Name: _____

CASE

Project 8.1.1 Cause and Infect

Purpose

Just days before the fruit ripened on the blueberry bush, thieves raided and picked every berry from the plant. All that remains are a few scattered and damaged berries lying on the ground below the bush. What, besides humans, could have stolen all of the fruit?

Certain types of pests cause specific damage to plants. Knowledge of the various ways different pests damage plants provide clues for determining the pest that is causing problems. There are so many plant pests it is impossible to list them all. However, pests have specific ways they feed or damage plants. How can you determine what is causing damage to plants? How can you stop the damage from happening?

Materials

Per pair of students:

- Computer with word processing, electronic poster software, and Internet access
- Poster board (optional)
- Markers (optional)
- Colored pencils (optional)
- Glue sticks (optional)
- Scissors (optional)
- Tape (optional)

Per student:

- Pencil
- *Agriscience Notebook*
- *Project 8.1.1 Evaluation Rubric*

Procedure

You will examine categories of pests, anatomical features, damage pests cause, and how to control pests.

1. Your teacher will assign a plant pest you and your partner.
2. Research the distinguishing characteristics of the pest and how to protect plants from insect destruction. Your research will need to answer the following questions.
    - What are the anatomical features of this pest?
    - What damage does this pest cause to plants?

- What are the most appropriate ways to control or deter this pest from damaging plants?

3. Your instructor will review the procedure for the creation of a poster and *Project 8.1.1 Evaluation Rubric* before beginning the project.
4. Develop a poster describing the pest and control methods. Your poster should include the following components.

    - Title – including the name of your pest category
    - A list of common species that fall into your pest category
    - A picture illustrating an example of your pest clearly showing distinguishing characteristics
    - A list of potential damage your pest will cause
    - A picture of signature damage caused by your pest
    - A list of appropriate methods to control or deter your pest
    - A picture demonstrating a control or deterrent method

Reference Sources for Research:

Herren, R. V. (2004). *The science of agriculture: A biological approach* (2nd ed.). Albany, NY: Delmar.

Iowa State University Extension: Yard and Garden – Weeds and Pests: **http://www.extension.iastate.edu/yardgarden/weedspests/**

Parker, R. (2010). *Plant and soil science: Fundamentals and applications*. Clifton Park, NY: Delmar.

Reiley, H. E., & Shry, C. L. (2007). *Introduction to horticulture* (7th ed.). Clifton Park, NY: Delmar.

Ohio State University: Plant Disease Series Index: **http://ohioline.osu.edu/hyg-fact/3000/**

Ohioline Yard and Garden: Insects and Pests: **http://ohioline.osu.edu/lines/pests.html**

Pest Tracker: National Agricultural Pest Information System: **http://pest.ceris.purdue.edu/index.php**

Purdue University: Purdue Plant and Pest Diagnostic Laboratory: **http://www.ppdl.purdue.edu/PPDL/**

Texas A&M: Plant Pest Identification Aid: **http://vegetableipm.tamu.edu/imageindex.html**

USDA: Animal and Plant Health Inspection Service: **http://www.aphis.usda.gov/plant_health/plant_pest_info/index.shtml**

5. When all posters are complete, your teacher will have you share your information with the class. As you view other groups' posters, fill in Table 1 on the student worksheet.

Conclusion

1. How do pests differ?

Pest differ by cause some are plants some are insects and some are animals.

2. What are some general practices that will protect a crop from multiple categories of pests?

Using pesticides will stop multiple different pests from insects to weeds.

3. List the different ways pests cause damage to plants. Which would cause the most severe damage or plant death? Why?

Pests will cause damage from starving plants from nutrients and water, to killing and eating plants.

4. Which types of pests are most common in your area or region?

The weeds because they are everywhere and grow anywhere with water.

5. What is the difference between preventing damage and eradicating pests after damage has occurred?

Preventing damage will stop your crop from being damage and eradicating pests after the pest will be removed but the plant or crop will already be damaged.

