



Fields of Opportunity

4H 381LDR January 2004

Note to the Project Helper



What a wonderful opportunity you have in store for you! A 4-H'er has asked for your help to explore the world of crop production; this includes as many learning experiences for you as for the 4-H'er. As a project helper, you don't need to know all the answers; you only need to know how to help the 4-H'er discover the learning process and find information to help answer the questions. You will be guide, teacher, and mentor as you explore crop production together. You may learn much more about yourself and your 4-H'er while you both learn more about corn and soybeans. Remember that the goal of 4-H is to help youth develop life skills such as leadership, communication, information seeking, and confidence building in themselves; the 4-H crops project is simply the tool to help develop these skills.

As a project helper, you should become familiar with these materials so that you can guide the 4-H'er through the learning experience. You also should help the 4-H'er learn the importance of setting goals and recording the learning experience. Your support and encouragement in following the experiential learning model will both strengthen the member's learning experience and provide the much needed support of a caring adult. The 4-H'er will know you are a trusted friend who offers support through 4-H and other life experiences.

This manual is based on the experiential learning model, in which you do an activity, reflect on what was done and learned (also called sharing), and think about ways to apply what was learned to other real life experiences. By learning experientially, youth have more fun, retain their learning longer, and are better able to apply their learning experiences to new situations. Your role is to help youth share what they learned and guide them in applying what they learned to new situations. The **4-H Crop Project—Soybean and Corn** is divided into three levels. Level one is intended for youth in grades 4 to 6, Level two for youth in grades 7 to 8, and Level three for youth in grades 9 to 12. However, youth may work through these levels as fast as they would like. You also may want a computer companion CD that includes more activities and up-to-date crop industry information. The CD will be updated more frequently with new research, new products, and new information.

Thank you for your commitment of time and talent to the 4-H'ers in your life. We hope you enjoy learning with your 4-H'ers, and serving as a mentor for them! What a wonderful opportunity to positively influence the lives of today's youth and tomorrow's leaders!



**IOWA SOYBEAN
PROMOTION BOARD**

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Introduction

CHAPTER 1

Working with Youth

Some of you may be thinking that you have a strong understanding of crop production, but really don't know how to work with youth. That's OK! As long as you really care about helping youth learn and grow, you will do a great job as a crops project leader!

There are a few basic things leaders need to know about working with youth. First, youth need caring adults in their lives, not just good organizers, but adults who care about youth. Build a relationship with the members in your group by getting to know them. Share your likes, interests and activities and encourage youth to do the same. Addressing your members by their first names shows you know and care about them. Encourage the members to come up with a fun name for their group, so they experience the need of belonging.

The 4-H program's century of success with youth can partially be attributed to the incorporation of eight elements essential to a positive youth development experience. They are listed below with a few examples. Try to incorporate as many of them as possible into your crop project meetings and workshops.

① Caring adult


A caring adult is actively involved as an advisor, guide or mentor.

- attend training
- participate with members in "fun and games," recreation, and socialize with them
- plan for time to get to know youth individually, their likes and dislikes, goals, etc.
- facilitate rather than dictate, let the members make decisions
- help members talk about what they learned from all activities

② Safe environment

Youth can participate in 4-H activities without the fear physical or emotional harm.

- have adequate adult supervision, don't be afraid to ask parents to help
- cooperate with your county office to get screened through the Child Protection Safety Policy

- 
- plan activities to develop trust among members
 - establish a risk management plan and a severe weather plan
 - establish group ground rules, expectations, or a code of conduct
 - select meeting places at which youth feel comfortable
 - consider safety when planning activities
 - make accommodations for physical and learning needs
 - encourage youth to communicate with respect and without restriction

3 Mastery

The process over time of building knowledge, skills, attitudes, and wisdom, and demonstrating their uses.

- plan activities to develop life skills, not just crops skills
- empower youth to teach each other
- measure success by youth goals, accomplishments, and learning
- encourage youth to grow toward advanced levels of activities and events
- plan time to discuss learning gained from activities; learning is strengthened by discussion

4 Service

Youth actively practice service to others.

- plan and implement community service projects
- encourage older youth to assist or mentor younger youth
- encourage youth to give back to their communities through leadership activities
- discuss what youth learned from the service to others

5 Self determination

Youth feel a sense of control over their lives, and exercise their potential to become self-directing, independent adults.

- involve young people directly in the planning process
- provide youth opportunities to lead the experience
- provide youth an opportunity to give feedback and make suggestions
- facilitate rather than dictate
- plan for youth to have choices and experience the consequences of those choices

6 Inclusiveness

Inclusive groups allow a sense of belonging to develop, encourage and support their members, and offer encouragement with positive and specific feedback.

- plan ways to welcome all youth to participate
- find opportunities to recognize diversity within the group, and to appreciate uniqueness
- provide opportunities for youth to teach and learn from one another

7 Futuristic

A futuristic view has hope and optimism to shape life choices, and to facilitate the transition into active participation in future events.

- encourage youth to expand into new experiences
- encourage youth to participate in events beyond the local level
- encourage youth to take on new responsibilities

8 Engagement

Engaged youth have a high degree of self-motivation and an unending capacity to create. They build interpersonal and intrapersonal connections while working in subject areas.

- provide leadership roles for youth
- encourage youth to select project areas of interest to them, set their own goals, and evaluate their learning
- provide the opportunity for youth to think for themselves and have choices
- encourage youth to share and reflect on what they did and learned

Now that you know the eight elements essential for a positive youth development experience, the second major information you need to know is what are youth like at different ages and stages of development. Each child develops at a different pace, but all children go through the same stages, in about the same order. Remembering the tips below will help make planning for youngsters a little easier, and will help explain why some activities seem to work better than others for each group.

Junior Members, Grades 4 to 6

This age group is full of energy! They like lots of movement, and probably won't sit still for too long. This age still prefers to be with others of the same sex. They probably won't remember a long list of instructions. Plan for active, hands-on group activities, and give instructions for only one or two steps at a time. Keep the activity moving to keep everyone's interest. This group needs a little more guidance, and they also admire older youth, so use older members to mentor and help the younger members. This age group likes symbols, ceremonies, and recognition, so consider certificates, pins, or other mementos for young members. Recognize them for joining, participating in meetings, completing mini-activities, and completing their records, and provide that recognition in front of parents, peers, and other members. Be patient! This age group will ask a million questions, but rather than hamper their curiosity, help to build it. Use questioning skills to help them explore their questions deeper and discover the answers themselves. Youth in this age group are developing their self-confidence and need positive learning experiences. Help them experience and recognize their successes. Plan some activities so everyone wins, and don't compare them to others.

Intermediate Members, Grades 7 to 8

This could be the most frustrating stage of growing up, for the youth and for the adults around them. Just remember, this will pass and they will become responsible adults. Meanwhile, the hormones in their bodies need to go through major fluctuations; their mood will swing almost as wildly as their hormones; they will discover the opposite sex; and begin asserting their independence. They want to distance themselves from their parents, yet deep-down they still want parental guidance. They need a variety of opportunities to succeed, and still enjoy being recognized for their success in front of others. At this point they can start digging deeper into learning experiences, and may be willing to commit longer periods of time to the few things that really interest them. They will still like working with older youth, who often are still their idols, so continue with mentoring projects. Start to provide for more independence, such as selection of their own activities and exhibits. Encourage them to explore leadership opportunities, and help them plan through the steps to follow up on their commitments to the group. This age group really likes social activities, so plan a few for your group. Most importantly, be a good listener. At this stage youth are reaching out for caring adults who will listen and help them when they feel others won't.

Senior Members, Grades 9 to 12

At the senior stage you see those frustrating pre-teens blossom into responsible (most of the time) adults. They now want all the rights and responsibilities of independent adults, although they often still need some coaching and mentoring to be able to demonstrate those abilities. Provide them leadership roles, and train them to mentor younger members. Provide opportunities for them to explore their interests more deeply, and challenge them to continue exploring. They still need to experience successes, but can begin to see the deeper, long-term successes rather than just the short-term experience. They still need recognition, but will prefer trips, tours, or scholarships to ribbons or medals. Plan for a senior-only activity, such as a field trip or tour, and provide some time for them to just "hang-out" as the older group to socialize. Finally, broaden their horizons by encouraging them to participate in state conferences or college tours.

If you remember the eight elements essential to a positive youth experience and the differences between the different stages of youth development, you will fulfill your role as a crops project leader well!

Project Meeting Ideas

Hopefully by now, you have lots of ideas for project meetings, field trips, tours, and speakers. But just in case, here is one more list of ideas and suggestions to use with your crops project meetings.

Remember, the list is limitless if you take a few minutes to look around your community or county.

- Tour a seed plant or seed testing laboratory.
- Organize a scouting group of your club members. You may want to provide this service to area farmers. This could be a great leadership and citizenship link to your project.
- Assist with a crop field day.
- Tour a crop center that uses variable rate technologies.
- Coordinate a field trip to a research farm field day.
- Visit a grain processing plant.
- Tour a farm raising specialty crops. Observe how they maintain segregation of the crops.

Potential Guest Speakers

- Seed dealers
- Chemical reps
- Ag lenders
- Commodity brokers
- Producers
- Commodity board directors
- Grain dealers
- Extension crop specialists



Games and Puzzles

CHAPTER 2

Crossword Puzzles and Other Games

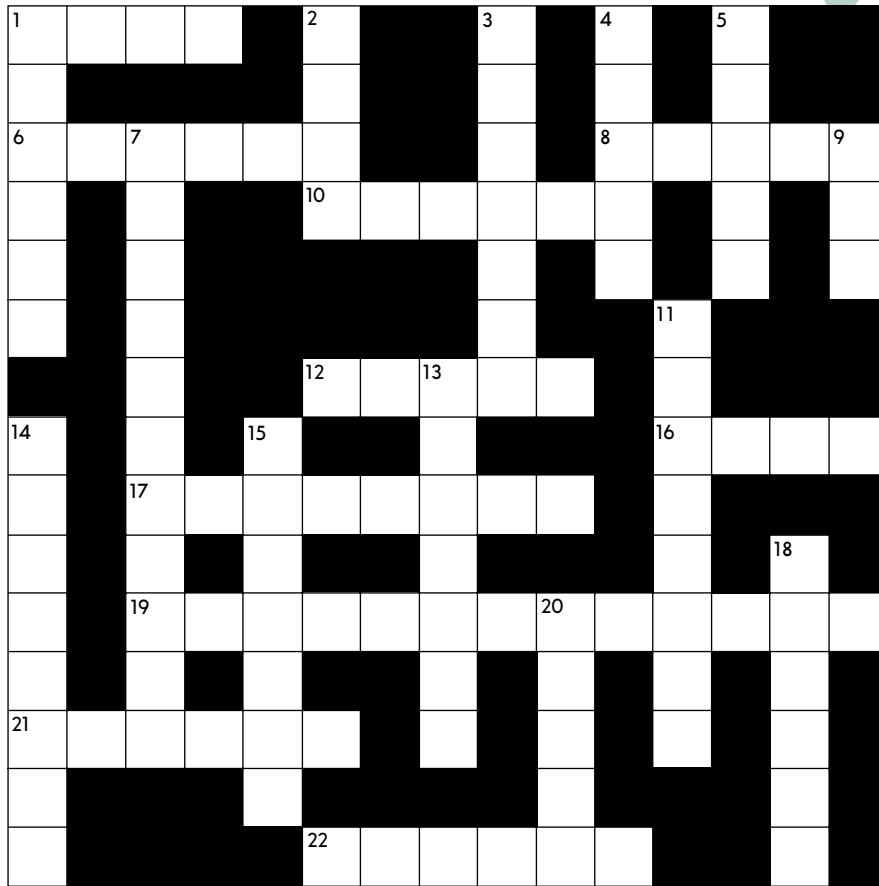
Youth love to have fun! You can capitalize on this to help make their learning experience positive **and** educational. Create word finds, puzzles, quiz games, or other fun ways to help make your project meetings fun and exciting. Following are a couple of word finds to use as meeting openers. You also can make your own word finds or puzzles using some key words you plan to discuss during your meeting. There are a number of websites that create puzzles with your own words. Some of them are

- www.puzzlemaker.com/
- www.brrd.ab.ca/qjohnstone/Teachers/GThompson/puzzle_makers.htm
- www.custompuzzles.com/online.htm

A simple search on the Internet will bring up many more puzzle maker programs.

