Integrated Pest Management

Grade Level: 4-8

Lesson Overview

Students will learn about Integrated Pest Management by making decisions for an inherited potato farm, realize the consequences of their decisions and discover how supply and demand affect commodity prices.

Student Objectives

1. Define integrated pest management and explain how this approach may be applied in both agricultural and non-agricultural settings.
2. Identify management options and resulting consequences in an agricultural setting.

Materials

- ✓ Integrated Pest Management Information Sheet
- ✓ Field of Potato Dreams Worksheet
- ✓ Field of Potato Dreams Power Point https://docs.google.com/presentation/d/1-7VoxHTxrYbIE5LceAxGRymxgZm1uIZF8D8rrZYStDw/edit?usp=sharing

Note: If using the Power Point, each student will only need a copy of the worksheet. If NOT using the Power Point, each student will need the sets of listed below.

- ✓ Field of Potato Dreams Decision Cards (1 set per student)
- ✓ Field of Potato Dreams Consequence Cards (1 set per student)
- ✓ Field of Potato Dreams Supply/Demand/Price Cards (1 set per student)

Vocabulary

- **habitats** – the place or type of place where a plant or animal naturally or normally lives or grows.
- **Integrated Pest Management** (IPM) – a comprehensive approach to pest control that uses combined methods (a balanced mix of pest management tactics such as chemical control, predatory insects, natural control, weather, no control) to reduce pest densities to tolerable levels while maintaining a quality environment.
- **parasite** - a living thing which lives in or on another living thing in parasitism (a close association between living things of two or more kinds of which one is a parasite obtaining benefits from the other which is a host and is usually harmed in some way.

- **pest** – unwanted organisms (plants or animals).

Background Information

For background information, please see the Integrated Pest Management Information Sheet.

Note: Yield for potatoes is actually measured in hundredweight. This scenario uses barrels to make it easier to visualize.

Procedure

1. Share the general information with the students to introduce integrated pest management.

2. Using either the Power Point presentation or the student decision, consequence, and supply/demand/price cards to complete the Field of Potato Dreams activity.

   Note: If using the card option, have a set of the cards cut and place decision, consequence, and supply/demand/price cards in separate marked envelopes for each student (these may be laminated for repeated use). When utilizing the supply/demand/price cards, students will blindly draw ONE card only.

Extension Activities

1. Invite a speaker that deals with integrated pest management into your classroom. Possible speakers may include a local chemical and fertilizer dealer representative, local pest control company representative, an agronomist, a crop scout, etc.
2. Boll Weevil lesson coordinates well with this lesson.

Additional Resources

- https://www.epa.gov/ipm/introduction-integrated-pest-management
- https://www.canr.msu.edu/ipm/schools-community/schools/elementary_urban_ipm_curriculum
- https://www1.maine.gov/dacf/php/integrated_pest_management/school-ipm-curricula/index.shtml
- http://www.agintheclassroom.org/TeacherResources/terra_nova_invasive_species.shtml

Standards

Illinois Science Standard

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Illinois English Language Arts Standard

RST 1: Cite specific textual evidence to support analysis of science and technical texts.

The **M**ultidisciplinary **AG**ricultural **I**ntegrated **C**urriculum (mAGic) was created in 2004 under the leadership of the Illinois State Board of Education (ISBE) and the Facilitating Coordination in Agricultural Education Project (FCAE). Funding was made available through the FCAE grant budget from the agricultural education line item of the ISBE budget. This revision, as printed, was developed in April 2021.

These mAGic lessons are designed to bring agriculture to life in your classroom. They address the Illinois Learning Standards in math, science, English language arts and social studies.

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Integrated Pest Management Information Sheet

Crop protection products have been used for centuries to control pest and diseases. A pest is an unwanted organism (plant or animal). Below is a brief look at their historical use.

Early Greece	Oil sprays & sulfur ointments used for pest control
Hundreds of years ago in China	Seed treatment to protect from insects and birds
18th century	Biological controls such as pyrethrum (from chrysanthemums) and nicotine (from tobacco)
Late 19th century	Mixture of lime and copper sulfate to control fruit tree disease
Early 20th century	Common pesticides included sulfur, arsenic, cyanide
World War II	Synthetic (or manufactured) organic (carbon-based) compounds used as pesticides
Today	Many crop protection products available and used

Integrated Pest Management (IPM) is a comprehensive approach to pest control that uses combined methods (a balanced mix of pest management tactics such as chemical control, predatory insects, natural control, weather, no control) to reduce pest densities to tolerable levels while maintaining a quality environment. IPM relies on understanding the life cycles of pests and their interactions with the environment. This information is used to maximize pest control while minimizing environmental impact and cost. In simplest terms, pests need food, water, shelter, and space for their habitat. If their habitat changes to a hostile situation, the pest will leave or die.