Name: _____

Project 8.1.1 Student Worksheet

Table 1. ***Pest Categories and Descriptions***

Pest Category	How Damage is Caused	Common Species	Control Methods
Chewing Insect	Holes, notches in foliage and leaf, poop and decay	Grass hoppers, earwigs, blister beetles, tomato hornworms, leaf miners	Cover crops, even vacuum them up, hand pick, get predator inects
Sucking Insect	Sucks juices from plant	White flies, aphids, leaf hoppers	Lady bugs, insecticides, and other control pests
Boring Insect	Attack trees, attack the tissue that carries water	Ambrosia beetle, cottonwood, megacyllene robiniae, lonf horned beetles	Remove dead lumber, use killing flies
Weed	Invades crops, smother pastures, poor crop qualities, competes for water and nutrients	Goosefoot chenopodium, hare barley, perennial ryegrass, pineapple weed, green foxtail	Pull them out, kill them, spray them
Vertebrate Animal	droppings, gnawing, burrows	Wood rats (Pack rats) Norway rats House mice Ground squirrels Pocket gophers	Keeping surroundings clean of weeds and other possible habitats, also get rid of any standing water and be careful to not over water leaving extra water for possible pest. Also traps can be used as well to kill or kept pest alive until relocated.
Bird	Feast on crops, dig holes, scale build up on fences, carry diseases	Pigeon, starling, sparrow, crow, woodpecker	Mesh nets, electric sounds, spray repellent, flashy tape, spikes

Mollusk	Larged ragged holes in leaves and flowers	Snails and slugs	Preadators, traps, chemicals
Nematode	Feed on roots, roots cant absorb water or nutrients	Ascardid,enoplea, secernentea, parasitic, chromadorea	Sanitation, crop rotation, soil solarization, fallowing

https://cals.arizona.edu/pubs/garden/mg/pests/intro.html

PESTS

VERTEBRATE PESTS Vertebrate animals (animals with a segmented spinal column or "backbone") are divided into five classes. These are mammals, birds, fishes, reptiles and amphibians. Although there are some vertebrate animals that we commonly think of as pests such as rats, mice and pigeons, all vertebrate animals have the potential to become pests. We usually consider animals a pest when they compete with humans or pose a physical danger or health threat to humans or other animals. Most vertebrate wildlife species do not thrive in close association with humans and may become pests only on occasion. Some vertebrate wildlife species can co-exist with humans and some become more-or-less dependant on humans. Vertebrate wildlife species that become dependant upon humans and human habitat are often referred to as "commensal". Examples of common commensal rodents are Norway rats, roof rats and house mice.

INTEGRATED VERTEBRATE PEST MANAGEMENT Integrated management of vertebrate pests is based on using knowledge of the habits and biology of a species to effectively reduce or eliminate the damage, caused by that species, in a manner which maximizes the safety of the environment, humans and other animals. Integrated vertebrate pest management most often involves a combination of actions, many of which are directed toward preventing pest problems as well as controlling existing problems. Prevention of animal pest problems provides a long term solution, whereas control, such as killing or otherwise removing offending animals, generally provides a short term solution.

Integrated pest management generally involves four major steps. These are: identify the species causing the problem, employ prevention options, select a control (population reduction) method and monitor the situation for signs of re-infestation.

PREVENTION IS LONG TERM -- CONTROL IS SHORT TERM

It should be noted that before any control options are implemented against a wild animal, the existence of a problem should be established. The mere presence or occasional sighting of an animal does not necessarily warrant control. Often the presence of an animal and minor losses of landscape or garden plants may be seasonal or occasional and can be tolerated -- and even provide an enjoyable wildlife watching experience. Control options should be employed only when there is intolerable damage or economic loss or there is a threat to human or domestic animal health or safety.

This philosophy of tolerance generally does not apply to commensal rodents which are not native to this continent and are usually controlled whenever their presence is detected. Commensal rodents always present a threat to health and safety.

ANIMAL DAMAGE IDENTIFICATION

It is important to identify the species of animals causing a particular damage problem. Identification is necessary to employ the appropriate prevention and control methods, determine the legal status of the target animal, and if pesticides are used, to comply with product labeling restrictions.

Most wild animals are secretive and the chance of actually seeing them causing damage is small. Some animals, such as ground squirrels are diurnal (active during daylight hours) and can be observed; however, many are nocturnal and not easily observed. Often the identification of an offending animal must be based on observations of tracks, droppings, trails, burrows, tooth marks and characteristic types of damage. For example, pocket gophers build distinctive mounds which differentiate their burrow entrances from those of ground squirrels. The identification of commensal rodent pests, which are characteristically nocturnal, is often

based on tracks, droppings, gnawing, burrows and signs along travel routes. Sometimes trapping is necessary to identify the animal and employ the appropriate measures.