Here is a quick energy-burner for young groups but remember to stop while they are having fun. Have everyone sit in a circle with one person in the middle. Go around the circle and each person will become a crop grown in Iowa; corn, soybeans, alfalfa, oats, or hay. The person in the middle calls out a crop, and all those members need to jump up and move to a different chair before the person in the middle gets to one of their chairs. Whoever is left standing is in the middle and calls out another crop. Remember to stop before they get too wild and crazy.

Crops Crossword Puzzle 1

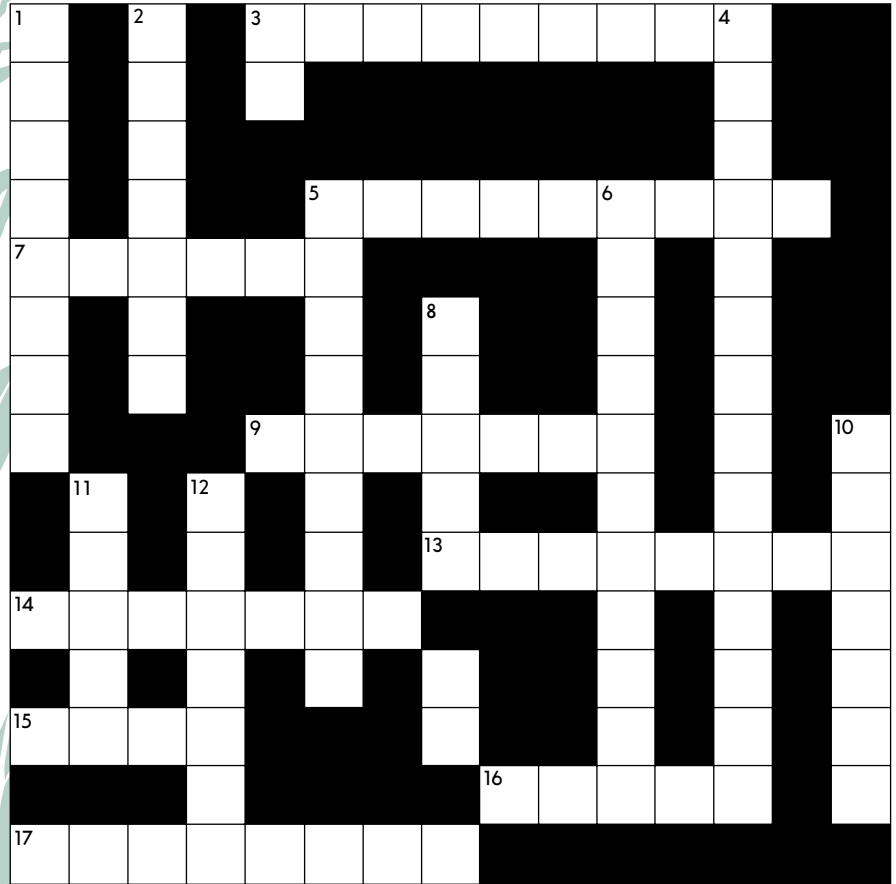
**Across**

1. Protects seed from bacteria and fungi
6. Soybean is a member of this family
8. Eight of these acids are found in soybeans
10. Two seed leaves
12. Important while planting a seed
16. First leaf of a corn plant
17. Study of crops and soils
19. Growth type of most soybeans grown in Iowa
21. Completes their life cycle in one year
22. Sheds pollen

Down

1. At the base of a corn leaf
2. Both corn and soybean plants start here
3. Has only one seed leaf
4. Corn is a member of this family
5. Country soybeans came from
7. Test seeds for this
9. Used in margarine and salad dressings
11. Ancestor of corn
13. A high percentage of this in soybeans
14. Most occurs during the spring and summer
15. Metamorphosis of a grasshopper
18. Used to make plastics and paper
20. Word for corn

Crops Crossword Puzzle 2



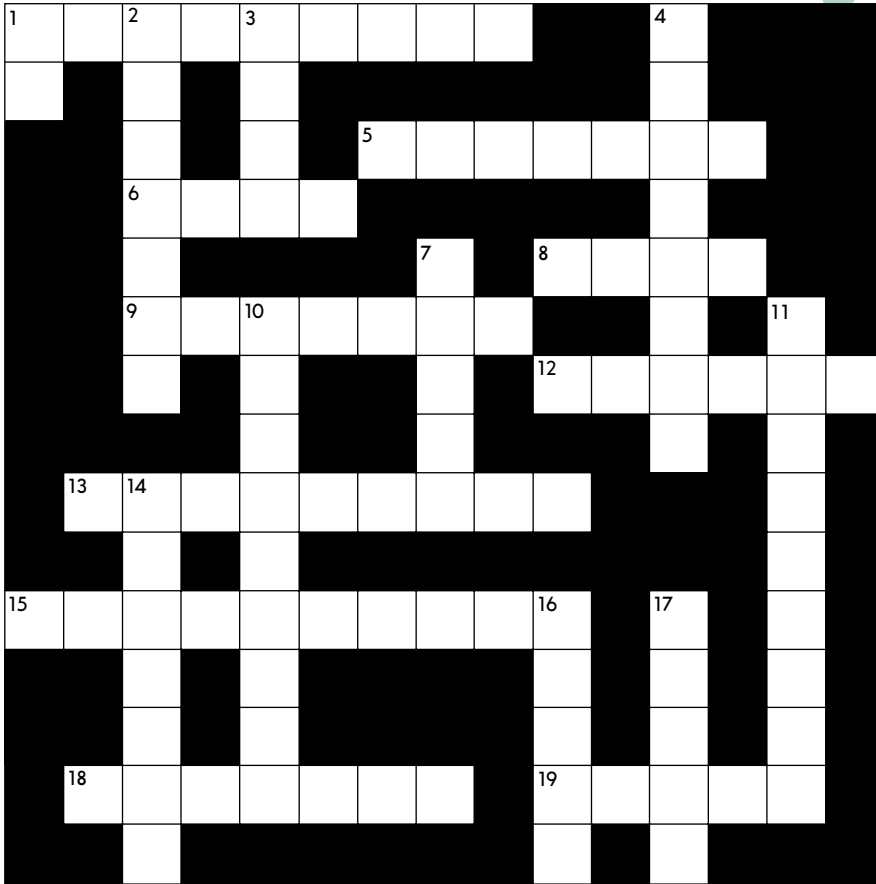
Across

- 3. Important for good stalk strength
- 5. Destroyed if soil is excessively tilled
- 7. Minimum recommended percent residue
- 9. Helps control weeds
- 13. Different crops in future years
- 14. Found in a soil's A Horizon
- 15. A plant growing where it's not wanted
- 16. Wind deposited soil
- 17. A channel of permanent grass vegetation

Down

- 1. Field visits
- 2. Soil loss
- 3. Measure of a soil's acidity or alkalinity
- 4. Needed by plants in lesser amounts
- 5. Relationship of Rhizobium bacteria and legumes
- 6. Affects the rate of crop growth
- 8. Determined by percentage of organic matter, internal drainage, and age
- 10. Farming across a field's slope
- 11. Increases soil erosion potential
- 12. Left after harvest

Crops Crossword Puzzle 3

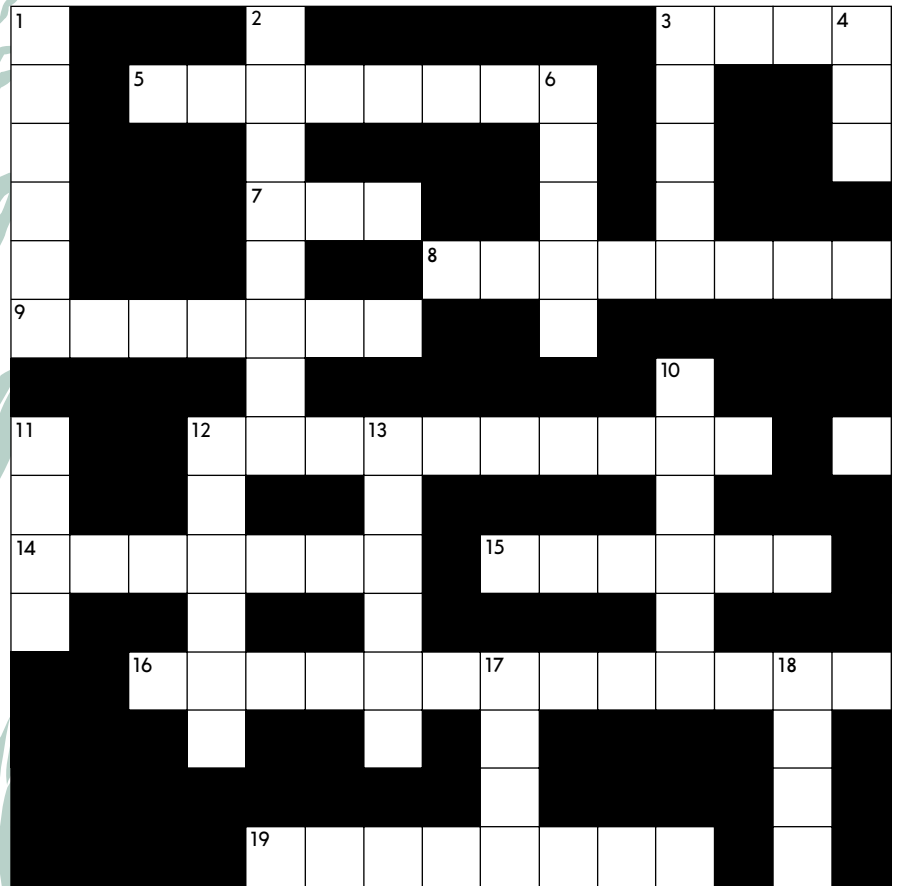
**Across**

1. Important for stalk strength
5. Divides a slope into distinct segments
6. Glacial deposited soil
8. A plant growing where it's not wanted
9. Left after harvest
12. Minimum recommended percentage of residue after planting
13. Chemical weed management
15. Natural pest control
18. Found in a soil's A Horizon
19. Increases erosion potential

Down

1. Measure of a soil's acidity or alkalinity
2. Determined by soil particle portion and size
3. Product of time, climate, and vegetation
4. Single-celled plant disease organisms
7. Multi-celled plant disease organisms
10. Relationship of Rhizobium bacteria and legumes
11. Destroyed if soil is excessively tilled
14. Soil loss
16. Wind deposited soil
17. Determined by percentage of organic matter, internal drainage and age