The IPM approach can be applied to both agricultural and non-agricultural settings such as home, garden and workplace. IPM is not a single pest control method, but rather, a series of pest management evaluations, decision, and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-step approach.

1. **Set action thresholds** – Before taking any action, IPM first sets an action threshold which is a point at which pest populations or environmental conditions indicate that pest control action must be taken. These thresholds have been developed as a result of many years of research.
2. **Monitor and identify pests** – Not all insects, weeds and other living organisms require control. Many organisms are harmless, and some are even beneficial. It is important to properly identify them. Some insects may cause damage during one stage of development but then become helpful as metamorphosis continues. It is important to know the growth stages of the insect question. Monitoring them accurately helps determine if or when the action threshold is reached.

3. **Prevention** – As a first line of pest control, IPM programs works to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. This may mean rotating crops, selecting pest resistant varieties, changing planting times and planting pest-free rootstock. These methods can be effective, cost efficient, and present little risk to the environment or people.
4. **Control** – Once monitoring, identification, and action thresholds indicate that pest control is required and preventative methods are no longer effective or available, IPM programs then evaluate the proper control method for effectiveness and risk. Here are some of the IPM techniques used:
    - Natural predators: introducing the types of animals that will naturally take care of the pests. Examples of natural predators include ladybugs, praying mantises, lacewing larvae, garter snakes, toads, and purple martins.
    - Natural parasites: introducing bacteria, viruses and insect parasites that will kill pests without harming other types of animals.
    - Mixed plantings: planting mixed stands of trees or crops instead of planting large areas with just one type of plant. Mixed stands are less susceptible to insect damage. The mixed planting may attract beneficial insects or attract pests away from one crop into other plantings. For instance, marigolds can be planted around the perimeter of a garden to repel nematodes.
    - Habitat changes: changing the habitat to physically control many pest species. For example, getting rid of old tires cuts down on the number of mosquitoes that could breed in that area.
    - Chemicals: using pesticides as needed in the proper amount, at the most ideal time, and applied in the appropriate manner. Global positioning systems (GPS) use computer technology linked to satellites to determine precise field locations where pest control is needed. This allows growers to better regulate the amount of chemicals used. Types of pesticides include insecticides (used on insects), herbicides (used on plants), fungicides (used on fungi), rodenticides (used on rodents), nematicides (used on nematodes), and arachnicides (used on spiders, mites, ticks, etc.).
    - Timing: regulating planting and harvesting to avoid those times when insects are most abundant and damaging.
    - Mechanical: removing eggs, larvae, cocoons, and adults from plants by hand; physically establishing barriers, setting traps.
    - Pheromones: using natural and synthetic pheromones to attract or confuse insect pests. Pheromone traps can trap insects, prevent them from mating, and help monitor the kinds and pests in the area.
    - Pest resistant varieties of plants: enable growers to plant new varieties resistant to certain pests (such as insect or weeds) while using less pesticides. For instance, researchers developed crop varieties resistant to glyphosate, which is an herbicide that kills plants. When these crops are planted, the glyphosate can be applied to kill all the weeds without damaging the crop.

Field of Potato Dreams Student Decision Cards

Make a copy for each student and cut along the line to make the cards for the activity in this lesson.

Decision A – Land Preparation

The land is ready for planting. You must now prepare the soil. A neighboring farmer tells you that your uncle's farm has always been infested with nematodes – tiny worms that feed on the roots of the potato plant. You have found a stash of chemical in Uncle Ned's shed. You know that a pesticide would get rid of the nematodes, but you are worried about applying pesticides, and wonder whether his old chemicals would even work on nematodes.

1. You do nothing, figures that the nematodes are probably gone by now. Besides, this option is free. Cost: $0 per acre.
2. You use the chemicals that were in Uncle Ned's shed. Cost: $10 per acre for labor.
3. You test for the presence of nematodes, then treat the soil with a recommended pesticide. Cost of the test is $5 per acres. The cost of the pesticide and labor is $40 per acre. Total cost: $45 per acre.
4. You plant thousands of marigolds among the potatoes – you heard that these flowers secrete a chemical that kills nematodes. That way, you don't have to use any pesticides. Cost: $50 per acre.

Decision B – Fertilizing the Soil

It is common practice to put fertilizer (nitrogen, phosphorus, and potassium) on a field. However, your farm is right next to a major river. You're concerned the fertilizer will run off into the stream. This might cause algae to grow and decay, robbing the stream of oxygen and light and eventually threatening fish and other aquatic species. What do you do?