Birds tend to be less secretive and are active during daylight hours. Bird identification is generally by direct observation

LEGAL STATUS

Many mammals and bird species and certain reptiles, amphibians and fishes are protected by state and/or federal laws. However, some common pest species are not protected and can be controlled, if they are causing damage. These animals may be controlled by any legal means which meet the requirements and are authorized under Arizona Revised Statutes (ARS) Title 17, Section 239 (see Appendix B). In Arizona, these species include:

Wood rats (Pack rats)

Norway rats

House mice

Ground squirrels

Pocket gophers

Rock doves (Pigeons)

Starlings

English sparrows (House sparrows)

Other species may be protected under federal or state listings as "Threatened" or "Endangered". Wildlife species may also be categorized as "game" or "non-game". Each of these categories are subject to different legal restrictions. Most bird species are protected by the U.S. Fish and Wildlife Service (USFWS) under the Migratory Bird Treaty Act. If there is any doubt about the legal status of any vertebrate pest, the Arizona Game and Fish Department (AGFD) should be contacted for advice. (See appendix A.)

If certain criteria are met, depredation permits may be obtained to use lethal control or live trapping of protected species. Depredation permits for species covered by either the Migratory Bird Treaty Act or the Endangered Species Act are obtained from the US Fish and Wildlife Service, usually through the state office of USDA/APHIS Wildlife Services (See appendix A). Depredation permits for state regulated species may be obtained from the AGFD. In addition to depredation permits, some species, both protected and non-protected, are subject to release regulations for live trapped animals.

AGFD issues permits to "Wildlife Rehabilitators" who are authorized to possess and transport injured or sick wildlife, including most protected species. AGFD also issues "Wildlife Service Permits" to individuals who can provide control services for certain species -- usually for a fee. (See appendix A.)

In addition to knowledge of the biology and habits of the target species, as well as relevant state and federal laws, management techniques may require specialized equipment, strenuous physical labor and/or the use of Restricted Use Pesticides. Therefore, the most effective solution, for a homeowner, to a wildlife damage problem may be to employ the services of a professional wildlife service permitee or a commercial pest control operator.

PREVENTION OPTIONS

HABITAT MODIFICATION

Wildlife habitat consists of four essential elements. These essential elements are food, water, shelter, and space. Although these requirements differ in composition and quantity from species to species, all animals require these elements to survive. Limiting or eliminating one or more of these specifically required elements for a specific species will limit or eliminate that species. If the essential elements of habitat, for a particular species exists, it is likely, that species will be present, in the long term, regardless of the short term control methods applied.

PREVENTION IS LONG TERM - CONTROL IS SHORT TERM.

Habitat modification is often reduced to the removal of attractants. For example, removal of food sources can be accomplished by simply removing pet food and water containers, storing food and animal feed in closed containers and placing garbage cans in racks with lids secured . Removing or limiting water by irrigation management, eliminating standing water sources and repairing leaky faucets. Shelter can be removed or limited by weed control, landscape design, removing trash piles, keeping lawns and ground covers mowed and shrubs trimmed.

Most rodents, snakes and many other vertebrates prefer to travel along walls under cover of vegetation. Keeping landscape plants away from walls reduces these sheltered travel routes. Open landscaping with minimal ground cover and litter is less attractive to most vertebrates.

Homeowners must realize that habitat elements that are provided to attract desirable species can also attract undesirable species. Birdbaths provide water to all species of birds including pigeons and starlings. Birdfeeders that spill seed on the ground may attract rodents -- which may, in turn, attract predators such as snakes.

An important aspect of modifying habitat to reduce undesired species, in dense urban areas , may be the cooperation of neighbors to reduce litter, standing water, brush piles, etc. on a neighborhood level.

EXCLUSION

The first line of defense against unwanted animals is perimeter fencing. A well maintained fence which is solid or with minimal size openings and extends below the ground surface, can exclude many animal pests.

Other exclusion techniques include placing physical barriers around trees, garden and landscape areas. A variety of configurations of electric fencing are available for specific types of animals and these can be very effective exclusion methods. Plastic netting can protect trees from bird damage. Underground cable and irrigation tubing can be buried inside pipe or surrounded by a layer of gravel to protect it from burrowing rodents.

Buildings should be inspected for possible entry points. Commensal rodents can enter a structure through surprisingly small spaces. Spaces of ½ inch or larger can provide access to rats and the common house mouse can enter through spaces as small as 1/4 inch.

FRIGHTENING

Frightening usually involves using sight and/or sound to scare animals away. Sound frightening devices include shotguns firing special sound producing shells, cannon devices and sirens. Bird frightening methods include playing tape recorded distress calls of the target species. Ultra-sound (sound beyond the normal range of human hearing) has been somewhat successful on very wary species such as rats. However, ultra-sound is limited by the fact that it does not travel as far as normal range sound nor does it travel around corners well. Sound in the normal range may be impractical due to the disturbance it causes to the homeowner and neighbors.