Crops Crossword Puzzle 4

**Across**

3. Saved by reducing tillage trips
5. A necessary activity
7. Requires more information and planning
8. Most at risk from accidental pesticide exposure
9. Attach loads here
12. Used to manage pests
14. Necessary to manage a farm
15. Usually needed to raise crops
16. Scientific manipulation of living organisms
19. Needed in grain by mold and insects

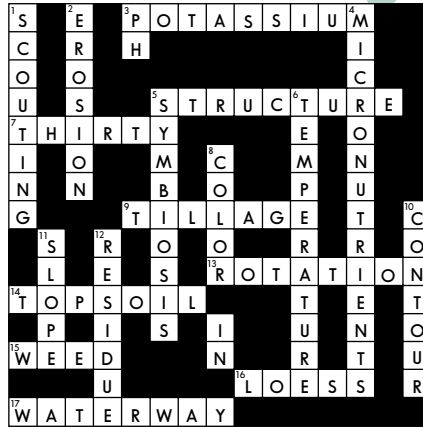
Down

1. Amount of grain people want to buy
2. Cost of items purchased and used in one season
3. Expenses that must be paid each year
4. Statistical comparison of hybrids and varieties
6. Can trap and suffocate you
10. Early plant breeder
11. One of first crops to be genetically modified
12. Gross margin minus fixed costs
13. Used to check grain moisture
17. Increases the drying rate of grain
18. Basic unit of heredity

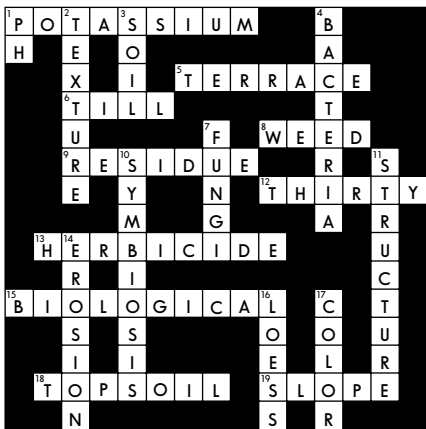
Crops Crossword Puzzle Answer Key



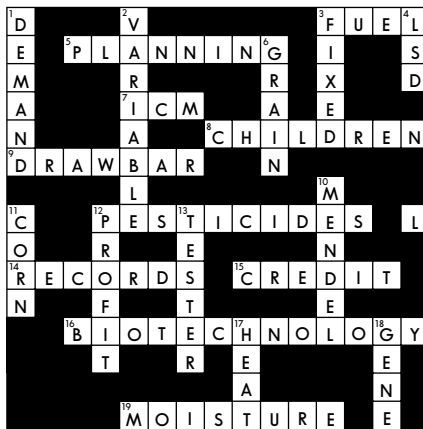
Puzzle 1



Puzzle 2



Puzzle 3



Puzzle 4

Quiz Bowl Review

A fun way to review what you covered at the end of a workshop or meeting is to have a quiz bowl. Make a list of questions from the topic covered at your meeting or workshop, 10 to 15 questions is probably enough. Split the group into two teams. Recruit a parent or two to help be "officials." Their job is to see who raises their hand first. Explain the rules to members (you probably only have to do this the first time you use this activity and they'll remember after that!). You will read a question and the first person to raise a hand gets to answer. Each correct answer wins a point for the team (small candies work great for scorekeeping). The team earning the most candies wins. Be sure everyone gets some candy at the end.

You can modify any game format with questions related to the topics you have discussed. Your members can help by writing the questions or suggesting game formats. Some games that have commonly been used are bingo, Scattagories, Pyramid, and charades.

Crops Bingo

This can be another game to review what you have covered in a workshop. Ask 4-H'ers to complete their card with one item they have studied under each column. Feel free to change the column headings to better fit what you have covered in the past. Have them also write each item on a recipe card along with a quick note about it, one idea per card. For example, under Organizations they might write "Iowa Soybean Promotion Board" and then write "funded this project book." Or under Careers they might write "editor" and then "ag career using journalism skills." Another option is to have several cards read before the meeting, so you read a clue and they mark the answer on their card. Then play bingo.

C R O P S				
Careers	Reaping the Harvest	Organizations	Planting	Safety Precautions

Scoping Out New Scouts

Scope out some new crop scouts by finding someone who can sign his/her name by each activity. Remember, each member can sign only one line!

- 1 _____
I have scouted for soybean aphids.
- 2 _____
I have planted corn.
- 3 _____
I have planted Roundup resistant soybeans.
- 4 _____
I have detasseled corn for seed production.
- 5 _____
I soil-sampled my fields last fall.
- 6 _____
I have all green tractors!
- 7 _____
I drive only red tractors!
- 8 _____
My harvest job is to drive the catch wagon.
- 9 _____
I helped with a field day last fall.
- 10 _____
I attended a county corn or soybean association meeting.

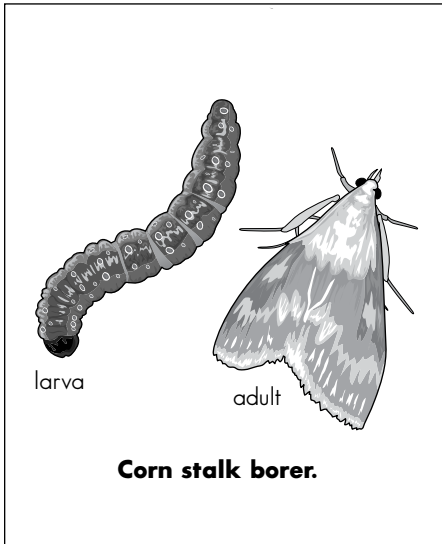
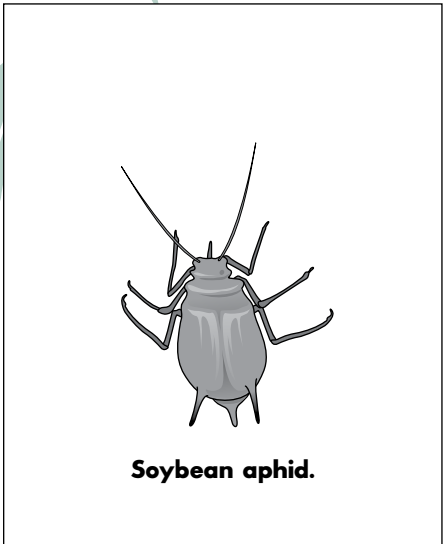
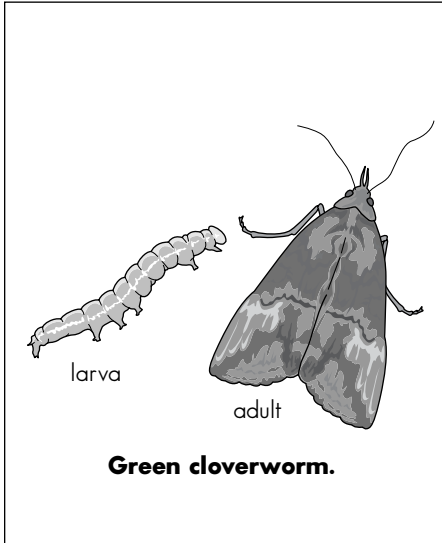
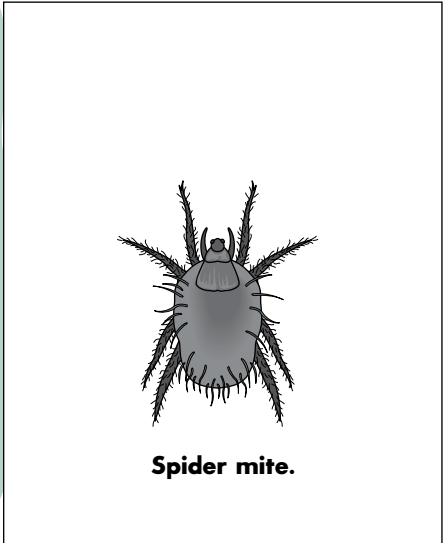
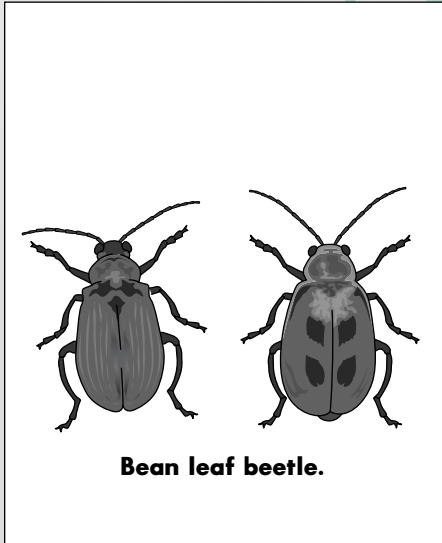
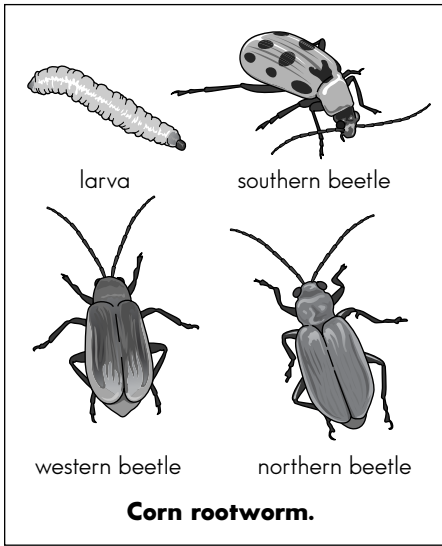
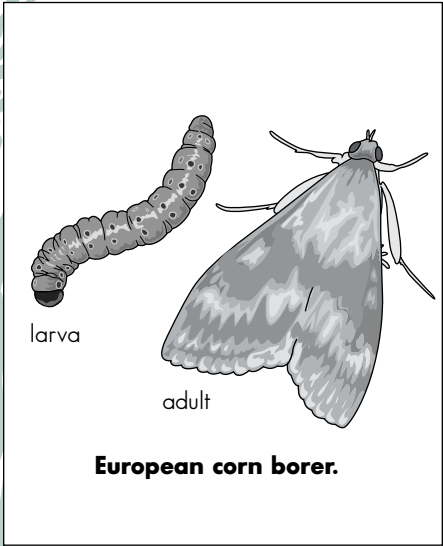
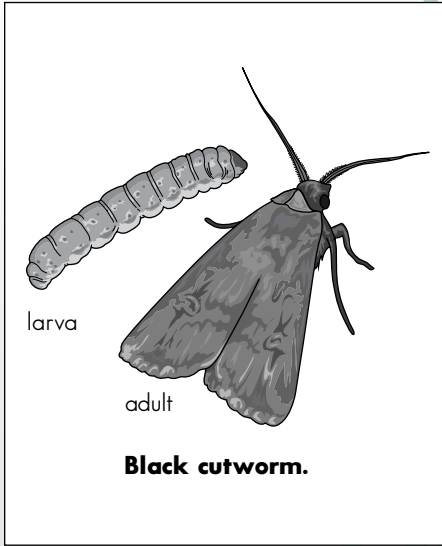
Pursuing Pests

Before the meeting, set up the room by hiding several pest cards. When members arrive, give everyone a clue sheet and instruct them to start searching for pests on their sheet. Have small candies for prizes for members who find the most pests. Hide underground pests on the floor under something, leaf feeders on tables and chairs, stem pests on table and chair legs. Be sure to hide a few far out of the way so they are hard to find!

