



Science Fair and Lesson Ideas

Grades 3-12

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California Foundation for Agriculture in the Classroom

Vision: An appreciation of agriculture by all.

Mission: To increase awareness and understanding of agriculture among California's educators and students.



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Introduction

Today, less than 2% of the nation's population produces the food, fiber, nursery products, and flowers that the nation's population consumes. This is due, in part, to the technological advances developed by innovative research scientists, mechanics, and farmers.

Over the past fifty years, the technological advances in agriculture have occurred at a rapid pace. Lasers are now used to level fields. Global positioning systems can measure acreage, track the amount of land covered with fertilizer, and assist in leveling a field. Computers, inside tractors, monitor the amount of seed being released into an alfalfa field or senses when a valve is clogged and alerts the farmer. Mechanized picking machines and harvesters have increased harvest efficiency. Water delivery systems not only transfer water as needed but also monitor water quality. Meteorology is a science that farmers depend upon. Weather forecasts help determine when to plant, when to irrigate, and when to harvest. The science of agriculture is fascinating. What will be thought of next?

Teaching new generations about the importance of agriculture is the primary goal of the California Foundation for Agriculture in the Classroom. Although most students will not farm, all eat and wear clothing produced by agriculturists, live in homes made of wood, and have the opportunity to vote on issues that relate to agriculture.

This packet is divided into three sections:

- The first section provides stimulating questions that teachers can use when teaching a specific scientific topic. As you begin teaching a particular topic, skim over the questions and think of how you can incorporate them and their answers into your science unit.
- The second section provides science fair ideas, in the form of questions, that relate to agriculture.
- The third section lists Web sites that educators and students may find useful when preparing a science lesson or a science fair project.

For additional educational information on how you can integrate agriculture into your curriculum, contact the California Foundation for Agriculture in the Classroom.

Science and Agriculture

What a Combination!

Questions

These topic questions encourage knowledge acquisition and critical thinking in the area of agricultural science. Skim over these questions periodically, perhaps when you begin to teach a new science topic.

There are thousands of connections between science and agriculture, if you just take the time to think about them!

Chemistry

- How is the chemical process of fermentation important in the formation of certain foods such as vinegar, wine, and cheese?
- Why do farmers pump carbon dioxide into silos?
- How does ethylene gas assist in the ripening of fruits?
- What are fertilizers? Are they needed?
- What trace minerals are required for successful crop production? Example: Iron is needed to prevent yellowing-chlorosis.
- How do you read a fertilizer label? Example: 5-10-5
- What are pesticides and why are they used?
- What are some pesticides found in nature?
- How is agriculture minimizing the amount of pesticides used on crops?
- How are pesticide or fertilizer residues analyzed? Why?
- What forms of nitrogen are used by plants?
- What are some chemical formulas of plant components?
- What are some chemical reactions (equations) that agriculturalists cannot live without?
- How do the valences of nutrients and minerals determine which substances are available for plant uptake?
- What are some chemical reactions used in water testing?
- What chemical reactions take place in a compost bin?
- Why and how is the sugar content of fruit tested?

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Physics

- What simple machines are used as hand-held tools in farming?
- What simple machines are used to make complex machines such as tractors and plows?
- What engineering principles are used to make efficient farming equipment?
- How are lasers used to determine the land topography of fields?
- How are fields leveled to assist with water flow? Or are they?
- What kinds of energy (potential, kinetic, light, etc.) are involved in harvesting equipment?
- How do water pumps work?
- How are the principles of water and air pressure used to irrigate fields?
- How do the color sensors on harvesters work so green tomatoes are separated from red tomatoes?

Meteorology

- What is the water (hydrological) cycle and how is it important in agriculture?
- How can weather forecasting assist farmers in producing crops?
- How does too much or too little rain create challenges for farmers?
- How do heavy winds affect farmers?
- How can too much direct sunlight damage plants?
- How does too much or too little rain affect the price of crops?
- What crops are most susceptible to freezing?
- How does the climate of a certain area determine what types of food and fiber can be grown in that area?
- What are windbreaks?

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Nutrition

- Where does our food come from? Discuss the main producers of certain types of food.
- Have students write to various food companies to find out how that food is produced.
- Are the nutritional requirements for all animals the same? Do pigs, cows, sheep, and humans require the same nutrients?
- How is our food grown or raised? Have students research the production of their favorite food.
- How do the conditions in which food is grown determine the nutritional quality of the product?

