be to keep it low in total fats and oils. There is disagreement on which oils or fats are best, but almost all authorities agree Americans

should cut down on fats in general and saturated (animal) fats specifically.

Using the above information your supermarket shopping would simply consist of stopping at the produce counter, dairy section, and shelves which hold dried beans, peas, rice and whole grain flours.

The golden rule in food selection is to buy the freshest food possible. Here is a description of what happens in Paris.

> While the sun rises in Paris, a major intersection in each neighborhood is completely transformed into a bustling marketplace. The fresh fruits and vegetables brought into the city only a few hours before are piled high on moveable stands. Housewives come out early to get the pick of the lot, but long before noon it is all sold out. Prices are lowered at the end of the morning to auction off the last odds and ends, and the stands are then whisked away until the following day. [35]

However, things are not the same throughout the world.

> In most of the modern Western world, transportation from market is not so rapid as in Paris. Vegetables and fruits may stand many days in transit, often traveling thousands of miles in refrigerated trucks and reaching their destination after a long period. They then go to wholesalers, and it may be s day or two later before they reach the retail outlet. They are then put in the produce section on refrigerated display counters and may remain there another day or more before they are finally purchased. On arrival in the kitchen, the vegetables may then be shoved into the refrigerator by the shopper, only to be cooked another several days hence. [36]

What guidelines do you use in your food selection? The unit end with a brief look at an environmental and political aspect of the food we choose.

Environmental Issues.

Whatever we buy as consumers , we encourage the production of that item . Along with concerns about the nutritional value of food, and its monetary cost, comes questions of its environmental cost. How much energy was needed to produce it? What were the environmental cost in terms of pollution for its production? Considering the packaging, is it biodegradable or will it be around forever. When we select an item do we do so because of its quality or because of the advertising we,ve seen or the attractiveness of its packaging?

Our landfill sights for getting rid of trash are being used up, and major struggles are taking place to find a way of both taking care of the waste we produce and not adding further to air, water and land pollution.

Governor William A. O'Neill, in July 1987, signed into law a bill that requires by 1991 the residents of Connecticut will have to start separating their trash into three types: recyclable, non-recyclable, and newspapers and magazines. At least 25% of the states solid waste will have to be recycled. When we buy something we need to ask what will happen to it after we have finished with it?

3. Food is a Political Issue.

Land reform, working conditions, trade control, farm supports, and food content regulation are some political food issues. We will look briefly at two of these issues.

Land reform questions are being asked throughout the world. Suzan George and George Paige ask a related question. "Why are so many food-producers, rather than we the consumers, the first to go hungry?" [37] They

and others believe that land ownership has a lot to do with it. 4% of the world's big landowners control half of the world's cropland. In the U.S., 5% of the farmers work over half the cropland. Some people believe land reform is essential for the development of a sustainable method of food production and distribution. [37]

Working Conditions. Do you buy grapes? Do you want to? The United Farm workers, lead by Caesar Chavez, is trying to launch a boycott against table grapes. One of the reasons they give is that among the grapepickers there is a high incidence of cancer and birth defects. They feel it is due to the pesticides being used on the fields in which they work. They want better control over the use of pesticides.

We may someday have machines that could harvest grapes, that would end the workers' concern but it would end their jobs too. Such a machine, however, would not settle the question of how much, if any, pesticides should be used on the food we consume. The complexity of food production and consumption includes, among other things, serious nutritional, environmental, and political issues.

VI. Conclusion

The primary purpose of this unit is to help us become better food consumers by developing an understanding of the world food situation, food production and transportation, different approaches to developing nutritional guidelines, and that each consumer food purchase we make has nutritional, environmental and political effects.

FOOTNOTES

1. Hunger Project, *Ending Hunger* (New York: Praeger, 1985),15. 2. Ibid., 156-7. 3. Ibid., 2. 4. Ibid" 410. 5. Desrosier, N.W., *Attack or Starvation* (Westport: Avi, 1961), 279. 6. U.S. Hunger Project, 2015 Steiner Street, San Francisco, CA 94115, (415) 346-6100 7. Hunger Project, *Ending Hunger* (New York, Praeger, 1985), 96. 8. World Food Council, U.N. Headquarters, New York, N.Y. 10017, (212) 963-0060 9. World Food Council, Report of the World Food Council On the Work of Its Twelfth Session, 16-19 June, 1986, (New York: United Nations, 1986), 2. 10. Hunger Project, *Ending Hunger* (New York: Praeger, 1985), 100. 11. Melillo, F.M., *Ecology Primer* (West Haven, CT: 1975), 50-51. 12. Ibid., 51. 13. Ibid., 51 14. N.W., "Boost for Credit Rating of Organic Farmers," *Science* , Vol. 189. Sept. 1985, 777. 15. Organic Farms, "Organically Grown Food, Answers to Some Common Questions." Pamphlet from Organic Farms, 10714 Hanna St., Beltsville, MD 20705. 16. Pimentael, D. "Land Degradation: Effects on Food and Energy Resources", *Science* , Vol. 194. Oct. 1976, 149-154. 17. Ibid., 154. 18. *Statistical Abstract of the U.S. 1987, 107th Ed* ., U.S. dept. of Commerce, Bureau of Census, p. 625. 19. Hunger Project, *Ending Hun* ger (New York: Praeger, 1985), 106. 20. Desrosier, N.W., *Attack on Starvation* . (Westport: Avl, 1961), 181. 21. Hunger Project, *Ending Hunger* (New York: Praeger, 1961), 101. 22. Ibid., 158. 23. Klindworth, K. and Kindya, W. "Transportation 1986" *Outlook "86"* (Annual Outlook Conference Session #20, Washington, D.C.) 426-437. 24. USDA Guideline 1: *Eat a Variety of Foods* , 1. 25. USDA Guideline 2: *Maintain Desirable Weight* , 1. 26. USDA Guideline 3: *Avoid Too Much Fat, Saturated Fat, and Cholesterol* , 3. 27. USDA Guideline 4: *Eat Foods with Adequate Starch and Fiber* 28. USDA Guideline 5: *Avoid Too Much Sugar* , 1, 29. USDA Guideline 6: *Avoid Too Much Sodium* . 30. USDA Guideline 7: *If You Drink Alcoholic Beverages, Do So In Moderation* . 31. Ballentine, R. *Diet and Nutrition: A Holistic Approach* , (honesdale, PA: Himalayan International Institute, 1982), 283-284. 32. Ibid., 282, 301 33. Ibid., 291.36. Ibid, 295-296. 34. Ibid., 292-293.

