Educating Iowans with a focus on youth regarding the breadth and global significance of agriculture.

'Phenomena...Mahna mahna: Agroecosystems

NAITCO conference

June 22, 2017

https://youtu.be/g4l1k4XLvo0

Science Standards

7th grade

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

8th grade

- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

High School

- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

National Agriculture Literacy Outcomes

Agriculture and the Environment

Plants and Animals for Food, Fiber & Energy

Food, Health & Lifestyle

Science, Technology, Engineering & Mathematics

Culture, Society, Economy & Geography

National Agriculture Literacy Outcomes

Iowa Agriculture Literacy Foundation

6th-8th grade

- T1.6-8.a. Compare and contrast the advantages and disadvantages involved when converting natural ecosystems to agricultural ecosystems
- T1.6-8.b. Describe benefits and challenges of using conservation practices for natural resources (e.g., soil, water, and forests), in agricultural systems which impact water, air, and soil quality
- T1.6-8.d. Discuss (from multiple perspectives) land and water use by various groups (i.e., ranchers, farmers, hunters, miners, recreational users, government, etc.), and how each use carries a specific set of benefits and consequences that affect people and the environment
- T1.6-8.e. Discuss the comparative environmental pros and cons of populations relying on their local and regional resources versus tapping into a global marketplace
- T4.6-8.b. Describe how biological processes influence and are leveraged in agricultural
- T4.6-8.f. Explain the harmful and beneficial impacts of various organisms related to agricultural production and processing (e.g., harmful bacteria/beneficial bacteria, harmful/beneficial insects) and the technology developed to influence these organisms

High School

- T1.9-12.a. Describe how wildlife habitats are created and maintained by farmers/ranchers and why these habitats are important (e.g., promoting pollinator habitat, insect refuges, creating buffer zones for nutrient management, etc.)
- T1.9-12.b. Describe resource and conservation management practices used in agricultural systems (e.g., riparian management, rotational grazing, no till farming, crop and variety selection, wildlife management, timber harvesting techniques)
- T1.9-12.c. Discuss the scientific basis for regulating the movement of plants and animals worldwide to control for the spread of potentially harmful organisms (e.g., invasive species and disease causing organisms such as foot and mouth disease and avian and swine flu) as well as the methods of control in place (state, national, and international policies, economic incentives)
- T1.9-12.e. Evaluate the potential impacts of climate change on agriculture
- T1.9-12.f. Evaluate the various definitions of “sustainable agriculture,” considering population growth, carbon footprint, environmental systems, land and water resources, and economics
- T1-9-12.g. Identify non-native or invasive species in your state that impact the sustainability and/or economic value of natural or agricultural ecosystems
- T2.9-12.a. Compare and contrast the differences between nature’s plant and animal lifecycles with agricultural systems (e.g., producers manage the lifecycle of plants and animals to produce a product for consumption)

Phenomenon #1

Over grazing

Agroecosystems - AUMs

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

How many cattle can you raise on one acre of land? How many sheep? What affects that number? Available plants for grazing?

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

- How rotational grazing or different grazing management strategies can maximize AUMs and maintain or improve the plant community.

Agroecosystems - AUMs

- **AUM or Animal Unit Month =** The amount of feed required to sustain a 1,000 lb cow and her calf (up to 6 months of age) for one month.
  - An average 1,000-lb cow will eat approximately 26.1 lbs of oven dried forage per day or 80% of her body weight per month.

- **Carrying capacity =** The maximum number of individuals of a given species that a site can support over a certain period of time without causing deterioration of the site.

- **Stocking rate =** The number of animals per unit area over a given period.

Agroecosystems - AUMs

Common animal unit equivalents (AUEs; Pratt and Rasmussen 2001).	
Type of Animal	**Animal Unit Equivalent**
Cow calf pair (1,000 lb cow)	1.00
Each additional 100 lbs of cow	0.10
Bull	1.40
Steer	0.85
Heifer	0.80
Sheep	0.20
Deer	0.20

Agroecosystems - AUMs

CARRYING CAPACITY - example

- 640 acres
- Produces 1,700 pounds of forage per acre annually

640 acres x 1,700 lbs/acre = 1,088,000 lbs annually

- Best management practice to increase pasture health: take half of the forage, leave half.

