Farmer Time | Experts In The Field

Exploring Drones In Agriculture

TEACHER GUIDE

Episode 1: Drones On Farms

YEAR 7-10

This resource has been developed by:

Primary Industries Education Foundation Australia

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Farmer Time

STORM & FLOOD INDUSTRY RECOVERY PROGRAM

Farmer Time | Experts In The Field

Exploring Drones In Agriculture

Teacher Guide

Overview

The Farmer Time | Experts In The Field three part series - Exploring Drones In Agriculture provides an excellent opportunity for students and teachers to engage with four experts and how they use emerging drone technology in agriculture.

Students will engage with the experts, focusing on the innovative ways drone technology in agriculture is used to improve efficiency, sustainability, and precision farming practices.

The Farmer Time | Experts In The Field project focuses on developing students' knowledge and appreciation of Australian agricultural production and the impacts of drone technology on the ongoing development of agriculture in our country.

The four Experts In The Field highlight the influences of current and emerging technologies on local environments, fostering responsible decision-making and judgment in adopting sustainable management practices.

Teaching Resource Options

Farmer Time | Experts In The Field three part series - *Exploring Drones In Agriculture*.

- **Episode 1 - *Drones On Farms* with Pat McCutcheon (~12:22 mins)**
- Episode 2 - *AgTech - Drones* with Ben & Brooke Watts (~14:00 mins)
- Episode 3 - *Drone Warrior* with Chris Warrior (~13:00 mins)

The resources have been designed as a three part series: each lesson is approximately 50-60 mins in duration. Teachers can adapt the lessons to deliver the content that is suitable to their student's learning styles and needs. Student workbooks can be printed prior to lessons.

Activities 1-3 that align with the Farmer Time | Experts In The Field videos. Suggested viewing options:

- Whole Class (WC): Classroom smartboard - WC view together
- Individual (I): Student's view on personal devices and work independently

Activity 4 highlight the innovative ways drone technology is used to improve the efficiency and precision farming practices. Students will identify and demonstrate how drones can assist with providing yield predictions, irrigation, and crop management for cotton growers.

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NSW Science Years 7-10 Syllabus - Stage 4	
Earth & Space	**Content** **ES4** Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management. (ACSHE121, ACSHE136) Students: • demonstrate how scientific knowledge of the water cycle has influenced the development of household, industrial and agricultural water management practices
Living World	**Content** **LW5** Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems. Students: • describe how scientific knowledge has influenced the development of practices in agriculture, eg animal husbandry or crop cultivation to improve yields and sustainability, or the effect of plant-cloning techniques in horticulture

NSW Science Years 7-10 Syllabus - Stage 5	
Living World	**Content** **LW2** Conserving and maintaining the quality and sustainability of the environment requires scientific understanding of interactions within, the cycling of matter and the flow of energy through ecosystems. Students: • evaluate some examples in ecosystems, of strategies used to balance conserving, protecting and maintaining the quality and sustainability of the environment with human activities and needs

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NSW Agricultural Technology Years 7-10 Syllabus - Core A	
Introduction to Agriculture	**AG5-2** explains the interactions within and between agricultural enterprises and systems Research a range of current and future employment opportunities in agriculture, for example: • operating unmanned aerial vehicles (UAV) • precision farming and Global Positioning System (GPS) technologies Research the required assets, infrastructure and management techniques required for plant and animal production (ACTDEK047)
Plant Production 1	**AG5-9** evaluates management practices in terms of profitability, technology, sustainability, social issues and ethics **Content** Examine current agricultural methods relevant to the chosen plant enterprise in terms of environmental sustainability, for example: (ACTDEK044) • flood irrigation Investigate technologies that assist in record-keeping and monitoring of the plant enterprise and its performance (ACTDEK047) • drone technology
Life Skills	**AGLS-7** identifies environmental effects of agricultural production **AGLS-10** uses information and communication technologies to collect, organise and present information related to an agricultural enterprise

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NSW Agricultural Technology Years 7-10 Syllabus - Core B	
Plant Production 2	**AG5-2** explains the interactions within and between agricultural enterprises and systems **Content** Research a range of current and future employment opportunities in agriculture, for example: • operating unmanned aerial vehicles (UAV) • precision farming and Global Positioning System (GPS) technologies Research the required assets, infrastructure and management techniques required for plant and animal production (ACTDEK047) **AG5-12** collects and analyses agricultural data and communicates results using a range of technologies **Content** Explain the impact of current technologies on sustainability, for example: (ACTDEK041, ACTDEK044, ACTDEP051) • precision farming • Global Positioning System (GPS) technologies
Life Skills	**AGLS-7** identifies environmental effects of agricultural production **AGLS-10** uses information and communication technologies to collect, organise and present information related to an agricultural enterprise