1. You apply no fertilizer. Cost: $0 per acre.
2. You talk to a farming expert about fertilizer. She recommends a soil test to see if the ground needs any nutrients. The test costs $5 per acre. It will also cost you to put in a buffer strip of grasses and shrubs to keep the fertilizer from running in to the river. You may also pay extra for the fertilizer, if needed.
3. You found your uncle's old fertilizer records. You apply twice the rate that he did, just to be sure there is plenty of fertilizer. This saves the cost of the soil test. Cost: $4 per acre.

Field of Potato Dreams Student Decision Cards (Continued)

Make a copy for each student and cut along the line to make the cards for the activity in this lesson.

Decision C – Planting

Potatoes are grown from pieces of potato that contain an eye. The new plant grows from the eye, which draws nutrients from the rest of the potato. Eyes can be bought from several sources. But not all are created equal! Some may harbor fungus and the dreaded potato leafroll virus. Where do you get them?

1. Because the weather is dry, you decide diseases won't bother your crop. You buy potatoes from a neighbor, cut them up and plant them in the fields. You don't bother applying fungicide to the eyes. Cost: $200 per acre.
2. You buy potatoes from a neighbor, cut them up, and then treat them with an approved fungicide before planting. Cost $205 per acre.
3. You buy certified virus-free seed potatoes from the local distributor. These are expensive, so you protect them with a fungicide. Total cost: $305 per acre.

Decision D – Beetles

You live in Maine, so you figure that the Colorado potato beetle can't get to your fields. Well, as you soon find out from a neighbor, the name means nothing. The Colorado potato beetle is a major pest in the Northeast. It can strip all of the leaves off the plants in no time flat. What do you do?

1. You hire a scout to look at your fields every week. You really don't know how much this is going to cost altogether (adding insecticides) until after the scout looks at you field. Cost of the scout: $10 per acre.
2. You do not spray insecticides on your field. The land has been out of production for a year (nothing for beetles to eat). You hang some electric bug zapper (you like that eerie blue glow to your fields). Cost: $30 per acre.
3. You spray your potatoes every other week during the summer. This is expensive, but you can't afford to let the beetles get out of control. You spray six times at a cost of $40 per acre each time. Total cost $240 per acre.
4. You spray three times to keep the beetles down, once at the beginning of the season, once in the middle of the season, and once at the end of the season. Total cost: $120 per acre.

Field of Potato Dreams Student Decision Cards

Make a copy for each student and cut along the line to make the cards for the activity in this lesson.

Decision E – Harvest

At last, it's time to harvest your field of dreams! Your uncle's old potato harvester machine is rusty. Some of the pieces are broken and other are loose.

1. You patch up the old machinery as best as you can. You have to buy some new parts, but you aren't sure whether the machine will last through the harvest. Cost of the repairs and operation: $45 per acre if it doesn't break down.
2. Moosehead Machinery has a brand-new harvester on sale. It will whip those potatoes out of the field. It costs $50,000, but you don't pay for it all in one year. Its average life span is 10 years. Thus, the annual cost of the machine is only 1/10 of its purchase price, or $50 per acre (remember, there are 100 acres on the farm). Add this to operating costs. Cost: $55 per acre.
3. You hire local high school students to harvest the potatoes by hand. You figure that each person can harvest an acre a day by hand. Cost: $60 per acre.

Field of Potato Dreams Student Consequence Cards

Make a copy for each student and cut along the line to make the cards for the activity in this lesson.

Consequence A – Land Preparation

1. The nematodes are still in the soil. They played havoc with your crops, but you still have some plants to grow. Yield: 40 barrels per acre.
2. These were the wrong chemicals to use on the field. They didn't kill nematodes, in fact, you really burned the potato plants. You spilled some of the pesticides in a ditch. Your state pollution control agency fined you and charged you the cost of cleanup. Next time make sure you read the pesticide label to see if it's the right type and amount. Added cost: $20 per acre. Yield: 20 barrels per acre.
3. By applying the correct chemical at exactly the recommended rate, you are able to keep the nematodes from destroying much of your crop. Yield: 80 barrels per acre.
4. Marigolds can kill nematodes, but they weren't very effective this year. However, next year your nematode problem is likely to be small. You only got a few potato plants for all your efforts. Yield: 40 barrels per acre.