Botany

- What is grafting and why is it important? Examples: almonds are grafted to peach stock, English walnut trees are grafted to black walnut trees, and grape varieties are grafted to hearty root stock.
- What is asexual reproduction and why is it important to farmers? Examples: Potatoes, strawberries, asparagus, and flower bulbs.
- Is the food you eat a flower, fruit, seed, root, leaf, or stem?
- How does a seed develop into a plant? Discuss the requirements for successful seed germination and growth.
- How are seedless foods grown? Example: naval oranges, seedless watermelons, bananas, etc.
- Why are insects raised for crop and orchard pollination?
- What is a parthenocarpic fruit? How is it produced?
- Discuss the interesting life cycles of crops such as figs.
- What is cross-pollination? How do farmers plant their orchards and fields to optimize cross-pollination?
- How do plants assist in cleaning and cooling the air?
- How can plants be used to produce rubber or cancer curing drugs?

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Ecology

- As the population of California continues to grow, why is land use such an issue?
- What would happen if California becomes so urbanized that agricultural production could not occur? Is this situation a possibility?
- While teaching about food chains and food webs, begin with an agricultural product that the students can learn about. Example: almonds or corn.
- Why is it important to preserve agricultural land? Or is it?
- Why is it important to prevent overgrazing of land? Example: the takeover of sage and star thistle in rangelands.
- When teaching about symbiosis, incorporate integrated pest management examples.
- When teaching about mutualism, discuss the birds that live in rice fields, or why pumpkins and beans are grown in corn fields.
- When teaching parasitism, discuss hoof rot in cattle and sheep, and bores in fruit and nut trees.
- Discuss the mutualistic relationship between a fig and a wasp.
- Discuss the life cycle of the glassy-winged sharpshooter and Pierce's disease.
- Discuss the importance of rotating crops in fields.
- What is no-tillage farming?
- What is organic farming?
- How does agricultural production assist in improving air quality?
- What are the major air pollution challenges in the Central Valley of California?
- What are methods farmers use to conserve water?
- How has agriculture impacted the water storage and distribution facilities and procedures in California?

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- Why is it important that farmers consider the water, soil, and air quality of the areas in which they work and live?
- Why are wetlands considered natural pollution barriers?
- Are rice fields beneficial wetlands?
- What challenges occur when urbanization and farming become neighbors?

Earth Science

- What types of soils are best for growing crops?
- How are soils classified for quality?
- What are the components of soil?
- How does the “cracking” of clay-like soil assist in the water made available to plants?
- Why are flood plains excellent farming areas?
- How do volcanic eruptions affect soil quality and fertility?
- What nutrients in the soil are required by plants?
- How are the minerals obtained for commercial fertilizer production?

Classification and the Five Kingdoms of Living Things

- While teaching classification or grouping, use agricultural products such as seeds, fruits, and vegetables.
- Classify food items according to their “kingdom” or origin—plants, fungi, monerans, protists, or animals.
- Discuss the variety of fungi humans consume. Examples: mushrooms, truffles, blue cheese, yeast, etc.
- Discuss the unique foods and products produced by plants.
- Discuss how monerans (bacteria) age and flavor foods such as cheese and yogurt.

Science and Agriculture

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- Discuss where beef, lamb, and pork come from.

Genetics

- What is biotechnology? What is its history in agriculture?
- What are some examples of genetically modified crops?
- Discuss the problems with pesticide resistant insects, weeds, and bacteria due to genetic mutation or genetically engineered changes.
- What is a hybrid plant?
- What is genetic splicing?
- How are the seeds purchased by home gardeners and farmers produced?
- Can genetic engineering produce drought resistant plants or plants that transpire less water?
- How has biotechnology increased the milk production of cows?
- Why is genetic diversity rather than extinction important in the success of agriculture and life in general?
- How and why are beef and pork leaner today than 50 years ago?
- How can plants be used to produce plastics?
- Can genetic technology be used to increase the nutritional value of plants?
- What are the issues associated with current trends in agricultural biotechnology?
- Are the challenges of biotechnology the same for agriculture and medicine?

Science Fair Ideas

Questions

Most students, at one time or another, create a science fair project. The key to having a successful experience is to create an answerable question that relates to the students' interest.

The following list provides general and specific questions that can be used as prompts to science fair experiments. In one way or another they are linked to California's leading industry, agriculture!