Answers Sheet

1. Black cutworm (stem pest)
2. Soybean aphids (sap feeder that can be found anywhere on the plant)
3. European corn borer (stem pest)
4. Bean leaf beetle (leaf feeder)
5. Corn rootworm (underground)
6. Spider mites (leaf or stem feeder)
7. Green cloverworm (leaf feeder)
8. Corn stalk borer (stem feeder)

Pursuing Pests Cutouts



Pursuing Pests Clue Sheet

Your mission, if you chose to accept it, is to hunt down these pesky pests! Here are some clues about each pest. Match the pests you find in your "field" to the clues below.

- 1 _____
This pest does not over winter in Iowa. Adult moths fly in on southerly winds in the spring and lay their eggs. These pests cause the most damage when larvae are about the length of the diameter of a dime and corn plants have fewer than five leaves completely unrolled from the whorl. They severely damage corn plants, and can even kill them. Young larvae (less than $\frac{3}{4}$ inch long) feed only on leaves. Older larvae (over $\frac{3}{4}$ inch long) can cut through plants.
- 2 _____
This pest was first reported in Iowa in 2000. They are about $\frac{1}{16}$ inch in length, pale yellow or green, and have dark-tipped cornicles (tail pipes) on the back of their abdomen. They feed on soybeans through piercing-sucking mouthparts. They are a carrier of a number of plant virus diseases including soybean mosaic and they cause shortened soybean plants. These pests seem to do better in cooler temperatures and lower humidity. They suck the plant liquids from the leaves, causing the leaves to look distorted. Lady beetle larvae are a natural predator and help to control this pest's population.
- 3 _____
This pest does over winter in Iowa in its larvae stage. Mature larvae are one inch long and have a dark head. Young larvae are a dull white while older larvae are dirty white to tan with darker, halo-shaped spots and a dark line down the center of the back. There are usually two generations per year. They feed on leaf tissue and pollen (if available) and may tunnel into the midrib of the leaves. Older larvae will bore into the stalk and, in late summer, the ear shank and the ear. They reduce yield and weaken the plant, making stalk rots more likely and increasing the likelihood that plants will lodge or drop their ears before harvest. The adult moths are attracted to the early planted corn for the first generation and the late planted corn for the second generation.
- 4 _____
These pests are small, drab brown, red, or yellow beetles, and usually spotted. They always have a black triangular spot behind the neck. They overwinter as adults, which feed on the hypocotyl and cotyledons and sometimes on the foliage of young soybean plants. Damaged leaves look as if they have been shot full of holes. The beetles lay eggs and later die. The first generation hatches, the larvae feed on soybean root nodules, the larvae pupate, and the adults emerge to lay eggs. The second generation then hatches, larvae feed on nodules, the insect pupates, and then beetles emerge to feed on leaves and pods late in the growing season. Late season feeding can severely reduce yields and lower seed quality. This insect also carries bean pod mottle virus from plant to plant. They are attracted to the soybean fields that emerge earliest in the year.
- 5 _____
This pest over winters in Iowa as an egg, then hatches in early June. The slender white larvae (worms) have a dark head and a black plate on the top of the last segment. They grow to a length of about $\frac{1}{2}$ inch before pupating and turning into the adult beetle. The larvae stage feeds on corn roots, causing yield loss and causing the plants to be more likely to fall over (lodge) if a strong wind blows on the field. Three species of this pest may be found in a field, beginning in July. This insect is most often managed culturally by using a crop rotation.
- 6 _____
These pests are technically not insects because insects have six legs and these pest have eight legs. However, they are very much like insects. They can be found in soybean fields from July through August and can be a serious problem under dry weather conditions. They can complete a generation in 5 to 7 days. They are very small (about the size of a grain of pepper) and greenish-white with a dark spot on each side of the body. They feed on leaf sap and leave a fine, white webbing on the undersides of leaves. Their injury first causes tiny, yellow dots on leaves, then leaf yellowing, browning, eventual leaf death, and, if severe enough, death of the plant. In most years, natural biological controls already in the field maintain the population at levels so low that other management is not needed.
- 7 _____
This pest attacks soybeans from flowering to harvest. This light green worm, which is the larval stage of a moth, has two thin, white stripes along each side of its body. It moves by arching its body, and it flips violently from side to side when disturbed. They eat holes in the leaves of the upper portion of the plant and may feed on blossoms. Badly damaged fields look ragged.
- 8 _____
This adult moth lays its eggs on weeds, particularly grassy weeds, in the fall. In the spring, the newly hatched larvae move from the grass to young corn plants. The larvae then bore into the lower part of a corn plant and feed on the whorl. They are light colored with purple bands around the middle segments of their body.

Wacky Weeds

This is another get acquainted game that helps youth identify common weeds. As youth arrive instruct them that this game is like Twenty Questions. Copy or write the name of weeds on paper and cut them into strips. Tape one weed on the back of each member, but don't let the member see it. 4-H'ers ask each other simple yes/no questions and try to guess the weed on their backs based on the answers others give them.

For example, they might ask, "Am I a grass weed? Am I a broadleaf weed? Am I a pest of soybeans? Am I a pest of corn? Am I a pasture weed? Am I an annual weed?"

If you have access to a computer and the Internet, you might review with the 4-H'ers what these weeds look like. They can be found on the ISU Weed ID web page at www.weeds.iastate.edu/weed-id/weedid.htm.

Woolly cupgrass

Yellow nutsedge

Common cocklebur

Common sunflower

Giant ragweed

Common ragweed

Wild mustard

Velvetleaf

Black nightshade

Jimsonweed

Pennsylvania smartweed

Common lambsquarters

Waterhemp/Pigweed

Common milkweed

Hemp dogbane

Field bindweed

Canada thistle

Kochia

Marestail

Indoor Activities

CHAPTER 3

I Spy Soybeans and Corn!

Do you know all the things we make from soybeans? Look around your home, school, church or wherever. Bet you find corn and soybean there.

For more information on specific soybean based products see the United Soybean Board web page at www.unitedsoybean.org/ and go to the New Uses link, or the Iowa Soybean Board at www.iasoybeans.com/ispb/index.html or www.iasoybeans.com/ispb/newuses.html



- ▶ How many items made from soybeans or corn did you find?
- ▶ What products surprised you?



- 1 As a small group, dream up a new use for soybeans.
- 2 How can you teach others about the uses of soybeans in our lives.

Using a Soil Survey

This activity will help youth understand how to use a soil survey to determine the soil types located in a field or on a farm.

Materials

Copies of your county Soil Survey
Worksheets for each group
Pencils

- ➊ Copies of your county Soil Survey Book can be obtained from your county Extension office or Natural Resources Conservation Service (NRCS). As a leader, prepare by studying the soil survey book. Most reports have a description, "How to Use This Report," on the inside cover and first page. Use illustrations such as those provided on the front cover of the Soil Survey Book.
- ➋ Select at least two locations that you want to study. They might be your farms or locations where you are planning to hold some group activities or meetings. Locate these areas on the map. Each location should be investigated by a different group of youth.
- ➌ Help each group find their location in the maps. Ask them, "What map unit symbols did you find in this field?" Record them on your worksheet.
- ➍ Now, turn to the "Index to Soil Map Units" (towards the front of the book). Find the name of each of your map units and the page where each is described.
- ➎ What soils do the symbols indicate? What percent slope is it? What corn and soybean yields are possible for your soil type? Record this information on the worksheet. Then write a brief description telling some of the characteristics of your soil types.
- ➏ The percent slope, color of surface layer, and thickness of surface layer are found in the section *Detailed Soil Map Units*. The corn and soybean yields are found in the table *Land Capability and Yields per Acre of Crops and Pasture*. The publication *Take A Good Soil Sample to Make Good Decisions*, available from www.extension.iastate.edu/Publications/PM287.pdf, also discusses the use of soil maps.



- What did you learn from reading the soil survey?
- When comparing your location to others, what difference are seen in the soils?
- What similarities are seen?
- What do you think causes these differences and similarities?
- How will you use this in your crop planning and decisions?
- What effects does soil type have on fertility decisions?
- How does the percent slope affect your farming practices?



- ➊ Why is it important to crop production to be able to read a Soil Survey map?
- ➋ Besides farming, what other occupations might use the Soil Survey?

Using a Soil Survey Worksheet

Soil Map Unit Symbol	Soil Name	Percent Slope	Corn Yield	Soybean Yield	Color of Surface Layer	Thickness of Surface Layer

- 1 Describe the characteristics of some of these soil types. _____

- 2 How does soil type affect your crop planning decisions? _____

- 3 Why is it important to crop production to be able to read a Soil Survey map? _____

- 4 What other occupations use the Soil Survey? _____

Soybean Cyst Nematode

In this activity 4-H'ers will compare plants grown in soil known to be contaminated with soybean cyst nematode with plants grown in "clean" soil.

Materials

4 clear 2-liter pop bottles
 Potting soil
 Aluminum foil
 Soil from a farm field known to contain (be infested with) soybean cyst nematodes (SCN)
 Seeds of a soybean variety that is resistant to SCN
 Seeds of a soybean variety that is susceptible to SCN
 (check with a local farmer, the county Extension education director, or your local elevator or seed dealer for seeds of a SCN-susceptible and a SCN-resistant variety)



- ▮▮▮▮ What were the differences in how the leaves and stems of the two varieties looked?
- ▮▮▮▮ What differences did you observe in how the roots of the two varieties looked?
- ▮▮▮▮ What differences did you observe between the two varieties in appearance of soils?



- 1 What other diseases or insects might cause similar symptoms on soybeans?
- 2 What can a farmer do to decrease disease or insect damage?

- 1 This activity needs to be started about 6 weeks ahead of the meeting to allow time for the plants to grow and the nematodes to infest the plants.
- 2 Remove the labels and cut off the tops of four clear plastic 2-liter pop bottles. Punch some holes in the bottom of each bottle for drainage. Cover each of the bottles with aluminum foil to keep light out. Label the bottle samples 1, 2, 3, and 4. Fill the bottles labeled samples 1 and 2 with potting soil, and the bottles labeled samples 3 and 4 with soil that is infested with SCN. Plant 4 seeds of the susceptible variety around the outside edge of bottles labeled sample 1 (with the potting soil) and sample 3 (with the SCN-infested soil). Similarly, plant 4 seeds of the resistant variety around the edge of bottles containing sample 2 (with the potting soil) and sample 4 (with the SCN-infested soil). The seeds should be planted about 1" deep. Water the soil in each bottle and place the bottles in a warm area with good sunlight or a growth lamp. Water the soil in the bottles every three or four days or whenever the soil feels dry.
- 3 After the soybean plants have grown for 5 or 6 weeks, you are ready for your club meeting.
- 4 Begin by discussing the visual symptoms of soybean cyst nematode, and the life cycle of the cyst. Ask your county Extension office for a copy of PM 879, *Soybean Cyst Nematode*.
- 5 Divide the members into two small groups, and give samples 1 and 2 to one group and samples 3 and 4 to the other group. Remove the aluminum foil from the bottles and instruct the two groups how to observe the leaves, stems, and roots of the susceptible and resistant plants and record their observations for the two varieties. After the two groups have recorded their observations, have them compare observations with each other. See if both groups observed similar things (including the same differences between the appearance of the two varieties).

Soybean Cyst Nematode Worksheet

Record your observations for each.

Sample	1	2	3	4
Leaves				
Stems				
Plant Height				
Roots				
Nitrogen Nodules				
Cysts				

For Each Sample 1, 2, 3, and 4

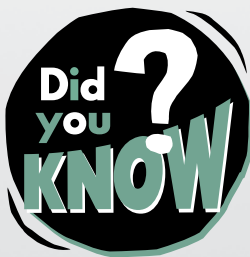
- ❶ Observe the leaves and stems of the plants. Do they have a good green color or some yellowing?
- ❷ Observe the roots of the plants. What color are the roots? Do you see any nitrogen nodules?
- ❸ Do you see any small, round, white or yellow objects (cysts)?