1,088,000 lbs x 0.5 proper grazing factor = 544,000 lbs

- Cattle will only fully utilize about half of that. Cattle will trample, bed down in, urinate and defecate on half.

544,000 lbs x 0.5 proper utilization factor = 272,000 lbs

- Carrying capacity is typically expressed in AUMs :

272,000 lbs / (26.1 lbs x 30 days) = 374.4 AUMs

Agroecosystems - AUMs

STOCKING RATE- example

- 640 acres
- Multiply AU by how many months the animals will be out on pasture.
- Herd on pasture from May 15 to August 15
- 130 cows

130 AUs x 3 months = 390 AUMs

- 272,000 available forage
- 101,790 forage required per month for 130 cows

272,000 lbs / 101,790 lbs/mo = 2.67 mo. or 80 days

Agroecosystems - AUMs

There are typically 20 deer that graze on this pasture. How long can the cattle remain in the pasture if the deer also forage there?

- **1 deer = 0.2 AU**
- **20 deer = 4 AU**
- **134 AU x 26.1 lbs X 30 days = 104,922 forage needed**
- **272,000 available / 104,922 needed = 2.59 mo. or 77 days**

Phenomenon #2

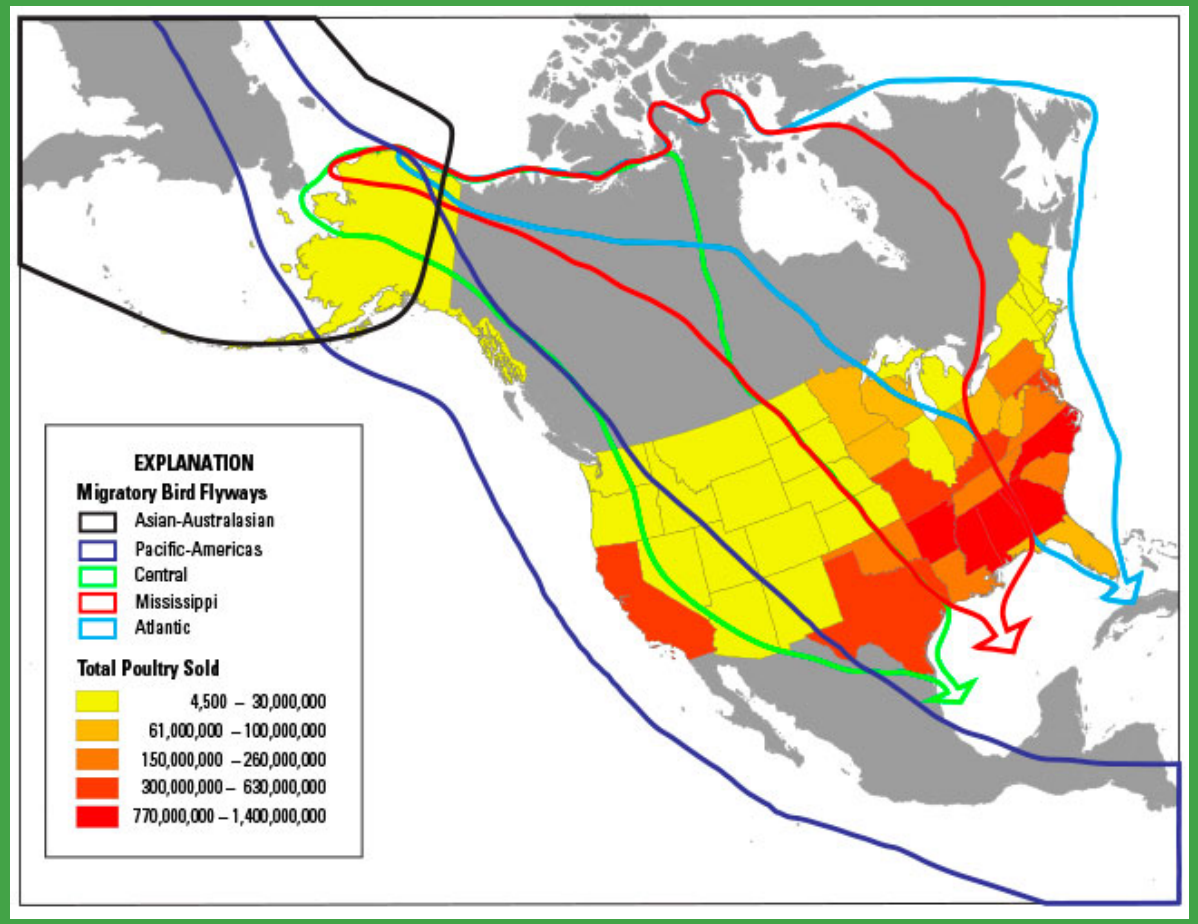
Avian influenza

Agroecosystems – Pests

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Avian influenza spread by migratory birds (ducks and geese). Influenza virus affects domestic bird populations when wild birds defecate on feed of domestic birds.

- Mathematically chart the spread of the virus population.
- How does this affect things like the price of eggs?



Phenomenon #3

Soybean Aphids

Agroecosystems – Pests

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Aphid count on soybeans to determine if/when to spray. Maintaining a balance in the ecosystem by increasing the number of ladybugs to control the aphids.