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Australian Curriculum: Science F-10 V9.0 - Year 7-8	
Science as a human endeavour	**Use and influence of science** Examine how proposed scientific responses to contemporary issues may impact on society and explore ethical, environmental, social and economic considerations **AC9S7H03, AC9S8H03**

Australian Curriculum: Science F-10 V9.0 - Year 9-10	
Science as a human endeavour	**Nature and development of science** Investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering **AC9S9H02, AC9S10H02**
Science as a human endeavour	**Use and influence of science** Analyse the key factors that contribute to science knowledge and practices being adopted more broadly by society **AC9S9H03, AC9S10H03**

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Australian Curriculum: Design and Technologies F-10 V9.0 - Year 7-8	
Knowledge and understanding	**Technologies and society** Analyse how people in design and technologies occupations consider ethical and sustainability factors to design and produce products, services and environments **AC9TDE8K01** Analyse the impact of innovation and the development of technologies on designed solutions for global preferred futures **AC9TDE8K02**
	Food and fibre production Analyse how food and fibre are produced in managed environments and how these can become sustainable **AC9TDE8K04**

Australian Curriculum: Design and Technologies F-10 V9.0 - Year 9-10	
Knowledge and understanding	**Technologies and society** Analyse how people in design and technologies occupations consider ethical, security and sustainability factors to innovate and improve products, services and environments **AC9TDE10K01** Analyse the impact of innovation, enterprise and emerging technologies on designed solutions for global preferred futures **AC9TDE10K02**
	Food and fibre production Analyse and make judgements on the ethical, secure and sustainable production and marketing of food and fibre enterprises **AC9TDE10K04**

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ATTRIBUTION, CREDIT & SHARING

This resource was produced by Primary Industries Education Foundation Australia (PIEFA) in collaboration with **Bralca.** Primary Industries Education Foundation Australia's resources support and facilitate effective teaching and learning about Australia's food and food industries. We are grateful for the support of our industry and member organisations for assisting in our research efforts and providing industry-specific information and imagery to benefit the development and accuracy of this educational resource.

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Drone technology can play a valuable role in supporting crop management practices in agriculture. In Episode 1 - Drones On Farms, journey out to Central NSW, and catch up with Pat to learn about the benefits of using drones in cotton and grain production.

Student Name:		Score: /40
Pre-video:	**Activity 1:** Identify & Match The Key Terms - Students familiarise themselves with key terms relating to drone technology and farming practices.	/9
During video:	**Activity 2:** Drones On Farms Top Ten - Short answers. **Activity 3:** Snapshot Summary - Identify the benefits of using drones to assist with farming practices	/10 /10
Post-video:	**Activity 4:** Further investigations • **4.1** Students individually (I) read content from both resources (Dr Allison McCarthy and Dr Derek Long), highlighting key points on how drones can assist with providing yield predictions, and irrigation and crop management for cotton growers. Use the questions below to help with answers. • **4.2** Students individually (I) use the Venn Diagram to display their knowledge and understanding about the use of technology and how agriculture is benefiting from these advancements (I). • **4.3** Teacher and students discuss findings as a whole class (WC).	/2 /5 /4

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Activity 1 : Prior to viewing the Farmer Time | Experts In The Field video, complete the following activity:

Identify & Match The Key Terms

Precision farming	**Field planning**	**Time management & efficiency**
UAS	**Aerial monitoring**	**Crop yield assessment**
Pest & disease monitoring	**Accessibility & flexibility**	**UAV**

Drones can assist in estimating crop yields by collecting data on *plant height, canopy density, and biomass*. This information helps farmers evaluate the success of different crops within the rotation cycle and make informed decisions for subsequent planting seasons.

Drones equipped with specialised cameras and sensors can detect early signs of *pest infestations* or *disease outbreaks*. This knowledge enables targeted interventions, such as timely pesticide application or implementing preventative measures.

Drones can *access areas* that are challenging to reach with traditional ground-based machinery, such as steep or uneven terrain.

Uncrewed Aerial System - includes the systems that support and control the UAV.

Drones equipped with cameras and sensors can capture *high-resolution aerial imagery* of fields throughout the growing season. These images provide farmers with a *comprehensive view* of crop growth and health.

Farmers can use this mapping data to divide their fields into *different zones* or sections, each designated for specific crops in the *rotation cycle*.