Botany

1. What are some different ways that plants are pollinated?
2. Will a seed of a hybrid plant produce fruit like its parents?
3. How and why do plants grow toward light?
4. How do you determine the age of a tree?
5. Are trees of wider diameters always older than trees with smaller diameters?
6. Can past significant geological events be determined by examining the annual rings of a tree?
7. How is seed shape associated with seed dispersal?
8. How does the color or material of a container affect root growth?
9. What affects do different colors of light have on plant growth?
10. How do plants climb?
11. How do nitrogen, phosphorous, and/or potassium (the three numbers on fertilizer containers) affect plant growth?
12. How do monocots differ from dicots?
13. How and why do some plants mimic other organisms?
14. Do all legumes have similar seed anatomy?
15. Do different colors of flowers attract different kinds of pollinators?
16. What kind of manure makes the best fertilizer?
17. How can plant disease and animal pests be genetically controlled?
18. Is there a connection between leaf shape, margin, and venation, and the type of food produced?
19. How powerful is a seed as it germinates?
20. What is the purpose of the root nodules on some plants such as peanuts, beans, and soybeans?

Science Fair Ideas

21. How are all parts of a particular plant used in agriculture?
22. How does thinning fruit or pruning fruit trees affect the size and quality of the fruit grown?
23. What is grafting and why is it used on many trees and vines?
24. What kinds of obstacles will roots grow through and around?
25. What kinds of additives are best for cut flowers displayed in vases?
26. How do florists make blue and other colored carnations?
27. What flowers attract the most bees?
28. How fast can a quality compost fertilizer be made?
29. What are the functions of the furry skins on some fruits?
30. How does ozone affect plant growth? Why is this an issue in California?
31. How do plant hormones affect plant growth?
32. How are seeds and seedlings affected by gravity?
33. Are plant hybrids useful in agriculture?
34. How do seed companies produce their “perfect” seeds?
35. How can a seedless watermelon be grown from a seed? Or can it be?
36. How does a seedless naval orange reproduce?

Physical Science

1. How are fields leveled for planting?
2. How are lasers used in agriculture?
3. Compare some common irrigation systems for energy efficiency, effectiveness, and water use.
4. What simple machines are used to make complex farming equipment?
5. What types of equipment can help reduce the amount of water used in agriculture?

Science Fair Ideas

6. What can be done to reduce corrosion of outdoor machinery?
7. How do mechanical pumps work to get ground water to the soil's surface?
8. How are computers used to assist with the development of machines?
9. How are gears used to make work easier in farming?
10. What is silage and what chemical interactions occur during its formation?
11. How do truck scales determine the weight of a truck load? Why are truck scales important?
12. How much energy (kilocalories or BTUs) is required to grow a ton of tomatoes or corn?
13. Is the chemical structure of a pesticide or fertilizer associated with how long it persists in the environment?
14. How are large factories such as tomato processing plants designed?
15. How does a generator work? How are generators used in agriculture?
16. Analyze why farming equipment changes so rapidly.
17. Compare the efficiency of old farming equipment to the efficiency of new farming equipment.
18. How and why do food packaging plants make packages air tight?
19. What is a grain elevator and how does it work?
20. Why do grain silos spontaneously combust? What can be done to prevent this?
21. Design and make a piece of equipment that has a specific role in agriculture.
22. How do various types of metals hold up to heat and pressure?
23. How can solar energy be used to reduce the amount of energy purchased by farmers?
24. How can crop residues be used to produce fuel?

Science Fair Ideas

25. What is the chemistry of the formation of silage?
26. Why does agricultural burning occur? Design an alternative process for agricultural burning.
27. How do farmers use the force of gravity to their advantage?
28. What is an auger and how does it work?

Earth Science

1. How do people determine how deep to plant seeds?
2. How can soil erosion be reduced on cultivated land?
3. How does soil type affect what type of food will be grown in a certain area?
4. How does soil testing help increase food production?
5. How do plants and microbes interact with the soil?
6. Are different soil types associated with the natural geography of an area?
7. How is soil aerated? Why is this done?
8. How do certain plants fix nitrogen into the soil? Why is this important?
9. How does agricultural burning affect soil quality?
10. How is the quality of soils rated? Could a soil's rating change over time?
11. Is tillage always necessary for growing food?
12. How can poor soil be made into productive soil?
13. Why do salts build up in soil? How can this be avoided?
14. How does the soil on hills differ from the soil in valleys?
15. Do earthquake faults occur in certain soil types? Do faults go through prime California agricultural land?
16. Why is nitrogen often put into soils? Are there natural ways to do this?

Science Fair Ideas

17. Is farming equipment built for specific types of soils?
18. Why are some crops grown, then tilled back into the soil without harvesting?
19. How do volcanic eruptions affect soil quality?
20. Why are some flood plains good places for agricultural production?
21. How have levees assisted and/or hindered food production?

