Natural Selection & Invasive Species
Grades 9-12 Science Curriculum
INSTRUCTIONS

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Curriculum Length:
(3) 50 minute Class Periods (9-12 Grades)

National Agricultural Literacy Outcomes (NALOs):
- Identify non-native or invasive species in your state that impact the sustainability and/or economic value of natural or agricultural ecosystems
- Identify current and emerging scientific discoveries and technologies and their possible use in agriculture (e.g., biotechnology, bio-chemical, mechanical, etc.)

Discuss how agricultural practices have increased agricultural productivity and have impacted (pro and con) the development of the global economy, population, and sustainability

Content Standards:
- HS-LS4-4 - Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- HS-LS4-5 - Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- HS-LS4-6 - Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Common Core Standards:
- CCSS.ELA-LITERACY.RI.11-12.7 - Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
- CCSS.ELA-LITERACY.RI.11-12.1 - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

Curriculum Purpose:
Survival of the fittest, only the strong survive are both common phrases to describe natural selection. This lesson plan will provide background on the definition of evolution and provide explanations and activities about how invasive species are affected by natural selection. Students will identify how cedar trees took advantage of a changing environment, Mystery Snails have invaded waterways, and how Corn Root Worms populations are becoming resistant to GMO crops.

Background Information:
An invasive species is defined legally in the USA as "A nonnative species which causes harm to the economic, environment or to human health". A species can be native in a region but it must be non-native in the ecosystem it invades to be considered invasive.
Non-native species can be added to a community either by natural range extensions or because they are introduced as a result of human or animal activity. Most non-native species have harmful ecological effects; these are referred to as invasive species. Virtually all ecosystems are at risk from the harmful effects of introduced invasive species (also see exotic species, marine invasive species, and aquatic invasive species).

Invasive species are a major threat to our environment because they (1) can change habitats and alter ecosystem function and ecosystem services, (2) crowd out or replace native species, and (3) damage human activities, costing the economy millions of dollars. For example, costs to agriculture, forestry, fisheries, and other human activities by introduced species are estimated at $137 billion per year to the U.S. economy alone. (McGinley, 2011) In their native environments, invasive species are bound by the constraints of their natural predators, climate, and other environmental factors. Once moved, the natural selection pressures from the environment change. This change can lead to population growth or limitation and over time, this natural selection results in changes in the inherited characteristics of the population.

Genetically modified crops are not immune to natural selections. As the environment changes members of a species struggle for existence. As people create stronger crops, genes in pests from weeds to insects are exposed. Some genes that are resistant to the modification provide a fitness that can lead to an evolution in the species.

Vocabulary:
- Biological Evolution - gradual change of organisms over time
- Common ancestor - Ancestral organism shared by two or more descendent lineages
- Phylogeny - evolutionary relationships among organisms
- Speciation - the formation of new distinct species
- Natural Selection - the process organisms better adapted to their environment tend to survive and produce more offspring.
- Coevolution - two or more species reciprocally affect each other's evolution

Required Supplies:
- **Art supplies:** Crayons, pencils, and/or markers, blank paper, tape and scissors
- Internet
- Printer
- Projector
- Mystery Snail - handout on google slide (one per student)
- 1 to 1 computers
- One stick per student or one picture per student of an Eastern redcedar tree (from the internet) can substitute

Before Day 1
- **Collect** 1 evergreen stick (real or fake) for each student in the class. You can print out an image of eastern redcedar per student in substitute.
- **Print** out Handout pdf (pg. 1) (enough for each student to choose 1 card)
- **Cut** out cards
- **Tape** cards to the board
- **Put** a twig or picture of an eastern redcedar tree on each student's desk.

DAY 1
Follow PowerPoint Presentation Slides
Activity: Use the PowerPoint presentation "Evolution of Invasive Species: Lesson 2"
Students enter classroom to find an evergreen stick (real or fake) or a picture of eastern redcedar in a field (in handout document) on their chairs. You instruct them to choose a card from the board. Have students deposit their stick/picture and card in a designated area as you go though each card then they can sit down except for the no Action card or a different non-management method card you created (see Interest approach box above for ideas). Explain that no action and other non-management methods will not reduce or remove Eastern redcedar which is why those students were not allowed to remove their stick/picture.

After the activity all students put their stick/picture in the pile and sit down. Go through PowerPoint slides discussing why Eastern redcedars threaten biodiversity and cattle production. End the day showing the video: https://www.youtube.com/watch?v=GYJF-k8enz0 of the University of Nebraska-Lincoln program studying Redcedar control methods.

Before Day 2
Print out Handout 2 (one copy)

DAY 2
Follow PowerPoint Presentation Slides -Interest approach (15 minutes)
Objective 1: Define evolution (10 minutes)
- After the interest approach have define evolution as a gradual change of species over time. The eastern redcedar example is not a good example of evolution its increase is just due to its adaptations to take advantage of a changing environment.
- Evolution is the gradual change of species over time. A species is a group of organisms that are similar enough to interbreed. Evolution tries to explain how all life on earth once shared a common ancestor but through environmental pressures gave rise to the diversity of life on earth today.
- The Common ancestor idea can be identified using phylogeny or the study of relationships between species. This can be diagramed using cladograms and family trees. Using a cladogram diagram a student can recognize that when a lineage splits because of a unique trait difference between the organisms this branch represents a speciation. For example the bony skeleton of the ray-finned fish branch those species of fish from sharks that only have cartilage. However, both have vertebrae that still link them to a common ancestor
- Connecting this to invasive species can be how all pig species derived from a common ancestor to produce 19 different species today. Both of the domesticated and feral hogs belong to the *Sus scrofa* species of hogs. Therefore, when more domestic hogs are released by accident or for game, they can continue to interbreed and reproduce.
Objective 2: Define Natural Selection as a mechanism of evolution (20 minutes)
- Evolution occurs through different mechanisms. The Natural Selection mechanism drives evolution by four main principles.
  - (1) A population of a species is able to reproduce and create viable offspring