Uncrewed Aerial Vehicle is a drone.

Drones in agriculture can assist farmers with accessibility and flexibility on their properties. Aerial monitoring, precision farming, field planning, pest and disease monitoring, and crop yield assessment can help farmers *manage their time effectively*.

Drones can fly over fields at *low altitudes*, spraying herbicides directly onto the weeds; this allows for more *comprehensive coverage* of the affected areas.

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Drones On Farms Top Ten

Activity 2 : View Episode 1 - Drones On Farms with Pat McCutcheon (~12:22 mins) and complete the following questions:

1.

Name the Aboriginal country, Farmer Time| *Experts In The Field* was filmed on?

2.

Pat McCutcheon was born and bred in what town?

3.

What sport did Pat play? Which two global sporting events did he play in?

4.

What is the summer crop produced on this farm?

5.

Identify the two irrigation techniques used to water the crop.

6.

How has drone technology assisted Pat with his farming practices?

7.

Name the two organisations that supported Pat with acquiring a drone.

8.

Crop management strategies - Go to Activity 3 - Snapshot Summary

9.

Identify a career opportunity Pat suggests for young people to be involved with in Agriculture?

10.

What size are the cotton farming and winter crop (grains etc.) production areas on Pat's farm?

Drones On Farms Top Ten

Activity 2: Fill in your answers

1.

2.

3.

-
-
-

4.

5.

-
-

6.

7.

8.

Crop management strategies - Go to Activity 3 - Snapshot Summary

9.

10.

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Snapshot Summary

Activity 3: During the Farmer Time | Experts In the Field video, take notes in the space below, then write a comprehensive summary answering the statement.

Note Taking	Key Points
Drones can assist farmers in implementing and monitoring crop management strategies in several ways. Using the key points, write notes from the video that support this statement.	**Choose *two points* from the list to take notes on:** • Precision farming • Crop yield assessment • Accessibility & flexibility • Time management & efficiency

Summary - Identify and explain the benefits of using drones to assist with farming practices.

Exploring Drones In Agriculture

Further Investigations

Activity 4:

- **4.1 Students individually (I) read content from both resources (Dr Allison McCarthy and Dr Derek Long), highlighting key points on how drones can assist with providing yield predictions, irrigation, and crop management for cotton growers. Use the questions below to help with answers.**
- **4.2 Students individually (I) use the Venn Diagram to display their knowledge and understanding about the use of technology and how agriculture is benefiting from these advancements (I).**
- **4.3 Teacher and students discuss findings as a whole class (WC).**

LW5 describe how scientific knowledge has influenced the development of practices in agriculture

CRDC

Cotton Research And Development Corporation

Dr Alison McCarthy - USQ Cotton Irrigation Researcher

Centre For Agricultural Engineering

Dr Derek Long - Drone monitoring of surface irrigation

Article 1

- **What does Dr Alison McCarthy research?**
- **How does VARIwise technology help provide yield predictions?**
- **How are drones assisting with crop management?**

Article 2

- **What do in-field sensors monitor?**
- **How are water advance rates being tracked?**
- **What technology was able to detect ground water?**
- **What drone is recommended?**

