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This Spud's for You!

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Upper elementary students often seem to think that saving energy is limited to car pooling, turning off the lights when leaving a room and turning down the thermostat in the winter. Seldom do they consider energy as critical in the manufacturing, packaging, transporting, storing and distributing of products. Rarely is energy recognized as being involved in eating a sack of potato chips, buying fast-food carry-out French fries or preparing frozen hash-browned potatoes in the kitchen. Although my students list sources of energy as "electricity" or "fossil fuels," they often do not relate such sources to food production and marketing.

In order to help students attain and comprehend concepts in energy, nutrition and consumer research, potato labs were instigated at Meeker Elementary School. The labs were designed to further the students' progress in utilizing process skills, controlling and manipulating variables, interpreting data and formulating hypotheses. The learning from the labs was then applied towards better consumer choices for energy-saving and more nutritious food.

The students began by identifying the number of calories, nutritional value and cost for a sack of brand-name potato chips. This led to discussions of food selections, choice-awareness and consumer decision-making. As the children began to think about highly processed foods, they compared them to home-grown products. As choices are being made about foods to consume, choices are also being made about energy consumption.

Students recognized that food is eaten to give the body energy. However, most children had not considered the tremendous amounts of energy used to get that food ready for them to eat. "Energy" to them meant oil wells in Texas or solar heated homes in Arizona. How much energy is used in canning potatoes? freezing potatoes? preparing chips? As they discussed these questions, many students failed to consider the energy used in fertilizing the growing products, treating the solid wastes,

warehouse storage, product packaging and transportation to keep the edible products fresh.

As discussions about nutrition and energy concepts continued, students wanted to expand their comparisons. Would it be possible to compare the energy required to prepare different products? What about comparing home-grown boiled potatoes cooked in a kettle of water on the stove with store-purchased potatoes baked in a microwave? How about frozen french fries reheated in a conventional oven compared with school-made potatoes baked in the class's solar oven? Ideas increased together with the experimentation, and, as ideas grew, so did the level of process skills. No longer limited to simple observing and classifying, students began to think of variables, ways of recording data and predicting. They talked about energy sources, nutrition, use of time for food preparation and environmental concerns.

The students listed the kinds and forms of potatoes they wanted to compare, including:

1. Fresh
   a. whole (with skins)
   b. whole (without skins)
   c. French fries
   d. diced/sliced
2. Frozen
   a. French fries
   b. hash browns
   c. potato rounds
3. Dehydrated
   a. flakes
   b. granules/buds
4. Canned
   a. whole
   b. diced/sliced
5. Ready-to-eat
   a. chips

Students then identified energy sources available for use at school to cook the potatoes for their experiments:

1. Hot plate with kettle and water
2. Electric skillet or fry pan
3. Deep-fat fryer
4. Conventional oven in the school kitchen
5. Microwave oven in the teachers' lounge
6. Solar oven built by the class

Basic safety and hygiene rules were listed and learned. It was agreed that the following procedures would be incorporated into their labs:

--Wash hands before handling food
--Use cutting boards and knives (or potato peelers) carefully and with adult supervision
--Wear safety goggles when working with hot grease and liquids which might spatter and cause eye damage
--Use hot pads and racks when working with heat sources
--Have a fire extinguisher available and know how to use it
--Proceed with lab activities only with adult supervision

Students wanted to compare the preparation of various kinds of potatoes and the energy from various heat sources needed to prepare them. It was necessary to list the exact comparisons that would be meaningful. With teacher assistance, the students identified the following questions and procedures:

1. What is the change in mass of the potato products due to the cooking process?
   a. Use a triple beam balance to measure the mass of the potatoes before and after cooking.
   b. Record the mass in grams and determine if mass was gained or lost.
2. How much energy was used in cooking the potatoes?
   a. Record cooking time in seconds.
   b. Identify the watts used for the heat source. (Some sources required other computations.)
   c. Multiply (watts) x (seconds) to determine the joules used.
   d. Use the formula 1 Kcal = 4200 joules to determine amount of Kcal used.
3. How much energy was used in marketing before the potato was cooked?
   a. Use information from the *Journal of Food Science,* Vol. 42, No. 3, 1977, pp. 768-74 (see Table 1). (The article "Total Energy to Produce Food Servings as a Function of Processing and Marketing Modes" by Hamilton Olabode was the only one available.)

b. Include Kcal used in manufacturing, distribution and preparation before cooking per potato serving for fresh, flaked, canned and frozen potatoes.

4. How much energy was used in preparing each form of potato from "soil to supper"?
   a. Use information obtained from questions number 2 and 3 listed above.
   b. Recognize that figures are only approximate and that variables are not well controlled.
5. What is the cost per serving for each potato product?
   a. Record the package amount and cost.
   b. Compute the potato product serving amount and cost.
6. What is the nutritional value of the potato product?
   a. Use "Nutritive Value of American Foods," Ag. Res. Service Handbook 456, USDA, November 1977.
   b. Recognize that serving sizes may not be exactly the same but may be used for comparison.

Table 1

ENERGY USED IN STEPS OF POTATO MARKETING

Energy In Kcal Per Serving for Various Kinds of Potatoes[1]

Marketing Area:	Fresh	Flaked	Canned	Frozen
Manufacturing[2]	29	237	508	329
Distribution and Retail[3]	127	49	93	264
Domestic[4]	330	264	369	1144

[1]Olabode, H. 1977. Total energy to produce food servings as a function of processing and marketing modes. *Journal of Food Science* 42(3):768-74.

[2]Includes energy used in space conditioning of storage bins and plants; washing, grading and sizing of the potatoes; processing; freezing or chilling; packaging/packing; manufacturing of equipment for potato processing; transportation of potatoes from the farm to the plant; and treatment of solid waste.

[3]Includes energy used in transportation from plant to warehouse; transportation from warehouse to retail store; transportation from retail store to consumer's home; storage in warehouses; and retail store utilities.

[4]Includes energy used in household storage (e.g. refrigerators/freezers); preparation of potatoes; dishwashing after eating; manufacturing of kitchen equipment/utensils; and treatment of solid wastes.

Students then conducted the potato labs, plotting information from their results onto a large chart. From the accumulated data, students were able to make both general and specific comparisons. For example, they discovered that highly processed foods lose a lot of nutritive value. They also learned that potatoes are a good, inexpensive source of vitamin C. Students compared the energy used with various types of food processing using a variety of heat sources.

The basic concepts involving nutrition and energy were used in other "spin-off" experiences. One class of sixth graders gathered information on apples. Some students became quite interested in the use of commercial dehydrators and experimented with using the solar oven to dehydrate fruits (i.e. bananas). The process skills and critical thinking skills which were involved in the potato labs had high carry-over in other science experiments and related learning experiences throughout the year.

The hands-on labs provided meaningful learning experiences involving materials and equipment that were readily available. The consumable materials used (potatoes) were relatively inexpensive. With proper safety precautions, the labs were conducted with the sophistication of "science research" and the practicality of "kitchen chemistry."

How do students feel about the potato labs? They really "dig" them!

References

Olabode, H. 1977. Total energy to produce food servings as a function of processing and marketing modes. *Journal of Food Science* 42(3):768-74.