- Problem since 2000-2004 when aphids were introduced

Agroecosystems – Pests

Speed Scouting Directions

1. Select the first plant at random. If less than 40 aphids are on the entire plant, mark a minus [-] for that non-infested plant. If at least 40 aphids are on the plant (STOP COUNTING when you reach 40 – this is the speedy part), mark a plus [+] for that infested plant.
2. Choose a direction at random and walk 30 rows or paces to the next plant.
3. Repeat Step #1 until 11 plants are sampled in different areas of the field.
4. Make a decision using the total number of infested plants (the total number of pluses).
5. If you must 'continue sampling' (7 to 10 plants with a +), sample five more plants and use the new total number of plants (16) to make a decision.
6. If no decision is reached, sample additional sets of five plants until 31 plants are sampled. Remember, always use the total number of plants to make a decision.
7. If no decision can be made after sampling 31 plants, resample the same field in 3 to 4 days.
8. A 'TREAT' decision must be confirmed a second time 3 to 4 days later. If confirmed, apply an insecticide in 3 to 4 days.

Agroecosystems – Pests

Speed Scouting Chart

Use these Notations: - = Less than 40 aphids/ plant ('non-infested')
+ = 40 or more aphids/ plant ('infested')

Total # of Infested plants:

DO NOT treat. Resample in 7-10 days	CONTINUE sampling 5 more plants	TREAT decision, confirm in 3-4 days
6 or less	7 to 10	11 or more
10 or less	11 to 14	15 or more
14 or less	15 to 18	19 or more
18 or less	19 to 22	23 or more
22 or less	23 to 26	27 or more