Compare Samples 1 and 2 or Samples 3 and 4

- ❶ Are plants equal in height?
- ❷ Are the leaves and stems of the two varieties similar in color?
- ❸ Are the roots of the two varieties similar in color?
- ❹ Are there similar numbers of nitrogen nodules on both varieties?
- ❺ Are there similar numbers of soybean cyst nematodes on both varieties?
- ❻ Are there differences in the appearance of the leaves/stems and roots of the two varieties in both soils? Why do you suppose there is or isn't?

Life Science Corn Curriculum Activities

CHAPTER 4



DNA Extraction

DNA has become a powerful tool in modern biotechnology. Scientists are able to identify genes that are the segments of DNA that code for a specific protein. By using chemical "tools" found in nature, genes can be "cut and pasted" into different organisms. Insulin is produced by bacteria that have the gene for human insulin pasted into them. Before any DNA can be worked with, it needs to be isolated from cells. The isolation of DNA is called DNA extraction. The cell membrane must be broken open to get at the DNA. In this activity you will use shampoo to open the cell membrane, since the membrane is made from a chemical that is in the same family as the grease in your hair. Once the cell is broken down, the DNA needs to be separated from the rest of the cell contents. This is done with filtering first; then making the DNA precipitate (not being able to stay dissolved). This would be the first step in any DNA work from working with corn genes to working in crime labs to identify people by their DNA.

After completing the following activity, youth will be able to see DNA from kiwi, banana, tomato, or other fruits or vegetables.

- ▶ DNA is the most efficient storage system known to humans. DNA can store 10 to 11 gigabytes of information per centimeter (cm). That's 1,800 gigabytes (1,800 billion bytes or 1,800,000,000,000 bytes) total.
- ▶ Humans share 50% of their DNA with bananas.
- ▶ DNA in all humans is 99.9% identical. It's the one-tenth of one percent that makes us all unique.
- ▶ On average, it takes 1.8 genes to express a specific trait.
- ▶ More than 200 genes found in the human genome have a bacterial ancestry. This is evidence of horizontal gene transfer in nature.
- ▶ Cells can contain 6 to 9 feet of DNA. In an average meal, you eat approximately 55,000,000 cells or between 63,000 to 93,000 miles of DNA.

Materials

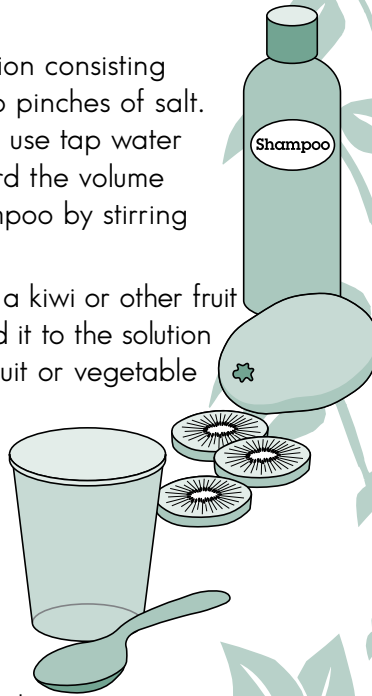
Three plastic glasses or other clear containers from your cupboard
Knife for cutting kiwi or other fruit or vegetable
Spoon for mashing kiwi or other fruit or vegetable
Coffee filter or paper towel
30 ml of distilled water (2 tablespoons or 6 teaspoons) or tap water
Clear colored shampoo without conditioner such as Suave Daily Clarifying Shampoo
1/2 kiwi or other fruit
Table salt, either iodized or non-iodized
Medicine dropper
Rubbing alcohol

Time

Prep: 20 minutes to gather supplies
Activity: 30 minutes

Doing the Activity

- 1 In one of the containers, make a solution consisting of one teaspoon of shampoo and two pinches of salt. Add distilled water if available; if not, use tap water to make a final volume that is one-third the volume of the cup. Dissolve the salt and shampoo by stirring slowly to avoid foaming.
- 2 Using a knife, peel and cut one-half of a kiwi or other fruit or vegetable into small pieces and add it to the solution from Step 1. Mash the kiwi or other fruit or vegetable against the side of the cup with the back of the spoon for 10 minutes. The detergent dissolves the lipids that hold the cell membranes together, which releases the DNA into the solution. The detergent causes lipid and proteins to precipitate out of the solution, leaving the DNA. The salt enables the DNA strands to come together.
- 3 Mash the kiwi for 5 to 10 minutes, then place the filter or paper towel inside the second glass. Fold the coffee filter's edge around the cup so that the filter does not touch the bottom of the cup.
- 4 Filter the mixture by pouring it into the filter and letting the solution drain for several minutes until there is approximately 5 ml (covers the bottom of the cup) of solution to test.
- 5 Remove the filter or paper towel.
- 6 Combine the solution with $\frac{1}{2}$ inch of rubbing alcohol. Try adding the solution to the rubbing alcohol first, then another time adding the rubbing alcohol to the solution. Compare the results.



To extend this activity, also do the DNA Smoothie activity available on the Iowa State Biotechnology website www.biotech.iastate.edu



- ▶▶▶ How did the process work?
- ▶▶▶ What does DNA look like?
- ▶▶▶ What was the purpose of each step of the process in extracting DNA?

Activity Source

- Iowa State University Extension—Science, Engineering and Technology



- 1 What other fruits or vegetables do you think would work for this experiment?
- 2 How can you share this information with others?
- 3 Try to extract DNA from other fruits and vegetables. How do the results compare? How does the DNA compare?
- 4 What project or exhibit ideas do you have after completing this activity?

Practical Applications of Biotechnology

Biotechnology is broadly defined as “using living organisms or their products as tools to make life better.” Humans have used biotechnology since the beginning of recorded history. Baking, brewing, breeding crops, and breeding livestock are all examples of biotechnology in the classic sense.

Today, biotechnology has been associated with a new technology centered on the use of DNA to alter living organisms to create a product. This modern biotechnology could be considered to have begun in the 1970s when scientists first transferred a gene from one organism to another. Modern biotechnology, like all new technologies, has been surrounded by controversy. Acceptance of new technology takes time, during which new products can be evaluated for safety and study made of their broad impact. The use of modern biotechnology has grown rapidly and surrounds us.

This activity takes a look at a few of the early biotechnology products. After completing the activity, do some research about the responses people have about biotechnology products. After completing the following activities, youth will be able to identify common products of biotechnology in their world and will identify barriers to the acceptance of new biotechnology related products.

Materials

20 3 x 5 index cards
 Magic marker
 The Hunt for Biotechnology Answer Key

Time

Prep: 10 minutes
 Activity: 25 minutes

Doing the Activity

The Hunt for Biotechnology

1 Create set of index cards for each group of 2 to 3 youth. Begin by writing each of the following terms on an index card.

- Tomato
- Jeans
- Ice Cream
- Cancer
- Potatoes
- Corn
- Milk
- Pigs
- Bread
- Heart
- Scales of Justice
- Pizza
- Sheep
- Football
- Mosquitoes
- Sewage
- Soybeans
- Diabetes

Tomato

Pigs

Jeans

Corn

Sheep

2 Now prepare the following two title cards to use in sorting the index cards.

- YES, this is related to biotechnology
- NO, this is not related to biotechnology

NO,
this is not related
to technology

YES,
this is related
to technology

3 Instruct each group to lay out the two title cards (YES, this is related to biotechnology and NO, this is not related to biotechnology) in front of them. Direct the group to sort the index cards into those two categories. Once you have completed your sorting, compare your list with the Hunt for Biotechnology Answer Key (pages 28 to 29).



- Which applications did you most easily associate with biotechnology?
- Which applications of biotechnology surprised you most?
- Why do you think you were surprised by them?
- Which of these applications of biotechnology have you experienced?

Activity Extension: 15 minutes

Share your index and title cards with several family members or friends. Ask them to sort them into the two piles. Then share with them the Hunt for Biotechnology Answer Key (pages 28 to 29).

Ask the Following Questions of Your Participant

- Which applications did you most easily associate with biotechnology?
- Which applications of biotechnology surprised you most?
- Have you experienced any of these applications of biotechnology?
- Would you object to using any of the biotechnology applications and why?

Today biotechnology surrounds us and is becoming an important tool in developing products for the home, for communities, and for better health. Compare the responses people gave and explore the reasoning they used for their choices.

Resource

- www.nal.usda.gov/bic/ (National Ag Library on biotechnology information hosted by United States Department of Agriculture)



- Which application of biotechnology would you like to know more about?
- Why would some people find it uncomfortable to use a product of biotechnology?
- How could you find out how people feel about the introduction of a new product of biotechnology?
- Why do you think that some of the biotechnology products create no controversy when introduced to the public, yet others do?

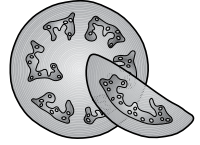
Hunt for Biotech Answer Key

Read further for explanations on how biotechnology is becoming a common tool in our living world.

Food Products

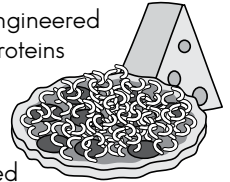
Tomato

Most commercial tomatoes must be picked while still green and are ripened while being shipped to market. This reduces the flavor of the tomato. People who enjoy tomatoes can tell you that they prefer vine-ripened tomatoes. Regular commercial tomatoes grown and sold in the United States would not make it to market before going soft and mushy if they were allowed to ripen on the vine. The Flavr-Savr tomato produced by CalGene in 1991 is able to be picked when ripe on the vine. It stays firm for several weeks because the genes that cause the tomato to go soft shortly after ripening have been suppressed. The tomato stays firm lots longer than the regular vine-ripened tomato.



Ice Cream and Cheese

About 85 percent of the cheese in the United States is now processed using rennin produced by genetically engineered bacteria developed in the 1980s. Rennin was found in the lining of calf stomachs and is needed to digest the proteins in making cheese and ice cream. The bacteria act as a small living protein factory, which now contains the genetic pattern for producing rennin along with all of its regular functions. The rennin is easily separated from the bacteria and packaged for use in producing these dairy products. Produced under the trade name "Chymosin," it has a great advantage to the rennin, which must be refined from calves, in that it can be produced in huge quantities very cheaply. Unlike rennin made from the stomachs of calves, the new product is also acceptable to vegetarians.



Milk

Bovine Somatotropin (BST) is a natural protein hormone that stimulates milk production. It is produced in the pituitary gland of lactating dairy cows and can be manufactured in the laboratory. Injections of additional BST produced in the laboratory boosts natural milk yields. It is injected under the cow's skin at regular intervals to extend the peak milk production period. Manufacturers of BST claim that it can increase milk yields by about 10 to 15 percent. It is impossible for laboratory technicians to distinguish between milk produced by cows stimulated by BST injections and milk produced by cows without BST injections.



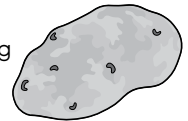
Bread

Considered one of the first products of biotechnology, bread is produced with yeast, which is a microbe that digests the sugar in bread dough and produces carbon dioxide gas, which causes the bread to rise and become light and porous.



