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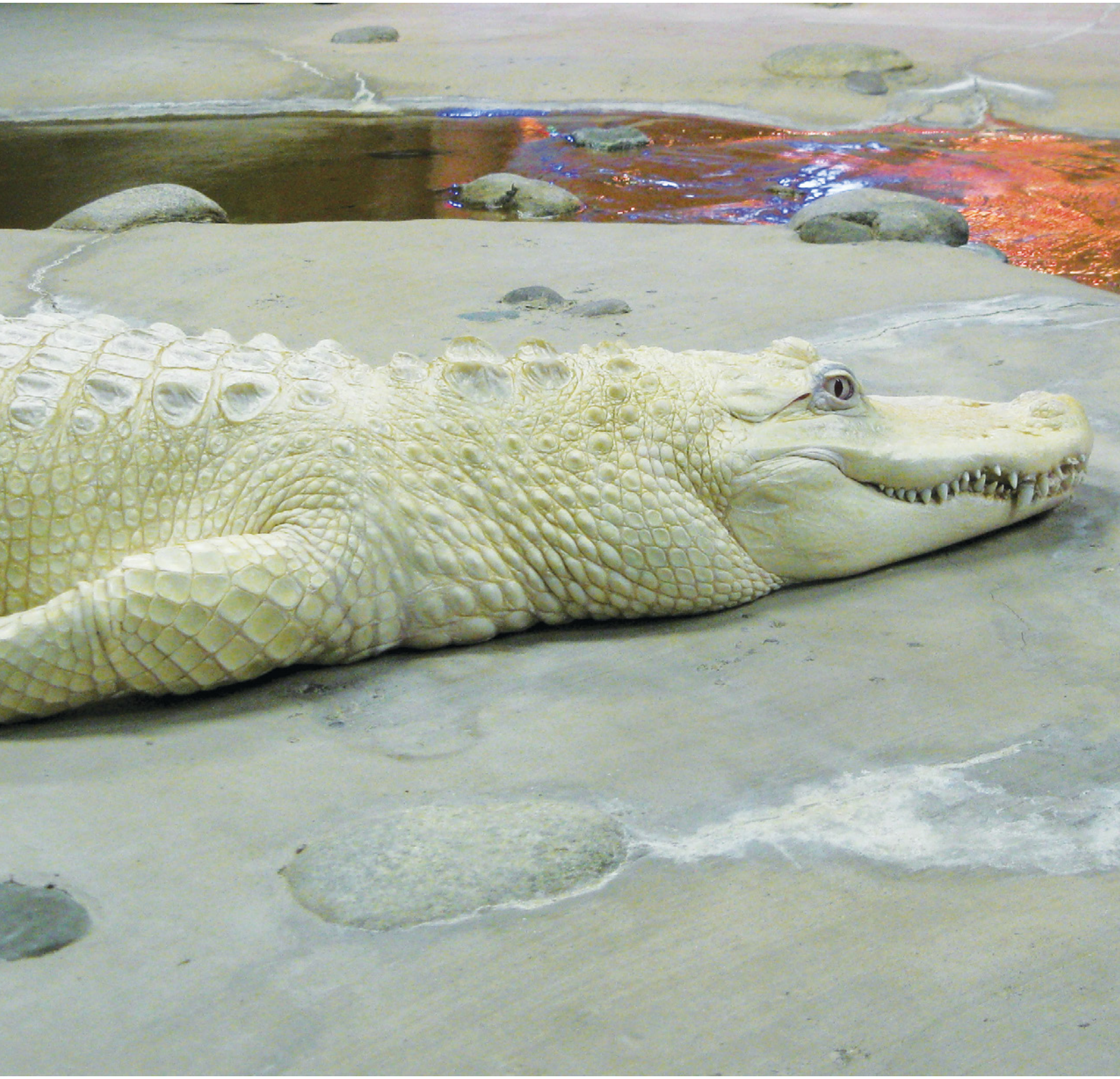

5-E CLASSROOM STEM ACTIVITY:

CRAZIEST FARMS IN THE WORLD - PRECISION FARMING

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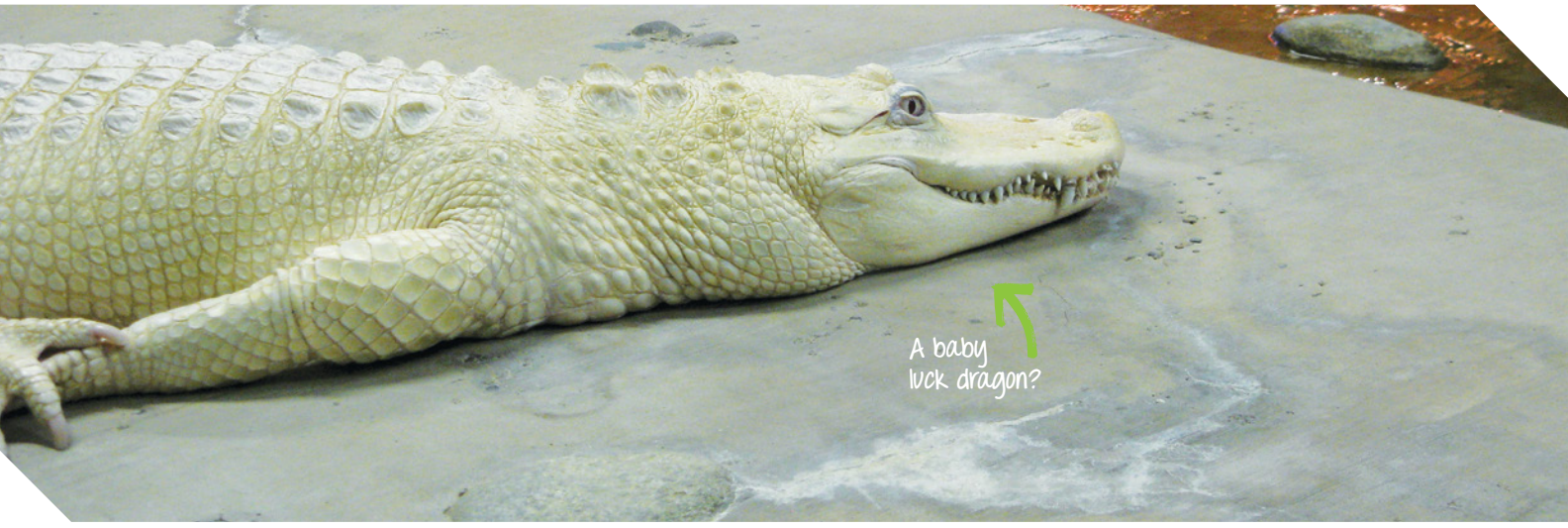
STEM Jobs℠

CRAZIEST FARMS IN THE WORLD

THESE AREN'T OLD MACDONALD'S FARMS—CHECK OUT THE CRAZY FARMS AROUND THE WORLD!

BY COURTNEY RUNN



Growing Underground (UK)

Underneath the bustling city of London, gardens are flourishing. "Growing Underground" is a new initiative to use the otherwise abandoned spaces beneath the city's sprawling metro system to grow plants. One of the biggest benefits of this type of farming is complete control over the environment. This allows the company to produce micro greens and herbs with extra flavor, experience year-round availability, avoid pesticides, use energy and water more efficiently and deliver to customers within hours.

The Black Ivory Coffee Elephant Dung Farm (Thailand)

Black Ivory Coffee is currently a delicacy, one of the most expensive coffees in the world. The secret ingredient that gives it such a unique, earthy flavor? Elephant poop. Yup, you read that right. To produce this speciality coffee, elephants at an elephant farm in Chiang Mai eat coffee beans, which are then plucked out of their dung. The beans sit in the elephants' stomachs and mix with other foods consumed by the massive animals and go through an almost fermenting process as it gets digested. Might sound gross, but people seem to love it.