1 2 3 4 5 6 7 8 9 10 11

12 13 14 15 16 ___ + ___

17 18 19 20 21 ___ + ___

22 23 24 25 26 ___ + ___

27 28 29 30 31 ___ + ___

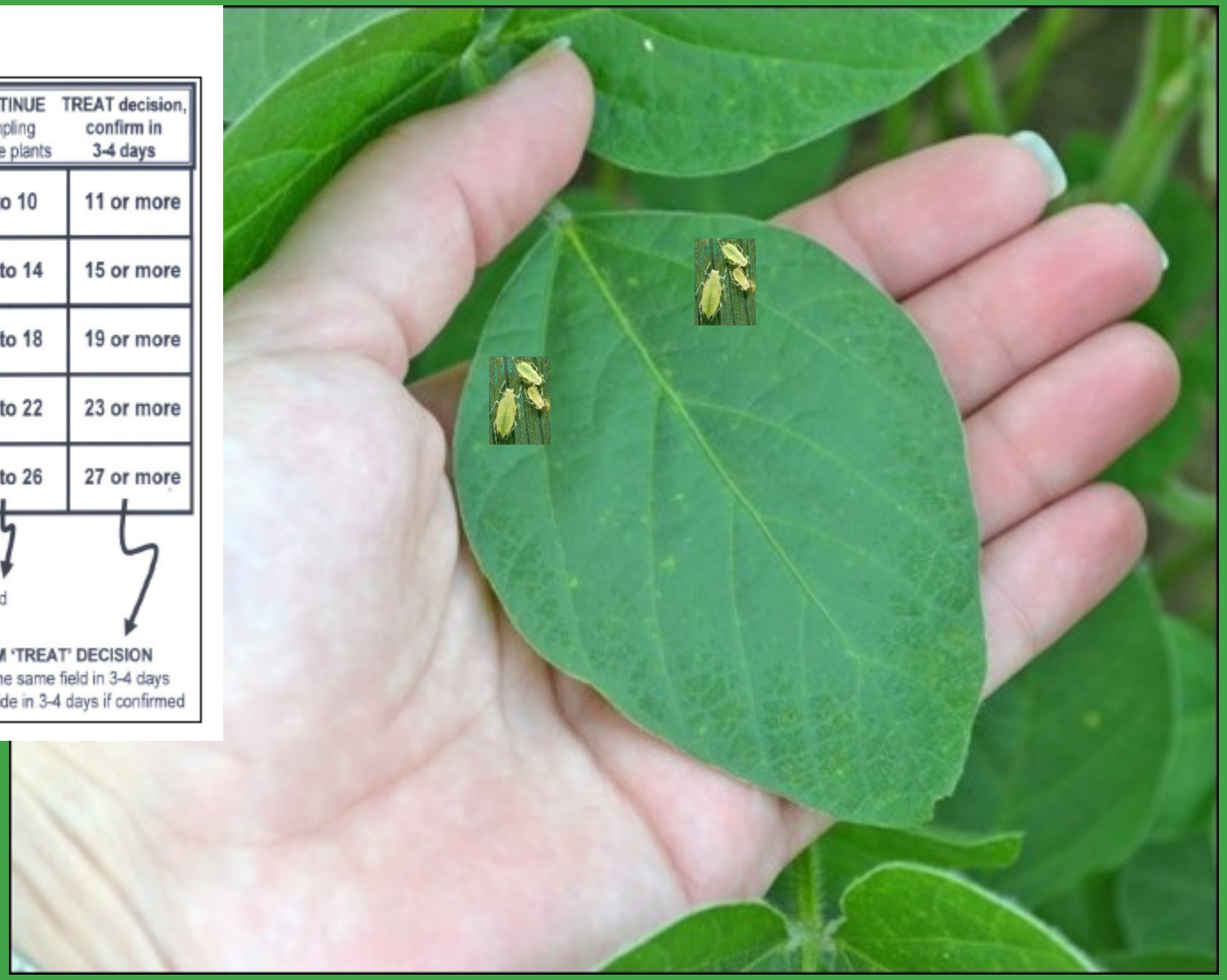
Remember: When you continue sampling, add the previous # of Infested plant to the new count to make the next decision.