Potatoes

Potato plants have been enhanced to produce an insecticide throughout the plant that kills the Colorado Potato Beetle, a major insect pest. Potatoes also have been enhanced genetically to include the genetic code for producing vaccines creating immunity to cholera, Hepatitis B, and many other diseases. Bananas along with potatoes have been modified to produce a very inexpensive vaccine that can be acquired by just eating the food.

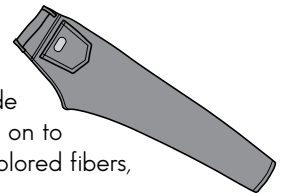


Special Note: In the 1980s, biotechnology techniques became available to genetically alter bacteria, which resulted in the production of biological products normally produced only by animals. Utilizing these techniques, bacteria can be grown in large quantities to produce the animal product very cheaply. The bacteria are killed and the animal product is separated and highly purified. Products on this list using the bacteria as protein factories include: Insulin, porcine Somatotropin, and Bovine Somatotropin.

Agricultural Production

Jeans

Cotton varieties have been enhanced to now contain additional genetic material to produce an insecticide throughout the plant protecting it from the Boll Weevil, the major insect pest of cotton. Work is also going on to produce cotton fibers that are already colored. By adding certain genetic material, cotton can produce colored fibers, saving processors the step of dyeing the cotton to make the final products.



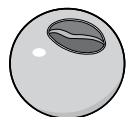
Corn

Corn varieties have been enhanced to now contain additional genetic material to produce an insecticide throughout the plant protecting it from the European Corn Borer that eats on the leaves and stalk. The attack of this pest insect has caused more than a billion dollars per year of loss to farmers in the United States. Corn varieties also have been enhanced to protect it from certain weed killers that would kill the corn when farmers spray the weeds.



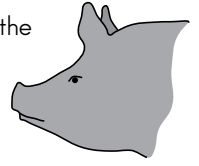
Soybean

Soybean varieties have been genetically enhanced to produce healthier oil and to protect soybean plants from certain herbicides that would kill them when farmers spray the weeds.



Pork

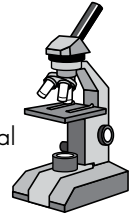
Work is progressing in use of porcine Somatotropin (pST) a natural pork growth hormone. The hormone enhances the ability of the animal to produce more muscle and less fat as it matures. When pigs reach certain maturity, the pig switches from producing mostly muscle and little fat to producing mostly fat and little muscle. By injecting the pigs with pST, the pig reaches maturity and continues to grow producing mostly muscle and a little fat. This brings a much leaner product to market.

**Sheep**

Dolly, a sheep in Scotland, was the first major mammal cloned. In addition, sheep and goats have provided a valuable resource as their mammary glands have been enhanced to produce pharmaceutical-based medications through their milk. Human growth hormone and blood clotting agents have been produced in the milk of modified animals, and these animals pass the trait on to their offspring, adding great value to these agricultural animals.

**Medical Diagnosis and Treatment****Cancer**

Genetic testing is providing indications of those who are likely to develop breast and colon cancer because of recognized patterns in the DNA. It is also leading researchers to understand how cancer cells change to become lethal disease cells. It is expected that someday this genetic information will help us learn how to combat this disease.

**Diabetes**

People with certain types of diabetes inject themselves daily with insulin, a protein hormone that regulates their blood sugar. The pancreas, and the pancreases of slaughtered animals such as swine, normally produce insulin. Sheep, also were used as a source of insulin. Now most diabetics use a bacteria-produced version of insulin, Humulin, which is produced in the laboratory. Without this plentiful source of insulin, the United States would likely not have enough insulin to meet demands.

**Heart**

Organ replacement research is progressing to modify the genetic pattern of primates and pigs to create more compatible organs for transplanting in humans. Research is also proceeding in Australia to create a process for cloning individual organs and regenerating heart muscle and spinal cords.

**Law Enforcement, Identification****Scales of Justice**

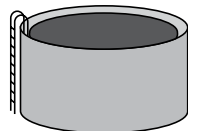
DNA evidence has become an accepted piece of police evidence in convicting many criminals in court. A national DNA registry of criminals has solved many old crimes as police evidence from these old crimes is tested. DNA evidence also has freed innocent individuals who were previously convicted of crimes. Their DNA fingerprints don't match the crime scene evidence.

**Football**

Special synthetic DNA is being used to verify sports memorabilia. In the 2002 Super Bowl, all of the balls used in the game were treated with a unique DNA identification so that they could be tested to verify that the football had been used during the Super Bowl. The synthetic DNA also was used on famous baseballs, authentic sports jerseys, and other valuable sports memorabilia to ensure their authenticity.

**Industrial Application****Sewage**

Using microbes to break down many chemicals in the environment is an important application of biotechnology. Sewage treatment plants harness these microbial recyclers to clean up wastewater before it returns to streams, lakes, and groundwater. Some sewage plants also collect methane, the microbes produced to fuel generators, digesters, and air compressors.

**Scientific Application****Mosquitoes**

In the movie, Jurassic Park, mosquitoes provided the DNA link that allowed recreating dinosaurs. In real life, a mosquito was actually discovered in some ancient tree sap called amber and was found to contain dinosaur DNA. It was not viable DNA that could be used for cloning, but it illustrates that such cloning might be possible in the future.



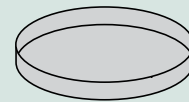
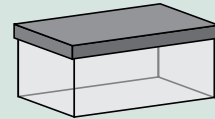
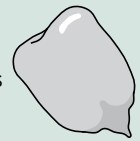
Bt Corn versus the European Corn Borer

After completing this activity, your members will understand the process of creating new crops with new traits created through the study of Bt corn using DNA techniques.

Before doing this activity, you should read the publication, *Insect-resistant Crops Through Genetic Engineering, Biotechnology Information Series, NCR #553*. This publication can be ordered from Extension Distribution Center or is available online at www.biotech.iastate.edu/biotech_info_series/bio9.html.

Materials

- 15 Bt corn seeds and 15 non-Bt corn seeds*
- Containers for growing 15 Bt and 15 non-Bt corn plants
 - 30 peat/plastic starter pots 4 to 6" diameter or
 - 1 large plastic container 14" w x 24" l x 11" h, such as those made for clothes storage
- 5 lbs of potting soil
- Sand or aquarium rock if using the large plastic container
- European corn borer (ECB) eggs*
- Containers for incubating ECB eggs
 - 1 Petri dish per group (100 mm x 20 mm recommended) or 1 glass jar per group
- Growing light or another light source
- Marking pen
- Fine tip watercolor paintbrush or flat toothpicks
- Filter papers or paper towels
- Several sheets of white paper such as copy paper



Preparation and Information

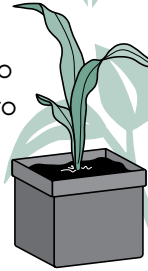
This activity does need some advance planning and you may want to find a science teacher to help. You will need to coordinate the arrival times of the corn seeds and ECB eggs. The corn seeds can be ordered from ISU or a seed corn company near you. Plan time for shipping and preparation. When the corn reaches the 2 to 3 leaf stage, you should order the ECB egg masses from the ISU Office of Biotechnology, which will notify the USDA-ARS Corn Insect Research Unit to send them. You need to let the corn grow to the 2 to 3 leaf stage before ordering the eggs because young corn plants have a natural resistance to ECB for a short time.

*Available in Iowa through Iowa State University's Office of Biotechnology, phone toll-free in Iowa 1-800-643-9504 or e-mail: biotech@iastate.edu.

Doing the Activity

1 Planting your corn

- You should plant approximately 15 seeds each of Bt and non-Bt corn. You will need to plant your corn 10 to 14 days before the lab activity. Remember that the corn will grow wide and tall. Plant the 15 Bt and 15 non-Bt corn seeds in individual 4 to 6 inch pots made of plastic or peat. Fill each pot with potting soil, leaving space at the top for watering. Press each seed about $\frac{3}{4}$ of an inch into the soil and cover lightly with soil. Allow 5 to 7 days to germinate, depending on the temperature. Grow the corn until it has 2 to 3 leaves, then order your ECB eggs from the ISU Office of Biotechnology.



2 Preparing and incubating ECB eggs

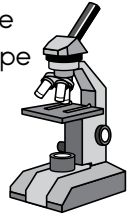
- One critical part of proper storage and incubation of ECB eggs is to keep them in high humidity. If you want to keep the eggs dormant for up to 7 days, place them in a plastic bag with a damp paper towel and store them in the refrigerator. Be sure that the eggs do not freeze.
- If you receive egg masses sent to you on wax paper, clear a 2 ft. square area on a table, desk, or countertop and cover the area with white paper. Sheets of copy paper are fine. Scrape the back side of the wax paper (the side without the eggs) on the sharp edge of the table, desk, or countertop. Turn the wax paper upside down above the area you have cleared and covered with white paper. Snap the paper. The egg masses will pop off and fly everywhere. Collect the egg masses in the containers you intend to use for incubation. Shipments of individual egg masses, are ready for incubation when they arrive.

3 Hatching the ECB eggs using a glass jar

- Label one jar Bt and one jar non-Bt. Place water in both glass jars and swirl until the sides are wet. Remove the excess water from the jars. Using a damp watercolor paintbrush or flat toothpick, place a few of the egg masses inside each jar on the sides and let dry. Place a damp paper towel in each jar and seal with lids. Incubate at 80°F (27°C) for approximately 1 to 3 days or until the eggs hatch.
- Eggs close to hatching have distinct black centers, which are the black heads of the larvae that are visible through the translucent eggshells. **Do not** set the egg masses in water for a long period of time or they will drown and die. Incubate the eggs until black heads appear in the egg mass.



- When black heads appear, you can observe the larvae of the ECB by using a dissecting or compound microscope under scan or low power objectives. You should be able to see the larvae move in the egg. At this time, the eggs are only about a day from hatching. One egg mass will yield approximately 10 to 20 larvae.
- Drop corn leaf cuttings into the jars and observe the ECB larvae's activity. Make sure you put Bt corn leaves in the jar marked Bt, and non-Bt leaves in the non-Bt jar. Try to schedule this so the leaves are in the jars with larvae a day or two before your meeting. Observe the larvae in each jar. Compare their appearance and activity.



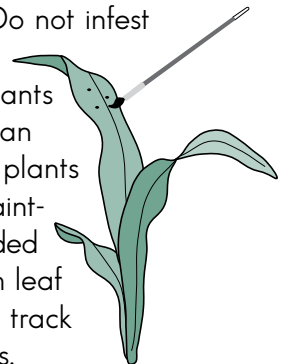
Bt Corn Activity Instructions

- 1 You are going to repeat the procedure that researchers first used to test corn for resistance to the European Corn Borer (ECB). The ECB causes billions of dollars of damage each year to the corn grown in the United States. Control of ECB without the use of insecticides has long been a goal of the corn industry.
- 2 In this activity, you will investigate a variety of transgenic corn that contains a gene from the bacteria *Bacillus thuringiensis* (Bt). The gene produces a Bt protein that is lethal to the ECB when consumed by its larvae.
- 3 Two weeks ago you started growing the two varieties of corn, Bt and non-Bt, that you will use in this investigation. When the corn had 2 to 3 leaves you began incubating the ECB eggs. It is critical that the ECB eggs be used when they reach the blackhead stage of their development. Eggs close to hatching have distinct black centers, which are the black heads of the larvae that are visible through the translucent eggshells.