Food Nutrition and Appearance

1. How are new foods developed by major food companies?
2. Why are certain trace minerals needed for the health of certain animals or plants?
3. What are the effects of different vitamin deficiencies on certain animals or plants?
4. What are the effects of different vitamin toxicities (overdoses) on animals or plants?
5. Analyze your school lunch or a meal at a fast food restaurant for protein, fats, minerals, etc.
6. How influenced are humans by the appearance of food rather than its taste or nutritional value?
7. How is the nutritional value of foods determined?
8. How is the number of calories in a certain food product determined?
9. What are the best ways to store fresh fruits, vegetables, or grain products?
10. Are fresh, home-cooked foods of better quality than processed or fast foods?
11. Trace the path of a meal back to its primary source of energy.
12. How does freezing food affect its texture and/or taste?
13. How are some molds and bacteria used to enhance the flavor of certain foods?

Science Fair Ideas

14. Why is algae added to some foods? What types of algae are used?
15. Why and how is meat aged by large meat companies or butchers?
16. Do freeze-dried foods have the same nutritional value as fresh foods?
17. How do sulfur and/or ascorbic acid assist in preserving food?
18. How are raisins produced? Do raisins have different nutritional values than fresh grapes?
19. What is ethylene gas and what is its importance in the fresh fruit and vegetable industries?
20. Why is carbon dioxide put in some foods?

Food Safety and Food Storage

1. What are different methods of preserving food?
2. How does canning preserve food?
3. How does drying preserve food?
4. Why are certain food additives put into foods?
5. Are certain food additives harmful? If so, why are they put into certain foods?
6. How are fresh fruits and vegetables kept pest free? Are they really 100% pest free?
7. How do fungi (molds and mildew) spoil food?
8. When is a fruit ripe and ready to eat?
9. What is aflatoxin? What is the relationship between aflatoxin and peanuts?
10. How is carbon dioxide used to prevent the spoilage of certain foods?
11. How do fresh-cut salad mixes stay fresh?
12. How are beans dried and why?

Science Fair Ideas

Animal Science

1. What is co-generation? How can this be used on dairy and cattle ranches?
2. How are the diets for cattle, sheep, goats, or zoo animals determined?
3. Where do certain cuts of meat come from on an animal?
4. What would be the affect of removing a certain animal from a food chain? Example: Extinction or physical removal.
5. How does the amount of water affect the types of wildlife found in a certain area?
6. How many insects will a common insect predator such as a toad or praying mantis eat in one day?
7. How do nematodes cause plant disease?
8. What do farmers do to reduce the amount of damage caused by nematodes?
9. Describe the life cycle of an insect pest. What stage in the insect's life is most detrimental to agriculture?
10. How are insects being used to reduce the number of pests in a field?
11. How can agricultural pests be reduced without using pesticides?
12. Why are hormones used in meat production? Do these hormones have an affect on the consumer of the meat?
13. What special plants are deadly to a particular animal?
14. Why are particular shellfish only harvested during certain times of the year? When are these special times?
15. What products, other than milk, do dairy cattle provide?
16. Why are there fisheries throughout the United States?
17. Why are fisheries often associated with dams?
18. What types of food are harvested from the sea?

Science Fair Ideas

19. Can hormones assist with wool production and shearing?
20. Abalone and oysters are sometimes raised on farms. How and why is this done?
21. What effects do certain chemicals such as phosphates have on marine animals?
22. What are the optimum conditions for hatching poultry or fish eggs?
23. What are some challenges in raising poultry?
24. How many eggs does a laying hen produce? Does that vary with age, season, etc.?
25. What organisms are major causes of deadly diseases in herds or flocks of animals?
26. What is hoof rot? What can be done to prevent it?
27. Does the West Nile virus affect agriculture?
28. Why employ veterinarians at every meat packing and processing plant?
29. Examine the internal organs of an animal that has been slaughtered for food consumption.
30. What useful products besides food are made from pigs, sheep, cattle, and poultry?

Related Web Sites

Agricultural Ideas for Science Fair Projects

www.ars.usda.gov/is/kids

AIMS Education Foundation

www.AIMSedu.org

American Chemical Society

chemistry.org

California Foundation for Agriculture in the Classroom

www.cfaitc.org

California Science Teachers Association

www.cascience.org

Kids' Science Page, National Agricultural Library

www.nal.usda.gov/Kids

National Science Teachers Association

www.nsta.org

Planet Ag

www.fl-ag.com/PlanetAg

ScienzFair™ Project Ideas

members.aol.com/ScienzFair/ideas.htm

The Kids' Guide to Science Projects

edweb.tusd.k12.az.us/jtindell

Wisconsin Fast Plants/Bottle Biology

fastplants.org