Consequence B – Fertilizing

1. Over the years Uncle Ned has grown many crops, depleting nutrients from the soil. Until the nutrients can be built back into the soil, there isn't much nutrition for the plants. Yield: 60 barrels per acre.
2. You get a healthy crop of potatoes. Yield: 100 barrels per acres. Added cost: $25 per acre for fertilizer and cost of erosion protection.
3. At first, the crop looks good but soon the excess phosphorus begins to take its toll (phosphorus reduces the ability of the plant to use zinc and iron). Plus, these extra fertilizers have run into the nearby river, causing algal blooms and fish kills. You decide to donate some money to a local clean water organization, because you feel bad about the river. Yield: 80 barrels per acre. Added cost: $10 per acre.

Field of Potato Dreams Student Consequence Cards (Continued)

Make a copy for each student and cut along the line to make the cards for the activity in this lesson.

Consequence C – Planting

1. Seed pieces decay, a fungus, kills half your crop. Yield: 50 barrels per acre.
2. Seed that is not certified as virus free is likely to have a high level of potato leafroll, which results in weak plants. The virus is carried in the eye and is not killed by fungicide. Yield: 50 barrels per acre.
3. It costs more to sow certified seed, but in this case, it was worth the cost. Yield: 150 barrels per acre.

Consequence D – Beetles

1. Your scout recommends applying insecticides three times, to coincide with the beetle life cycle. These applications cost money but result in an undamaged crop. Added cost: $120 per acre. Yield: 100 barrels per acre.
2. Many beetles fly into the fields. The beetles are not attracted to the bug zappers. You lose most of your crop. Yield: 20 barrels per acre.
3. Your crop looks pretty good, but because you are using so much insecticide, a resistance to the insecticide develops within the beetle population. At the end of the season, some damage results. Yield: 80 barrels per acre.
4. Timing is essential for good insect control. Only one of these sprays is effective and you lose half of your crop. Yield: 50 barrels per acre.

Consequence E – Harvest

1. Your old machinery actually makes it through the harvest, even though it leaves a few potatoes in the field. Yield: 95 barrels per acre.
2. The new harvester does a super job, getting each and every potato. Yield: 100 barrels per acre.
3. You figure wrong. Good farm labor is hard to find. These students didn't work as fast as you had hope, and they only harvested a quarter of acre per day of potatoes. They also left a lot of spuds in the fields. Add an additional $60 per acre for harvest costs. Yield: 70 barrels per acre.

Field of Potato Dreams Student Supply/Demand/Price Cards

Make a copy for each student and cut along the line to make the cards for the activity in this lesson.

Supply: This was a good year for growing potatoes – too good. The market is oversupplied. **Demand:** Demand is steady, but it can't match the supply. **Price:** $3 per barrel	**Supply:** Drought in the Upper Midwest and Pacific Coast regions reduce the size of potatoes. Supply of large baking potatoes is low. **Demand:** There is a strong demand among fast-food markets for large baking potatoes due to the introduction of Hot N' Tasty Taters. **Price:** $12 per barrel
Supply: Reports of late blight in the Upper Midwest. However, the blight doesn't affect the fall crop, resulting in a large supply. **Demand:** The conventional wisdom is that the blight is coming, and potatoes will be scarce in the future. Recent publicity about the long lives of Japanese restaurant workers shift consumer interest to rice instead of potatoes. **Price:** $5 per barrel	**Supply:** Storms in the Pacific Northwest lower the quality and availability of potatoes from Oregon, Washington, and Idaho. **Demand:** Exports are up substantially, due to the mania for potato chips in Asia. **Price:** $15 per barrel

Name _____

Field of Potato Dreams Worksheet

	Column 1 *Number from Decision Cards*	**Column 2** *Cost of Decision from Decision Cards (per acre)*	**Column 3** *Added Cost from Consequence Cards (per acre)*	**Column 4** *Barrels of Potatoes (per acre)*
A. Land Preparation				
B. Fertilizing the Soil Before Planting				
C. Planting Potatoes				
D. Attack of the Colorado Potato Beetles				
E. Harvest				
Subtotals				

Note: Yield for potatoes is actually measured in hundredweight. This scenario uses barrels to make it easier to visualize.

Use the subtotals from the table above to complete the following items.

_____ barrels per acre x 100 acres = _____ barrels
Column 4 **Farm Size** **Total Yield**

The potatoes are harvested and taken to the broker. How much will the broker pay you? Pick a POTATO PRICE CARD. This will determine your price per barrel.

$**_____ x _____ barrels = **$_____
Price Per Barrel **Total Yield** **INCOME**

$**_____ + **$_____ + $1,000 = **$**_____ x 100 acres = **$**_____
Column 2 **Column 3** **Fixed Cost** **Cost Per Acre** **Farm Size** **TOTAL COSTS**

$_____ **- $**_____ **= $**_____
INCOME **TOTAL COSTS** **PROFIT**

Explain the choices you made, how they affected the outcome, and if you would do anything differently next time.