Vertical Farming

Vertical farming is still being tested, but the creator Dickson Despommier hopes to see this type of farming flourish as our urban centers continue to expand. An expert in environmental science and health, Despommier believes that the combination of an expanding global population, growing urban centers and poor use of land will create an environmental disaster. He hopes that his method of farming vertically will help to reverse this dilemma.

Giraffe Farm (U.S.)

This farm is a little different—it grows giraffes! Giraffe Ranch, located 45 minutes north of Tampa, Fla., offers visitors a chance to learn about and see giraffes, hippos and camels in a protected environment. The farm is clear that it is not a zoo, but a place for these animals to be free and roam. You can experience the animals by going on a typical safari in jeeps or choose to take camels or segways as your mode of transportation.

Cape Trib Exotic Fruit Farm (Australia)

This Australian farm specializes in exotic fruit, growing over 150 different species. The couple who owns the farm has traveled the world and uses seeds from around the globe in their farming. The farm also hosts a bed and breakfast so guests can extend their stay at the tropical fruit farm.

St. Augustine Alligator Farm (U.S.)

You'll want to watch your step at this farm! The St. Augustine Alligator Farm is currently the only zoo in the world that contains all 23 crocadillian species, including the rare albino alligators. The zoo also features exotic birds, lemurs, komodo dragons, native Floridian reptiles and more exotic animals. If you have a flair for adventure, visitors can zip-line over crocodiles!

5-E CLASSROOM STEM ACTIVITY: PRECISION FARMING

Here are some ideas for how high school teachers could use this story as a launching point for integrated STEM learning. Our activities follow the 5-E Learning Cycle Model, and the activity below is intended to last three to four 1-hour class periods (although portions of the activity could be used in shorter time periods).

Part 1: Engage

1. Have students read the STEM Jobs[SM] article: "Craziest Farms in the World."
   - I) Watch Rory Aronson's Ted Talk on precision farming: *youtu.be/9CJt4MFn22M*
   - II) Explore the FarmBot site: *go.farmbot.it*
2. Lead a class discussion about how precision technologies are being applied in farming.
   - I) Precision farming is a site specific approach to crop management that utilizes: Geographic Information Systems (GIS) to map fields and apply data to field grid maps; Global Positioning Systems (GPS) to locate exact points on the field for gathering data on crop yield and chemical application; and remote sensoring technologies are utilized to gather and record data about crops, soil, fertilizer and water.
   - II) Precision farming increases production efficiency by dividing large fields into smaller areas based on factors like soil fertility and water holding capacity.
   - III) Sustainable agriculture is promoted by improving the precision at which fertilizers and other chemicals are applied to a field.
   - IV) Chemicals are used more efficiently with reduced risk of negatively affecting the environment.
3. Pose questions to students about the benefits of new technologies like FarmBot: What properties make Rory's solution work for improving agriculture? What kinds of challenges are you aware of that farmers face? Can you think of other functions that FarmBot or other precision technologies could employ to address challenges in agriculture?

Part 2: Explore

1. Place students in groups of 3-4 and give groups the following task:

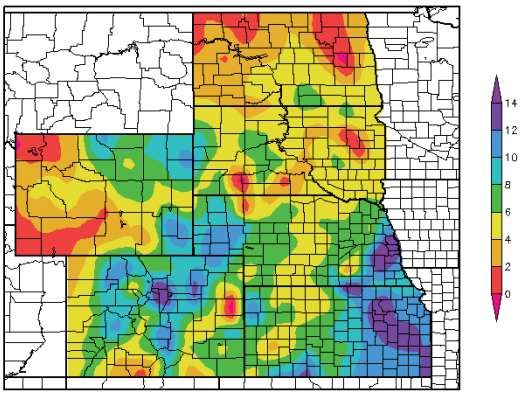
Today, your group will investigate the importance of map making as it relates to precision farming. In each group, review the data from the 180 day precipitation charts on the next page and prepare a presentation for the class including the following. You and your team are preparing an analysis for area farmers based on the rainfall data you have:

