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# Using Drones for Precision Agriculture

Jiyul Chang
*South Dakota State University*

Madhav P. Nepal
*South Dakota State University*

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# Using Drones for Precision Agriculture

*Jiyul Chang[1*] and Madhav P Nepal[2]*

*[1]Department of Agronomy, Horticulture & Plant Science,*
*[2]Department of Biology & Microbiology, South Dakota State University, Brookings South Dakota*

***Abstract:*** In this teaching module, students will learn what Precision Agriculture is and how to apply drone into Precision Agriculture practices. To use data (images) taken by drone, students will learn the basic theory of Remote Sensing. Using images, students learn how to make NDVI (Normalized Difference Vegetation Index) maps and how to apply drone (remote sensing technique) in agriculture.

***Lesson Description:***

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| **Grade Level:** Grade 9-12 |
| **Estimated Time for Completing Activity:** Two 45 minute class periods, or One 90 minute block |
| **Learning Outcomes:**<br>• Familiarize major concepts in Precision Agriculture<br>• Learn about theory of remote sensing<br>• Learn about how to fly drone and its applications<br>• Learn how to make NDVI map using the data (images) taken by drone<br>• Explore how to find problem areas in crop fields using images |
| **South Dakota Standards of Learning:**<br>• ITA 8: Use basic principles of agricultural systems technology.<br>• AST 4.1 Analyze how emerging agriculture technologies have affected AFNR industries.<br>• ALC 5 Use technology to enhance productivity. |

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- ALC 5.1 Research, select, and use new technologies, tools, and applications to maximize productivity in the workplace and community (National AFNR CRP.11)

**National Standards: Next Generation Science Standards** (www.nextgenscience.org):

- HS-LS2-1: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems

**South Dakota Standards of Learning**

HS-ESS3-3, HS- ESS3-5, HS–LS2-2, HS-LS2-1, HS-LS2-7
(https://doe.sd.gov/contentstandards/documents/sdSciStnd.pdf)

**Oceti Sakowin Essential Understandings and Standards (https://indianeducation.sd.gov/documents/OcetiSakowinEUS.pdf)**

***ESSENTIAL UNDERSTANDING 1***: The original land base and natural resources of the Oceti Sakowin were under communal stewardship prior to immigrant settlement. The Oceti Sakowin tribes have a distinct and unique interrelationship with the environment that contributes to South Dakota.

- Indicator #1: Analyze the land base and natural resources of the nine reservations in South Dakota
  *Standard*: Students are able to identify the physical geographical changes to explain the causes that impacted the land base and boundaries.
- Indicator #3: Evaluate the strategies in which the tribal governments and other leaders are taking action to improve the lands and natural gifts.

*Standard*: Students are able to identify and explain how a tribal government manages the ecosystem and its natural gifts.

**Materials:**

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- Crop field images taken by drone which have problem areas
- Internet access to reach basic applications

**Vocabulary:**

- Precision Agriculture
- Site-Specific management
- Drone
- Remote Sensing
- Image processing
- NDVI (Normalized Differential Vegetation Index)

**Lesson Links:**

- https://www.youtube.com/watch?v=581Kx8wzTMc
- https://www.youtube.com/watch?v=du7wJX6hEP4
- https://www.youtube.com/watch?v=DusHg6bhDq0
- https://www.youtube.com/watch?v=HFs_wOfjj0k
- https://www.youtube.com/watch?v=rxOMhQwApMc

**Background:** Precision Agriculture is the site-specific implementation of management practices that will economically optimize yields while maintaining the soil, water, atmospheric, plant, and animal natural resources. GPS (Global Positioning Systems), GIS (Geographic Information Systems), computer software, and sensors are required to implement site-specific management. Sensor mounted in drone can take images of crop fields. From the images, unhealthy plants due to nutrient deficiencies, weeds, insects, or disease can be identified and treated immediately.

**Procedure:**

1. In classroom, show YouTube video about Precision Agriculture (https://youtu.be/581Kx8wzTMc)
2. Ask students to explore more about the concepts of Precision Agriculture using internet

- https://agfundernews.com/what-is-precision-agriculture.html
- https://en.wikipedia.org/wiki/Precision_agriculture

3. Next students learn about how to use drone for Precision agriculture. Take students out to an open field and teach them how to control drone. During flying drone, students look ground things through camera mounted in drone. (If a sensor has NIR [near infra-red] band, an image taken from drone can

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make NDVI map. However if a sensor does not have NIR band, students just learn how to fly drone and see how the ground looks like in bird eye.)

4. Move into classroom, students will watch the YouTube videos about basic Remote Sensing and NDVI.
    - https://www.youtube.com/watch?v=EYQsXs1Jr0Y&t=197s
    - https://www.ag.ndsu.edu/publications/crops/agricultural-remote-sensing-basics/ae1262.pdf
    - https://msu.edu/~brook/publications/prec_ag/remote.htm
5. Using computers, students use QGIS software to make NDVI maps using prepared images. (If a sensor does not have NIR band, teacher should prepare images, which has NIR band to make NDVI map.)
6. Ask students to make NDVI maps using the data (images) taken by drone
    - https://gisgeography.com/ndvi-normalized-difference-vegetation-index/
    - https://agribotix.com/whitepapers/farmers-need-know-agricultural-drones/
7. Teach students to find out the problem areas in crop fields using images
    - https://www.ag.ndsu.edu/agmachinery/documents/pdf/basics_for_remote_sensing
    - http://www.regional.org.au/au/gia/08/259woodrow.htm

**Assessment:**

1. What are Precision Agriculture practices?
2. How can Precision Agriculture practices help to make sustainable agriculture?
3. What kinds of techniques or equipment can be used in Site-Specific Management?
4. Why Remote Sensing technique can be used to identify unhealthy crop plants in farming fields?
5. What is NDVI map?
6. Discuss the steps involved in NDVI map creation from the images taken by drone.
7. How can you identify unhealthy plants due to nutrient deficiencies, weeds, insects, or disease?

**Extensions:**

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Students will play QGIS software to make more NDVI maps using images prepared from other crop fields.

**Teacher Notes:**

Teachers should watch the videos in advance, know how to operate drone, learn about basic theory of Remote Sensing. Teachers should also know how to use QGIS (https://www.qgis.org/en/site/), which is a free GIS software to make NDVI map.

**References:**


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