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- - (2) A population of species has variations among the offspring due to mutations, which are changes in the DNA, and new recombination of genes which are new gene combinations caused by meiosis and sexual reproduction.
    - (3) Competition and predation act on the population of species limiting the numbers of the population.
    - (4) This competition and predation are environmental selectors of the population's offspring. Whichever offspring are are better able to survive will have better chance reproducing and passing on their traits. This relates to common sayings like "survival of the fitness" and "only the strong survive"
- A classic example is color of moths and how there are dark and light moth variations and predators generally only eat the lighter colored, more easily seen moths. Therefore, the population becomes darker and darker because the lighter moths are selected against.
- Feral hog example: Read **Handout 2** to the class while **PowerPoint slide 19** is on the screen
- Western Corn Rootworm resistance example: Scientists genetically engineered corn plants with Bacillus thuringiensis (Bt) bacterium which produces toxins in the plant to kill insects that eat the plant. When the western corn rootworm eats the corn plant some survive eating the level of toxins the plant produces and pass those genes onto the next generation. Now western corn rootworm are resistant to the toxin in many locations and other controls (including crop rotation) must be employed to protect corn crop yields.

<u>Before Day 3</u>
Print off Day 3 Handouts.
- **One copy** of the **<u>Predator Handout.</u>**
- **Enough** copies of the **<u>Offspring Handout</u>** so **all but 1 student has a handout**.

DAY 3
Objective 3: Natural selection of invasive species Activity (30 minutes)
- Ask the class whose birthday is closest to October 31st. This student will become the predator of an invasive species. Have the student bring a pen and something to write on and walk them into the hallway. Give them the Predator Handout. Instruct them to draw an animal that hunts snails. Tell them they have 5 minutes to do this and you will come get them when it is time.
- Give each of the students in the class a Mystery Snail Handout. Tell students they have 5 minutes to draw, color and tap up their drawing somewhere in the classroom. Tell the students there is a predator that will be coming into the classroom to eat their snails. Give students tape to hang their drawings.
- After 5 minutes get the student in the hallway. Take their drawing from them. Tell them once they enter the classroom they have 1 min. to grab as many snail drawings hanging in the room as they can.
- Release the student and stop them at the end of 1 min.
- Tape their predator drawing to the board.
- Make a pile of the snails they collected. Then have students retrieve any snails that were not collected and put them in a pile.

- ● Show PowerPoint slide 28 and tell class about those bullet points
- Divide the class into small groups. (20 mins)
  - • Put PowerPoint Slide 29 up.
  - • Groups have 10 mins to comment on each of the questions on the slide:
    - ○ How could more snails have survived? **Possible answers:** *changes in color, hide under items, move, harder shells, smaller, larger*
    - ○ What happens if a different mutation occurred on one of the snails that lived? **Possible answers:** *that mutation would be passed on to the next generation*
    - ○ What happens if two of the snails got caught and put into an aquarium because they are pretty? **Possible answers:** *those two snails might reproduce and could be sold and released somewhere else*
    - ○ What happens if there are no predators? **Possible answers:** *less things to control the population and could lead to be a problem*
    - ○ What happens if thousands of snails die in an irrigation canal? **Possible answers:** *could clog irrigation outlets.*
  - ● Go over each question as a class and have students state what they came up with.

Essential Links:
- ● Slide Show for lesson
  https://docs.google.com/a/npsne.org/presentation/d/1T7h5pl3JGPBeIRHUPl4q4UMQFHI
  DDYrvzUq4fo8hCnY/edit?usp=sharing
- ● Video: https://www.youtube.com/v/GYJF-k8enz0

Did you know? Ag Facts:
- ● U.S. farmers planted about 169 million acres of these GE crops in 2013, or about half of total land used to grow crops.
  http://ageconsearch.umn.edu/bitstream/164263/2/ERR162.pdf
- ● U.S. farmers used Herbicide Tolerant soybeans on 93 percent of all planted soybean acres in 2013. http://ageconsearch.umn.edu/bitstream/164263/2/ERR162.pdf
- ● Genetically Engineered corn with stacked traits grew from 1 percent of corn acres in 2000 to 71 percent in 2013.
  http://ageconsearch.umn.edu/bitstream/164263/2/ERR162.pdf
- ● Found consumers willing to pay 14 percent less for Genetically Engineered foods.http://ageconsearch.umn.edu/bitstream/164263/2/ERR162.pdf

Enriching Activities:
- ● Describes pig linage - http://www.untamedscience.com/family/suidae/
- ● Eastern Redcedar tree background - http://ianrpubs.unl.edu/live/ec186/build/ec186.pdf
- ● Explore more about the understanding Evolution- evolution.berkeley.edu/

Sources/Credits:
- ● Understanding Evolution. 2015. University of California Museum of Paleontology. 22 July 2015 <http://evolution.berkeley.edu/>.
- ● Mark McGinley (Lead Author); J. Emmett Duffy (Topic Editor) "Invasive species". In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First

published in the Encyclopedia of Earth July 25, 2010; Last revised Date April 8, 2011;
Retrieved June 28, 2015