Sight frightening devices include plastic owls or snake models, hanging foil strips and constant or pulsating lights. These devices can be effective for short periods of time, but most animals soon habituate to them and they become ineffective.

Many frightening techniques and products can be effective for some species under some circumstances. Frightening techniques may be legally employed against protected species. However, most animals will eventually learn that the frightening element will not harm them and damage will continue. In some cases, frightening can serve as a temporary solution until other integrated methods such as exclusion and habitat modification can be implemented.

REPELLENTS

Repellents are generally based on aversions to pain, taste, touch or odor. Some common materials used as taste repellents include cayenne pepper and Thiram (a fungicide). Odor repellents include ammonia soaked rags, naphthalene, and predator odors. Tactile or touch repellents are generally sticky substances that animal or birds avoid stepping or perching on.

The efficacy of repellents varies greatly with species and environmental conditions. The efficacy of repellents may also vary with the alternatives the offending animal has available. For example, if a garden is located in a heavily landscaped urban area with several gardens and other lush vegetation in close proximity, a variety of repellents may be very effective because the offending animal can easily find an alternative source of food. However, if the garden is isolated and is the only nearby source of a highly desired food source, these same repellents may have little or no effect. Several commercial, chemical repellents are available. Commercial repellents must be registered for the specific target species, application site and how the material is to be applied. Chemical repellents should not be applied to food crops unless the label specifies that use.

POPULATION CONTROL MEASURES

Population control measures remove offending animals either through lethal methods or live trapping and relocation. Measures to reduce or eliminate animals provide control of an existing problem. Unless these control measures practiced in concert with preventive measures, such as exclusion or habitat modification, they will probably have to be repeated with re-infestation. Population control measures remove offending animals either through lethal methods or live trapping and relocation. Measures to reduce or eliminate animals provide control of an existing problem. Unless these control measures practiced in concert with preventive measures, such as exclusion or habitat modification, they will probably have to be repeated with re-infestation.

NOTE: Whenever population control methods are employed, there is the danger of removing non-target species. The removal of non-target species, with lethal control or live trapping and relocation, may be in violation of state and federal laws - see ARS 17-239 (Appendix B).

PREVENTION IS LONG TERM -- CONTROL IS SHORT TERM

TRAPPING

Trapping offers some advantages over the use of poisons to control pests. Trapping is generally safer for the environment, humans and pets. Trapping also provides assurance that the animal is removed. Poisoned animals may recede to hidden places to die and their decomposing carcasses may then cause odor problems. These odors can be quite labor intensive and costly to remove. Poisoning may also pose a risk to humans or non-target animals. Successful trapping involves some knowledge of the target animals behavior, as well as the proper selection of the trap, trap placement, and the appropriate bait.

Live traps include a variety of wire and box type traps. Live traps are often used to capture and relocate an offending animal. Live traps come in a variety of sizes for different species and are often available for rent. Padded jaw leghold traps are sometimes employed to live trap animals for relocation. There are state regulations dealing with the re-location of certain wildlfie species - always check with your regional office of the AGFD (see Appendix A) before re-locating any wild animal. Some live traps and glue boards, designed primarily for commensal rodents, trap the animals alive and the animals may then be euthanized (killed).

Lethal traps include snap traps, body gripping traps and specialized traps designed for certain species, such as gopher traps and mole traps. (For precautions on handling dead animals see "Handling Animals")

TOXICANTS

The use of chemical pesticides may pose some hazard to the environment, humans, pets and non-target wildlife. Commercial pesticides include directions for use and label restrictions. Label directions and restrictions must always be precisely followed. Some pesticides are labeled as "Restricted Use Pesticides" and may only be purchased and applied by "Certified Pesticide Applicators".

Whenever pesticides are used to control vertebrate pests, both primary and secondary non-target toxicity must be considered. Primary non-target toxicity may result from the consumption, or other means of direct contact, of non-target animals to the pesticide. Secondary non-target toxicity refers to the hazard to non-target animals that may scavenge on poisoned carcasses. Rodenticides are pesticides used to control rodents and are the most common vertebrate toxicants used by homeowners.