35. Ibid., 295. 36. Ibid., 295-296. 37. George, S. and Paige, N., *Food For Beginners* . (Oxford, Great Britain, 1982), 76.

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Ballentine, R., *Diet and Nutrition: A Holistic Approach* (Honesdale, PA: Himalayan International Institute, 1982) A very clear statement of both eastern and western views on nutrition. Especially interesting are points of agreement.

George, S. and Paige, N., *Food for Beginners* (Oxford, Great Britain, 1982, 1982). Written by two activists, it is a cartoon presentation of why we have world hunger and what must be done to end it.

Hunger Project, *Ending Hunger* (New York: Praeger, 1985). A well written and documented book on the world food situation. It presents facts and views and distinguishes clearly between the two. Wonderful pictures.

USDA, *Nutrition and Your Health: Dietary Guidelines for Americans* , set of seven articles. Hyattsville, MD: 1986) Each guideline gives facts, suggestions, and recipes. A classroom set of all seven could provide a solid base from which to have class discussions in each area.

Questions & Activities

World Food Situation 1, Make a bar graph illustrating the comparison data between developed and developing countries. 2. Write a paragraph describing what you learned from the graph in #1. 3. What is malnutrition? List five causes of malnutrition. 4. Discussion question: Why did some countries develop before others? Food Production, Storage & Transportation 5. Describe how a plant grows. 6. Make a circle graph showing the percentage composition of good growing soil. 7. Briefly describe each of the following in words and then sketch each cycle: water cycle, nitrogen cycle, and carbon cycle. 8. What percent of U.S. cropland was irrigated in 1984? Make a circle graph illustrating this. 9. Energy does not cycle it flows to earth and out to space. Describe on thing that could happen to energy stored in a plant before it flows away from earth in the form of heat. 10. Activity. Look at the root, leaf, stem, and flower parts of a plant under a microscope. Sketch what you see. 11. You went to the supermarket and bought a loaf of bread. List six energy consuming processes that went into getting that loaf on the shelf for you to pick up. 12. Make a circle graph illustrating the use of energy to produce and deliver a 1 kg loaf of bread in the United Kingdom. 13. What is organic farming? l4. Describe a “km3”. How many gallons in one? 15. Activity. Put seeds in two pots with the same soil. Water and fertilize one and add only water to the other. Compare growth over a three week period. 16. Discussion question: Should we use chemical fertilizers and/or pesticides? 17. If cropland erosion takes place at the rate of 12 tons per acre per year and new soil is made at the rate of 1.5 tons per acre per year, how many inches loss is that per year? If left without help, how long would it take a field with a 12 inch deep topsoil base to erode completely away? 18. Why do we need to store food? 19. Activity. Choose 4 foods. Cut very thin slices from each. Look at each under the microscope and sketch the structure you see. Label each food. 20. What are the common ways of preserving food? 21. Make a line plot showing the percentage distribution of the main producers of wheat. Label significant data. Repeat for rice. Repeat for corn. 22. What is the main mode of transportation for domestic foods? 23. What is a “mmt”? 24. Discussion question: Should we have international or national and local control of food reserves? Better Food Consumers 25. For one week

keep a record of everything you eat or drink and the time of day you do it. 26. Compare the typical teenager diet to the preferred ratio of protein, carbohydrates and fat according to the data Ballentine gives. 27. Evaluate your diet with regard to protein, carbohydrate and fat proportions. 28. Evaluate your diet with regard to the 7 guidelines given by the USDA. 29. Two jars of strawberry preserves, of the same make, are available at the price of $1.39 for a jar containing 12 ounces and $1.89 for a jar containing 18 ounces. What is the price per ounce for each jar? 30. Discussion Question. How can you get the freshest possible food for yourself and your family? 31. If you decided you wanted to improve your diet, what is the first step Ballentine suggests? the second? the third? 32. Discussion Question. Do you think the new trash bill in Connecticut requiring residents to separate their trash into three kinds is a good idea? Give reasons for your answer. What problems do you foresee? 33. Compare the nutritional, environmental, and political aspects of drinking fresh fruit juice compared to canned soda. 34. What are some foods that can be produced and consumed without harming you or the earth's ecological system? 35. What are some foods that cannot be produced and consumed without harming you or the earth's ecological system?

Appendix

Schedule and Lesson Plans

Week 1: Give work on measurements needed to understand unit.

Week 2; Read section on the World Food Situation. Do problems for that section. * Will need extra effort to help students write paragraph needed.

Week 3 & 4 Read Food Production, Storage, and Transportationsection. Do questions for that part. * For one week have students keep track of food they eat for use in the next section.

Week 5 & 6 Read section on Becoming Better Food Consumers. Work through problems for that section. * It is especially important to use the students' own records of food intake for comparison and discussion of the issues involved.