4 Live plants

At the same time you infest the leaf cuttings with the ECB larvae, you can infest some of the growing plants. Do not infest all your plants because you will need a comparison. Do not leave your uninfested plants near the infested ones because the larvae can move from one plant to another and all the plants may become infested. Use a damp fine tip paintbrush or flat toothpick to pick up a blackheaded egg mass. Place 2 to 3 egg masses on each leaf or in the leaf whorls of the corn plant. Keep track of the corn varieties and record observations.





- ▶▶▶▶ What differences did you observe in the Bt and non-Bt corn?
- ▶▶▶▶ What characteristics of the plants relates to the observed differences?
- ▶▶▶▶ What can you infer from your observations about the corn plants?
- ▶▶▶▶ Were there differences between non-Bt corn infested with the insect versus similar plants without ECB?

Resources

- *Bt Corn and European Corn Borer, Long-Term Success Through Resistance Management* (North Central Regional Extension Publication NCR 602)
Extension Distribution Center
Iowa State University
119 Printing and Publication Building
Ames, Iowa 50011-3171
Phone: (515) 294-5247
Web: www.extension.umn.edu/distribution/cropsystems/DC7055.html
- You also can contact your local seed corn dealer for additional information on Bt corn.
- Prepared by the Office of Biotechnology, Iowa State University.

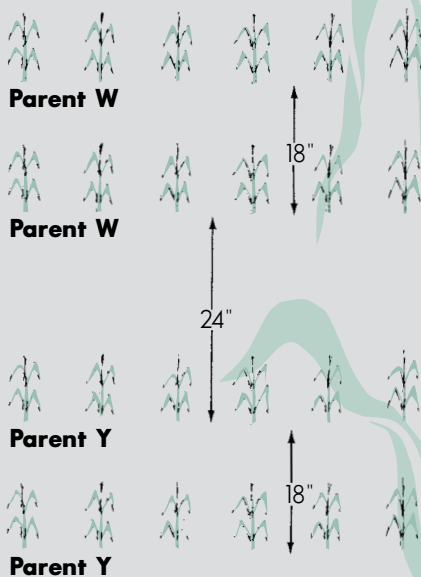
Field Activities

CHAPTER 5

Corn Crossbreeding

Every individual plant has a group of features that make up its “personality.” Some of these qualities are desirable and others are not. Plant breeders try to produce plants that have as many good features as possible with as few undesirable traits as possible. This process for corn is called hybrid production. They produce hybrids by **crossbreeding** plants to combine the best features of the plants they started with. For example, if one corn hybrid produces very high yields and another one is capable of resisting diseases, the plant breeder would try to cross them to produce a new hybrid that would have both of these good features.

The process of **crossing** two hybrids is done by allowing the pollen from the tassels of one hybrid to reach the ear silks of a second hybrid that will become the female or seed-bearing parent. The corn kernels that are produced will combine the characteristics of both the “parent” plants. Traditionally, both corn hybrids will produce pollen. To prevent the pollen from the female or seed-bearing parent from pollinating itself, the tassel is removed. In seed production fields, this is done mechanically and by hand. In this activity you will actually crossbreed two different hybrids of corn. You will be placing a bag over the silks and tassels of the two hybrids to control self-pollination rather than detasseling plants.



Crossing corn plants. Parent W and Parent Y are different colored seed varieties.

Materials

Field or garden plot area
Yellow corn seeds
White corn seeds

- 1 Select seeds of a white corn hybrid and a yellow corn hybrid that mature at about the same time. (They must both produce pollen when the silks are ready to receive it.) Your seed dealer or county Extension staff may be able to help you get suitable varieties.
- 2 In the spring, plant a short row of each variety of seeds (6 to 10 seeds) 1 1/2 inches deep. Label or mark each row with wooden stakes marked “Parent W” for the white corn row, and “Parent Y” for the yellow corn row. Observe the plants as they grow.

- 3** Place a large transparent bag over the tassel area of each plant before the tassel appears. Fold and fasten the bags securely with a paper clip, pin, or twist tie, but be careful not to damage the stalk. Place a small paper bag over the ear shoot of each plant. Fold and fasten it as above.
- 4** Watch carefully to see when the pollen starts falling from the tassels. When you see that pollen is being shed,
- Select one of the plants labeled Parent Y.
 - Gently pull the tassel over.
 - Shake the sack and tassel to collect the pollen in the bag, on the side of the bag, not at the bottom where it would spill when the bag is removed.
 - Remove the bag containing the pollen.
 - Select a plant labeled Parent W. Remove the bag from the ear shoot, and cover the ear with the bag containing pollen labeled Parent No. Y. Be careful not to spill the pollen.
 - Hold the mouth of the bag around the base of the ear shoot. Shake it to dust pollen onto all of the silks.
 - Fasten the bag onto the ear shoot with pins, clips, or a twist tie to keep out other pollen.
 - Attach a string tag labeled WF x YM to the pollinated ear to indicate that the ear of Parent W (white female) was fertilized with pollen from Parent Y (yellow male). Also, write the pollination date on the tag.



Collecting pollen.



Cross pollinating.



- ▶▶▶ What did you learn about crossing two corn hybrids?
- ▶▶▶ Was every kernel the same? Why or why not?
- ▶▶▶ How do they do this in real-world production?



- 1 What other plants could you cross this way?
- 2 What are some other traits breeders would want to crossbreed for?
- 3 How are soybeans cross bred?

- 5 Make a similar cross by applying pollen from a plant labeled Parent W to the ear of a plant labeled Parent Y. Label the ear WM x YF, and record the pollination date.
 - Using all of your other plants, make and label other crosses in both directions (WF x YM and WM x YF) between Parent W and Parent Y plants.
- 6 You might also pollinate a few plants to themselves to show normal white and normal yellow ears for a comparison.
- 7 Observe the ears as they grow. Allow them to mature on the stalk. Harvest the ears when they are nearly dry. Strip back the husks, and hang them in a dry, well-ventilated place to finish drying. Keep the label on each ear. Shell the ears when they are fully dry, and place the kernels in envelopes labeled the same as the ears. Store them in a cool, dry place. These seeds are first-generation crosses or hybrids (F1).
- 8 Record the shade of yellow for each ear for each direction of cross.
 - Yellow (male) x white (female)
 - Yellow (female) x white (male)

Rootworm Beetle Silk Clipping

This activity will take two meetings, one as soon as silks appear on the corn ears, around mid-July, and the second at harvest time. It will demonstrate the effect insects have on yield by feeding on the silks.

- 1 Start the activity asking the youth how to design an experiment to test for the effects of insects on corn yield. Using this method will get them involved in the process, and get them thinking about what they will be examining.
- 2 Select 10 corn plants along the edge of a row. Mark the plants with a tag, or put a flag or stake in the ground beside each plant so you can easily identify and locate them again.
- 3 On five of the plants, cut off the silks with a scissors. Never let the silks get more than $\frac{1}{4}$ inch long, so check them every 3 to 4 days. Either assign members to check the silks at regular intervals, or assist by checking them yourself. Let the other five plants grow normally. These will be your "control" plants. During this time also be looking for evidence of insects. Record any evidence that is found. What types of insects are found? How many are present? Keep a journal of the dates, weather conditions, and amount of rain that has occurred recently as well as the other information, as a part of your experiment.
- 4 At harvest time, harvest the ears from all 10 plants. Be sure to label each ear with tape and a marker indicating if it was from a plant with cut silks or an uncut control plant. Shell the ears, and weigh the corn from each ear. Record your findings in the following table. Also record any evidence of other insect damage, lodging, weather damage, etc.

Weight Comparison of Results

Treated Plants (Silks Cut Off)	Weight of Harvested Corn
1	
2	
3	
4	
5	
Total	

Uncut "Control" Plants	Weight of Harvested Corn
6	
7	
8	
9	
10	
Total	



- ▮▮▮▮ Compare the yield and health of the experimental plants to that of the control. What differences were seen? What similarities?
- ▮▮▮▮ From these results, what can you conclude about the damage that adult corn rootworm beetles could cause to corn?
- ▮▮▮▮ Why should farmers be concerned about insects feeding on silks?

- 1 What other insects might cause similar damage?
- 2 What are some things farmers might do to reduce insect damage to their crops?



The Effect of Day Length (Hours of Light and Darkness) on Flowering

This activity will demonstrate to youth how day length controls flowering and maturity of soybeans. Actually, it is the length of the dark period (night) that triggers the process of flowering. As the hours of dark or night decrease prior to June 21, it triggers the flowering process in soybean plants to begin, even though the flowers are not seen until late June. As the days become shorter in late summer and fall, the soybean plant begins to mature and drop its leaves.

You also can use this activity to reinforce the importance of selecting appropriate varieties for your specific location. Remind the youth that the length of a specific day varies according to how far north of the equator it is, and that a variety should not be planted much farther north or south of the region for which it is adapted. If, for example, a variety adapted to northern Iowa is planted in southern Iowa, it would flower and mature too early resulting in lower yields. If a southern Iowa variety is planted in northern Iowa, it may not be mature prior to frost.

Materials

Soybeans growing in an easily accessible location
A light-tight box large enough to cover about a foot of the soybean row

- 1 This activity will be an ongoing activity over the growing season. Determine how members can help in monitoring and scouting the field and recording observations. Assign youth to take turns

covering and uncovering the plants, and observing daily for signs of flowering.

- 2 Prior to the meeting, ask two or three youth to help make a light-tight box large enough to cover about a foot of the soybean row. Make the box big enough so that adequate air exchange occurs between the inside and the outside. One good way is to make a frame of wood and cover it with at least two layers of black sateen cloth. Make the frame 12 to 18 inches long, 12 inches wide, and 10 inches high.
- 3 Start by asking youth how they might design an experiment to determine how daylight affects soybean growth and development. This activity is just one way to determine those effects. Then locate a field of soybeans that is easily accessible to you and your youth.
- 4 Begin this activity when the first two trifoliolate leaves are fully unfurled and green. At this stage, begin to increase the length of night the plants receive. Select and mark the place in the row where you are going to use the frame with flags so you cover the same plants every evening. The other plants in the field will be the control group.
- 5 To start the experiment, cover the plants with the black sateen box frame so the plants receive at least 13 hours of darkness. For example, place the frame over the row at 7 o'clock in the evening and remove it in the morning at 8 o'clock. Cover the same plants each day. Continue this treatment for 14 days. (For the most exact results, keep covering the plants each evening until the first flowers appear.) Look carefully for the flowers each day. They are small and sometimes difficult to see. Be sure no light is allowed to interrupt the dark period. Do not forget to cover the plants every evening. Push soil around the bottom of the frame so that no light reaches the plants.
- 6 Help youth determine how they will keep a group journal of all observations made. They might also report back the progress at future meetings, or make a stop by this experiment before each future meeting. They should include observations in their journal for weather conditions, temperature, rain, and the health of the plants. They also can look for signs of insects or other pests.



- How did the two groups (the covered plants versus the uncovered plants) compare?
- Which group flowered first?
- Why did that group flower first?
- How tall was it when it flowered?
- Did the plant height affect flowering date, or was plant height also determined by daylight?

- 1 What can you conclude about the differences in plant heights and flowering dates when plants receive less sunlight (covered plants) compared to those receiving normal light (uncovered)?
- 2 What impact does this have on variety selection?



Daylight Observations

Observe the plants receiving the normal light-dark period in the row next to the plants you cover. Record these observations.

Soybean Variety	
Date Planted	
Plant Height at Start of Experiment (From Soil to Top of Plant)	
Evening Hour Soybeans Were Covered	
Morning Hour Soybeans Were Uncovered	

Make the following comparisons between the covered and uncovered plants.