- ***I)*** *Provide a visual analysis of similarities and differences between the two maps.*
  - ***A)*** *It may be helpful to create "quadrants" or grid sections to more easily identify the areas you are comparing or discussing.*
- ***II)*** *Identify ways that differences in rainfall patterns affect farming and crop growth across the map.*
  - ***A)*** *Discuss how precipitation changes may affect farmers in various areas across the map.*
- ***III)*** *Provide a graph or diagram to explain the overall differences between expected and actual precipitation.*
- ***IV)*** *Create a list of questions you would ask of farmers in these areas to better understand and advise on crop impact.*

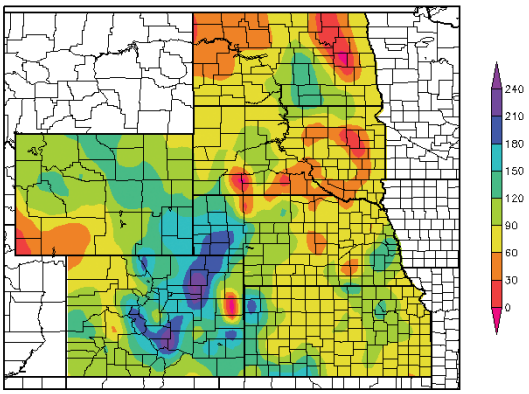
Once you've finalized the materials and roles for your presentation, you can present them to the class or capture the presentation using a camera, phone or iPad.

Circulate and assist student groups as they lay out their plans and identify materials and processes they will use. Reinforce that the presentation does not have to be perfect, and that they should focus on investigating and researching the impact of variation in rainfall, and the value of reviewing and analyzing data of this type for modern precision agriculture.

Below is a map of ACTUAL rainfall for the selected 180 day period:
hprcc6.unl.edu/~adutcher/jasa/180dp.png

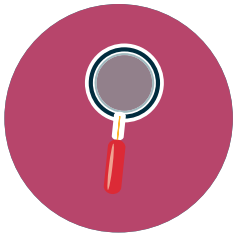


This map shows the NORMAL (expected) rainfall for the 180 day period:
hprcc6.unl.edu/~adutcher/jasa/180dpct2.png



Part 3: Explain

① Have students present their plans to the class. Encourage students to give feedback to the other groups on their presentation.
② Discuss the similarities and differences between strategies with the class. Categorize each food type, the goals students were trying to achieve and the strategies they employed.
③ Engage students in discussing scientific principles involved in their project and how physics and chemistry concepts play various roles in achieving desired outcomes.



Part 4: Elaborate

① Have student groups investigate other types of crop data using the following website: *cropwatch.unl.edu*
- **I)** Have students select one of the following data sets and add this additional information to their analysis:
  - **A)** Planting Progress Report: *cropwatch.unl.edu/crop-report-4-20-15*
  - **B)** Weather Forecast Report: *cropwatch.unl.edu/late-april-forecast*
  - **C)** Pest Scouting Report: *cropwatch.unl.edu/alfalfa-weevils-2015*
    - **1)** Corn Cutworms: *cropwatch.unl.edu/cutworm-monitoring*
  - **D)** Soil Temperature Report: *cropwatch.unl.edu/seed-cold-stress*
- **II)** Have students investigate the types of remote sensing technologies that are or can be used. How could these reports be improved through technology?

There are a variety of web resources for students to investigate—here are a few—but encourage your students to discover and share others:

oklahoma4h.okstate.edu/aitc/links/teac.html
cropwatch.unl.edu/c/document_library/get_file?folderId=506359&name=DLFE-12660.pdf
cropwatch.unl.edu/cropwatchprecipitation
earthobservatory.nasa.gov/Features/PrecisionFarming/precision_farming5.php

Part 5: Evaluate

Have each student summarize their experience (or journal) with notes about how concepts in mapping, technology and mathematics are relevant to precision farming. Ask them to record at least three specific examples from either videos they watched or the presentations they made.

Common Core Math Standards:

CCSS.Math.Content.HSG.MG.A.1. Use geometric shapes, their measures and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

CCSS.Math.Practice.MP3. Construct viable arguments and critique the reasoning of others.

CCSS.MATH.CONTENT.3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.

Next Generation Science Standards:

HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.