Plant Stage: _____

Notes: _____

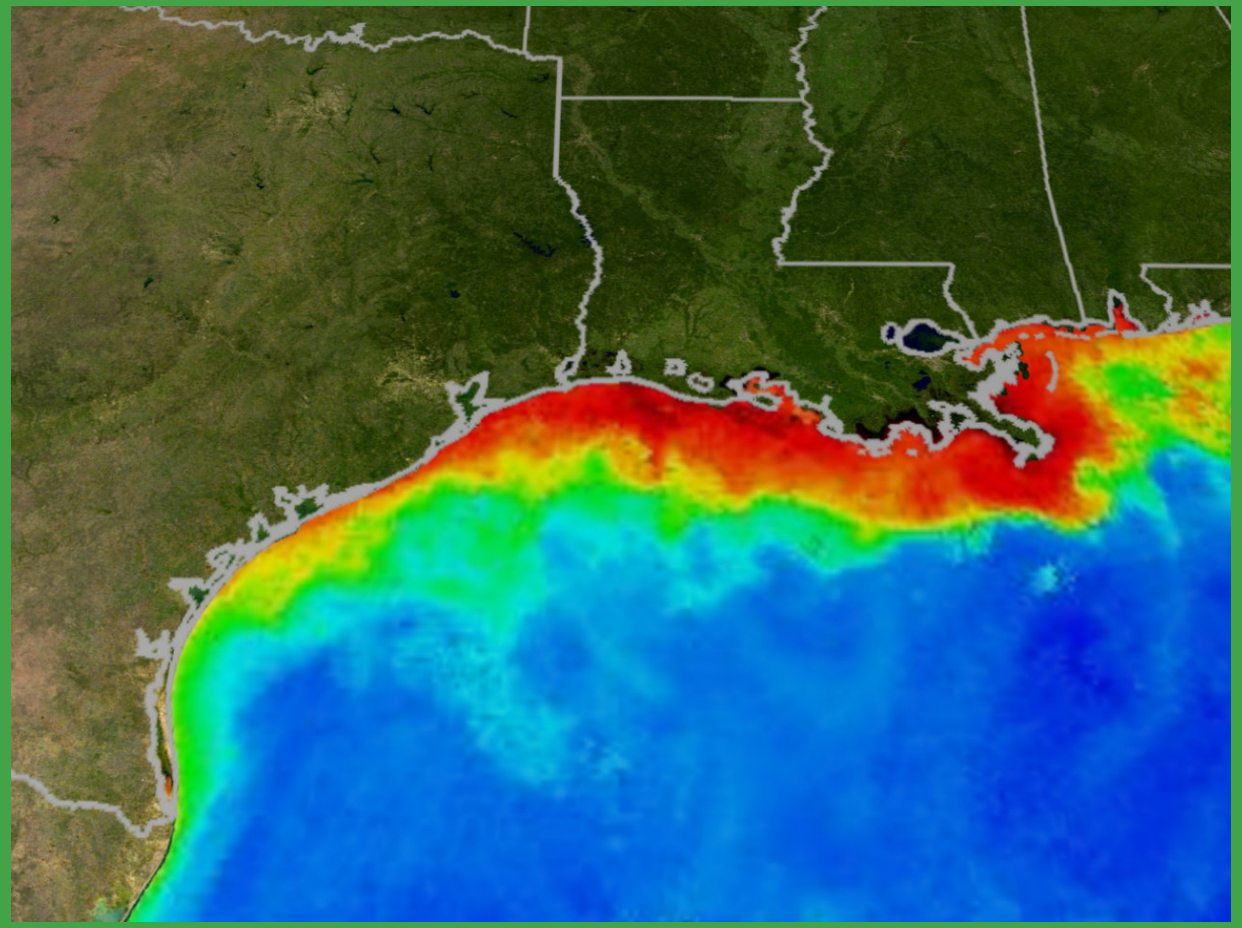
STOP SAMPLING!
Resample the same field in 3-4 days.

CONFIRM 'TREAT' DECISION
Resample the same field in 3-4 days
Apply insecticide in 3-4 days if confirmed



Phenomenon #5

Hypoxia in the Gulf of Mexico



Agroecosystems - Watersheds

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

- Managed access points for livestock to streams and water sources to minimize soil erosion.

- Grass water ways around corn fields to reduce erosion.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

- Terraforming (i.e. building terraces on hillsides) reduces soil erosion from water and can help keep watersheds cleaner.

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