	Covered Plants	Uncovered Plants
Average Plant Height (14 Days after Plants Were Covered)		
Date First Flower Was Seen		
Plant Height When First Flower Was Seen		

Weather Conditions	
Evidence of Pests	

Checking Accuracy of Farm Moisture Tester

Farmers with their own grain drying and handling facilities depend on the farm moisture tester to monitor their drying and storing. However, on-farm grain moisture testers can vary in their accuracy. Moisture testers at grain elevators are inspected twice a year by the Iowa Department of Agriculture. Comparing the moisture readings from on-farm testers with the elevator tester is a good way to check the accuracy of an on-farm tester.

- 1 Collect several samples of corn varying in moisture. Collect at least three samples of corn around 15 percent moisture and three samples in the 20 to 25 percent range. Place each in a separate sealed container marked by number. Test each sample at the local elevator three times and record the moisture content of each. Calculate the average of the three, but don't share with the youth yet. Try to do the elevator test just a few hours before your workshop.
- 2 Have the 4-H'ers test each sample with their on-farm moisture testers and record the results on their worksheet. Test each sample three times in your tester and calculate the average. If the difference between average readings from the two testers for any single sample is greater than 1.0, or if the average difference for all samples at one moisture level is greater than 0.5 point, have your tester serviced.



- ▮▮▮▮ Why would testers vary for the same sample?
- ▮▮▮▮ Why would you compare samples at 15 and 20+ percent moisture?

- 1 What other measurement devices used in farming need to be checked regularly?



On-Farm Moisture Tester Comparison

Sample	On-farm Tester Moisture				Elevator Moisture				Difference
	1	2	3	Average	1	2	3	Average	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Learning about Grain Moisture Conditions

For grain to be stored without spoiling, it needs to be dried down to a moisture content safe for storage and kept cool. This experiment will show you that grain spoils or “goes out of condition” if its moisture content or temperature is too high.

- ① Obtain corn of several different moisture contents, around 25 to 30 percent moisture, 18 to 22 percent moisture, and 15 percent moisture or less. The high moisture grain can be obtained from the field near harvest time in the fall. The lower moisture samples can be taken from stored corn.
- ② Measure the corn moisture, and put one quart of corn at each moisture level in an open container (a metal coffee can or quart jar will work). Prepare two containers of corn at each moisture level. Label containers for moisture content level. Next, put one container of each moisture in the refrigerator and the others somewhere in the house out of sunlight. Check the grain every other day, and observe for signs of mold. If you have a thermometer, you also may want to take the temperature of the grain every other day.
- ③ Record your findings on a separate sheet each time you check the grain, and note how long it takes for mold to develop or the temperature to increase. Also, record if no mold develops. Summarize your findings in the table on the next page.



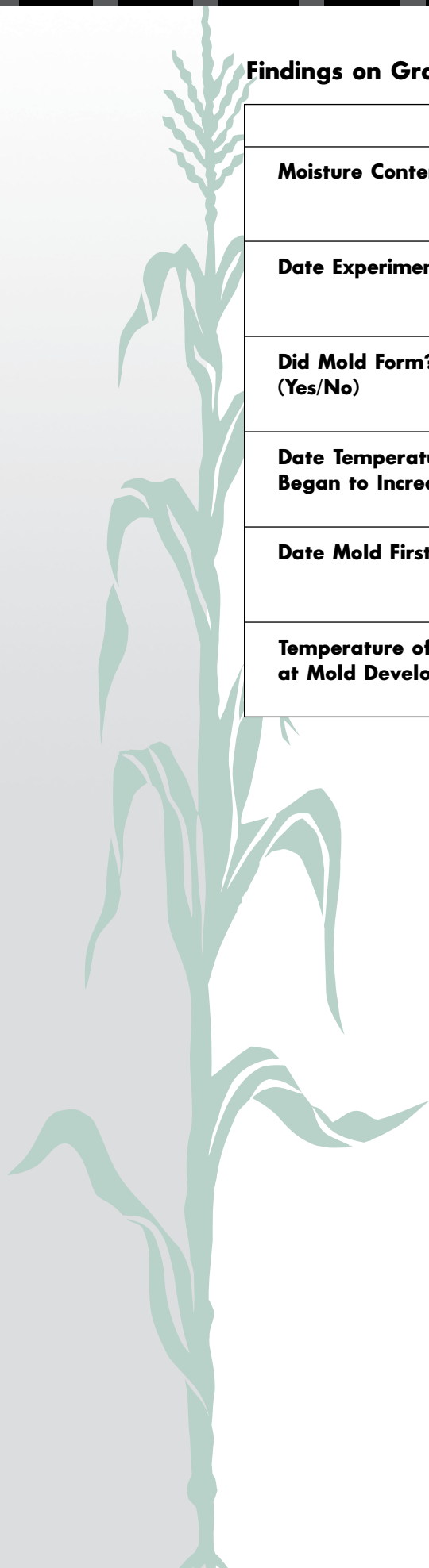
- Why did the temperature increase on some samples but not others?
- Why did some samples develop a mold?
- What moisture level kept the grain in the best condition?

- ① What other factors, besides moisture, affect storage quality of grains?



Findings on Grain Moisture Conditions

	Sample 1	Sample 2	Sample 3
Moisture Content			
Date Experiment Began			
Did Mold Form? (Yes/No)			
Date Temperature Began to Increase			
Date Mold First Noted			
Temperature of Grain at Mold Development			



Precision Farming with GPS/GIS

Most areas in the state now have GPS kits, or will know how to reserve one. These kits are part of the Iowa 4-H E-SET program (Extension Science, Engineering and Technology). Each kit is equipped with receivers, instructions, and activities. This is just one of the activities from that curriculum that specifically applies to agriculture and crop production. Contact your county Extension office to locate and reserve a kit for your use.

Materials for Each Team of 2 to 3

GPS receiver

Computer with Excel and mapping engine or other GIS software

A large field that contains distinguishable landmarks within field boundaries

GPS (Global Positioning System) is a valuable tool for finding locations. When GPS data are combined with other types of data from a specific location using software that allows the data to be managed, a Geographical Information System (GIS) is created. In agricultural applications GPS data can be connected with information such as precipitation, soil types, yield, seed type planted, and so on. GIS is a powerful tool for managing data and making it easier to interpret. If a certain location can be analyzed for rainfall, fertilizer and pesticide application, and soil type in relation to yield, it allows farmers to make better management decisions. GIS allows this type of data analysis. The data are usually in a map format with graphical data representation overlaid on the map. This activity is an introduction to the concept of GIS. Excel software is used to manage the data, but normally GIS would use sophisticated software such as ARCView.

Doing the Activity

- 1 Separate the participants into teams of 2 to 3, depending on group numbers and GPS receivers available.
- 2 Go to the field and mark all boundary landmarks as waypoints and name them. (For this activity you will need an outdoor area that can be mapped at the perimeter and includes features inside the boundary of the field that can be mapped to represent a weed patch. A ball diamond, parking lot, or playground would work if a field is not available.)
- 3 After marking perimeter waypoints, go to the distinguishing landmarks within the field and mark and name these. This represents a weed patch.
- 4 Use the GPS menu and open each of the waypoints you marked. Transfer waypoint coordinates as latitude and longitude into an Excel spreadsheet.



- ▮▮▮ What is the usefulness of being able to use GPS to mark out weed patches or other areas in a field?
- ▮▮▮ Why is GPS so useful in mapping fields?
- ▮▮▮ What are some farming decisions that can be aided by using this process?
- ▮▮▮ What applications outside of agriculture could benefit from this technology and process?



- 1 What else can farmers map besides weed patches?
- 2 If the GPS data are linked to GIS, what data would you envision entering besides location of the weed patch in the field?
- 3 What agricultural applications could or do benefit from this procedure?
- 4 What advantage would GPS/GIS give to the farmer?

- 5 Map the field and weed patch within the field using the graphing wizard in the Excel software. Instructions for using Excel for this activity are listed below.

Using Excel (Bold Text Indicates a Break in an Activity)

- 1 Open a new Excel document
- 2 In cell A1, A2, A3, and A4 enter the names of your team members working on this project. (Center each name and widen the field, if needed, so that name will fit)
- 3 Label cell B6 Waypoints; put 1 in B7, 2 in B8 and so on till all waypoints are entered.
- 4 Label cell C6 Latitude
- 5 Label cell D6 Longitude
- 6 Enter Latitude for waypoint 1 in C7 and Longitude in C8. Do the same for each waypoint in the list. Enter all numbers to the smallest increment!
- 7 You have finished entering data and now need to construct your chart!
- 8 Highlight all latitudes and longitudes by clicking on first latitude and scrolling down through all of them and also moving over one column to highlight longitudes.
- 9 Click on Insert and choose Chart or click on chart icon in heading.
- 10 Choose XY Scatter and click on next.
- 11 Data Range should automatically enter because you have highlighted all latitudes and longitudes.
- 12 Be sure that Columns are marked, not rows, then click on Next!
- 13 Click on Gridlines and make sure none of the options are marked, then click on Next!
- 14 Connect your coordinates that mark the outside boundaries of the field.
- 15 Click on View from heading and select Toolbars. Click on Drawing, then use the line tool from below and connect the outside locations with a line segment.

Extending the Activity Further!

- 16 While collecting waypoints from outer edges, also collect some from the middle that may be outlying edges of a pond, flower bed, or weed patch that would show land that can not be put into production.
- 17 Connect the waypoints using the draw tool also.
- 18 There are several other extensions to this basic activity that will give students an idea as to how GIS collects and displays data!

Resources

CHAPTER 6

Wonderwise

Women in Science Learning Series is a curriculum that covers a range of science topics. It introduces youth to women who have made science their career. These scientists are leaders in their respective fields. The curriculum is built upon the concept of participants doing the same type of hands-on activities that scientists model in the video. There are nine different units: *African Plant Explorer*, *Space Geologist*, *Vet Detective*, *Parasite Sleuth*, *Rainforest Ecologist*, *Sea Otter Biologist*, *Urban Ecologist*, *Pollen Detective*, and *Genetic Counselor*. Each kit includes a video, CD-ROM, and activity book. Contact your county Extension office to reserve a kit for your group. More information can be found at www.wonderwise.unl.edu/

Pollen Detective includes a video about botanist Peg Bolick, who helps youth explore flower parts and pollination. It also includes activities on dissecting flowers to find pollen, analyzing pollen samples, designing flowers to attract pollinators, and 'digging' for pollen in artificial rocks.

African Plant Explorer includes a video on scientist Fatimah Jackson, and the poisons in everyday foods. The activities include examining the chemical properties of starch, using cassava to batik African symbols on cloth, and exploring the world travels of everyday foods.

Food, Land, and People

Project Food, Land, and People promotes approaches to learning to help people better understand the interrelationships among agriculture, the environment, and people of the world. This program resource is offered for all grades Pre-K through 12, after attending a 15-hour Food, Land, and People workshop. Contact your county office for a staff member or teacher trained in this curriculum. More information can be found at www.foodlandpeople.org.index.html

Ready to Navigate with GPS

Contact your county Extension office to locate and reserve the nearest GPS kit. Many county staff are trained to teach about GPS using this kit. It includes the following activities.

- What's a compass?
- What's a bearing?
- Lost! Triangulation with a compass
- Bearing Course
- Trilateration
- GPS Trail
- Precision Farming with GPS

Soils Alive!

The background information and activities contained in this leader's guide stimulates a sense of stewardship for the environment. It includes group discussion, role play, experimentation, demonstration, and simulation about the soil. Contact your county Extension office for publication 4H-326.



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