Rodenticides are generally classified as anticoagulants or non-anticoagulants. Anticoagulants are chemicals that interfere with an animal's blood clotting mechanisms, destroy small blood vessels and cause the animal to bleed to death, internally. Anticoagulants are toxic to all mammals and birds and can be very effective control agents. The earlier anticoagulants are referred to as "first generation anticoagulants" and require the target animal to consume multiple doses over time. Later anticoagulants or "second generation anticoagulants" can be effective in fewer doses and can be lethal in single doses. However, both first and second generation anticoagulants may take up to several days to kill. Since the animal's death takes place a period of time after the toxicant is consumed, there is no discomfort associated with the bait and "bait shyness" does not occur. Bait shyness occurs when an animal consumes a sub-lethal dose of a toxin and gets sick or feels some discomfort. The animal then associates the discomfort with the toxic bait. This association causes the animal to avoid any further consumption of that particular bait. Bait shyness may be a problem with some non-anticoagulant rodenticides.

Non-anticoagulants are acute toxins which, if consumed in sufficient amounts can be lethal with a single feeding. Since bait shyness may be a problem with non-anticoagulant rodenticides, pre-baiting with the bait medium alone, without the toxin, is often recommended. Pre-baiting provides an opportunity for the target rodent to become accustomed to feeding on the bait before the toxic formulation is introduced.

The use of "bait stations" is often recommended and sometimes legally required when toxic bait is used above ground where non-target animals or humans might be exposed. Bait stations can be obtained commercially or homemade and are tamper resistant boxes that contain the toxic bait. These boxes or "stations" have entry holes which permit access only to animals of the general size of the target species. Bait stations also protect the bait from weather and physical disturbance. Keeping bait fresh is especially important when using anticoagulant baits that require multiple feedings and are usually left in place for longer periods of time.

FUMIGANTS

Fumigants are toxic gasses used primarily to control burrowing rodents. Fumigants work best in moist, heavy soil which will prevent the gas from diffusing through the soil. Fumigation is often less effective in lighter, drier soils often found in Arizona. These soils often permit the gas to diffuse away from the burrow system resulting in a less than lethal concentration of toxic gas. Gas cartridges containing a variety of active ingredients are available commercially. These cartridges are ignited with a match and placed in the burrow. Soil is packed behind the cartridge to contain the toxic gasses. Gas cartridges should never be used under buildings or other structures or in close proximity to any flammable materials.

Given the proper soil conditions, carbon monoxide from a gasoline engine can be an effective fumigant for pocket gophers and some other burrowing rodents. This can be accomplished by attaching one end of a hose to the exhaust from a gasoline engine and the other end placed in a rodent tunnel. Soil is then packed around the hose and the engine is run for a few minutes filling the burrow system with carbon monoxide.

SHOOTING

Shooting can be an effective control method for some species under certain circumstances. Shooting is most often not practical in urban or suburban situations. A safe backstop must be present when shooting is employed. Many cities and towns have laws prohibiting the discharge of firearms within their limits - these laws often include BB and pellet guns. In Arizona, it is illegal to discharge a firearm within 1/4 mile of an occupied structure without the owner's or occupant's permission. Pellet rifles can sometimes be used when a firearm cannot be used. Pellet rifles have less range, usually lower velocities and less impact energy.

BIOLOGICAL CONTROL

Biological control for most pests may include predators, parasites, pathogens or contraception. Pathogens, parasites and contraception have been used to control vertebrate pests, but are usually not practical nor available for homeowner use.

Natural predators seldom keep urban vertebrate pests population levels below a tolerable level. Domestic cats and dogs can be of limited value in some situations. However, there is also the danger that these pets may kill or injure non-target, desirable species.

HANDLING AND DISPOSING OF ANIMALS

Wildlife species can serve as hosts for certain diseases that affect humans. The agents that cause these zoonotic diseases can be contracted from wildlife directly by bites or contamination, or indirectly through the bite of arthropod vectors such as mosquitoes, ticks, fleas and mites that have previously fed on an infected animal.

As a general precaution never handle wild animals, dead or alive, with bare hands. When disposing of dead small animal carcasses or destroying nests, wear rubber or latex gloves or handle dead rodents with a plastic bag turned inside out. When removing a dead rodent from a trap, spray the animal and the trap thoroughly with a disinfectant. Clean the trap and adjacent areas thoroughly with a disinfectant. At elevations above 4000 feet in Arizona, spray dead rodents with a pesticide to kill fleas, with may carry plague, before spraying with disinfectant. Dispose of small animals (rodents) in double plastic bags in trash. If larger animals are to be disposed of call your local rabies control office (See appendix A).

Prepared by: Lawrence M. Sullivan Extension Natural Resources Specialist School of Renewable Natural Resources The University of Arizona