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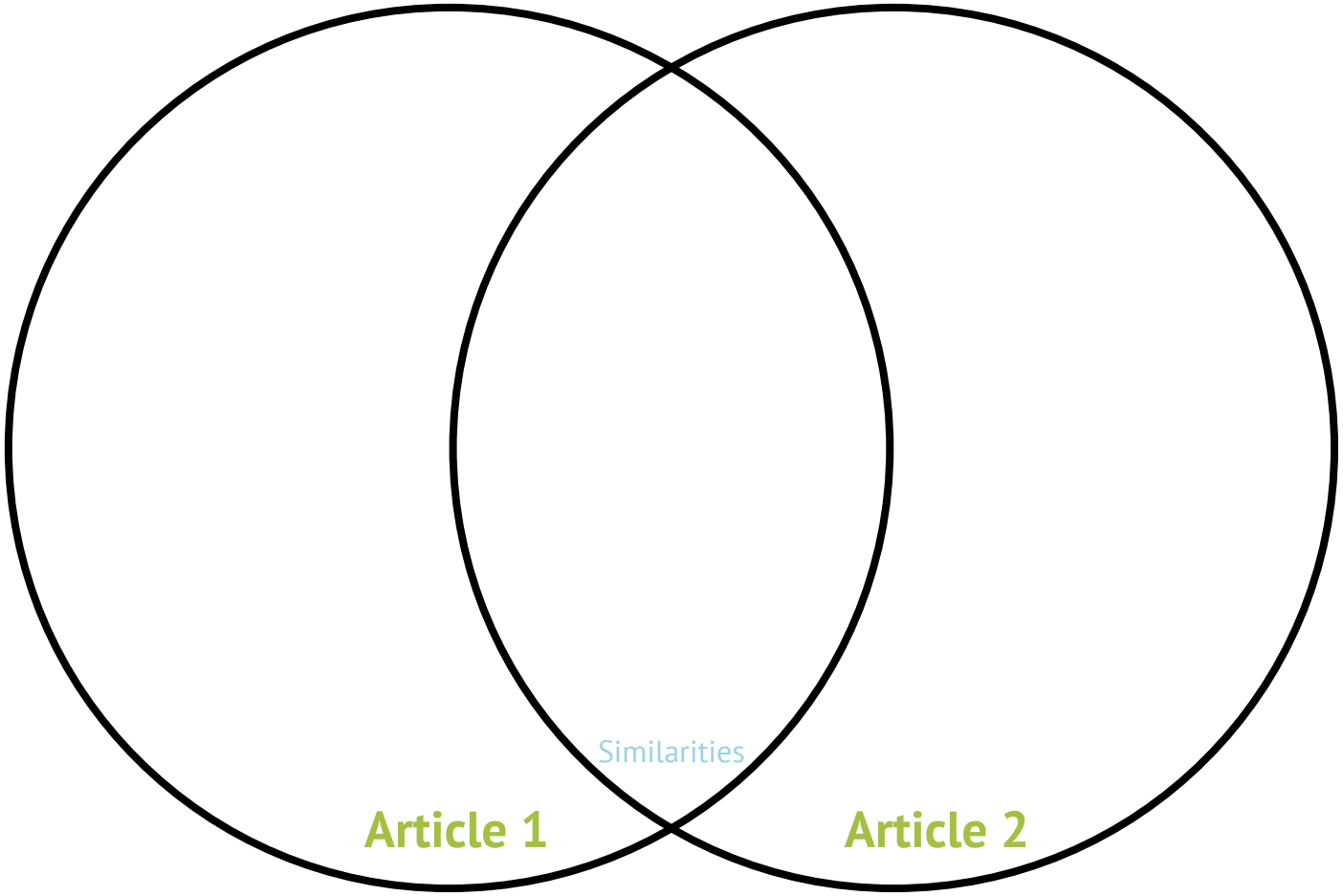
Further Investigations

Activity 4: Use the Venn Diagram to display similarities and differences between the two articles.

- **Article 1: Dr Allison McCarthy - USQ researcher wins international award for CRDC-supported research**
- **Article 2: Dr Derek Long - Research: Drone monitoring of cotton surface irrigation**

LW5 describe how scientific knowledge has influenced the development of practices in agriculture



Class Discussion

Participate	Be polite	Take notes
Think critically	Actively listen	Question
Address the room	Speak clearly	Be respectful

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Further Investigations

Activity 4: Additional notes.

- **Article 1: Dr Allison McCarthy - USQ researcher wins international award for CRDC-supported research**
- **Article 2: Dr Derek Long - Research: Drone monitoring of cotton surface irrigation**

LW5 describe how scientific knowledge has influenced the development of practices in agriculture

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Industry Resources

These resources further extend a student's knowledge and understanding with relevant information provided by external organisations.

Cotton Australia

Pocket Guide

Education Resources

Cotton Australia

Growing Into Leadership Podcast Series

Tocal College

Drones in agriculture

Tocal College

Civil Aviation Safety Authority

CASA

Drones

Cotton Australia & Cotton Info

The water cycle and responsible water use. By Renee Anderson

Irrigation with siphons

Cotton Research and Development Corporation

CRDC News & Events

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Teacher Guide Answers:

Lesson objective

In Episode 1 - Drones On Farms, students will learn and gain an understanding of how farmers can benefit by adopting the use of drone technology in Agricultural Technology.

Lesson overview

Pre-video:	**Activity 1:** Identify & Match The Key Terms - Students familiarise themselves with key terms relating to drone technology and farming practices. (Students work independently or in pairs)	**5-10 mins**	**9 marks (1 mark per correct answer)**
During video: (12 mins)	**Activity 2:** Drones On Farms Top Ten -Short answers **Activity 3:** Snapshot Summary - Identify the benefits of using drones to assist with farming practices. (Students work independently)	**20-25 mins**	**Activity 2: 10 marks** **Activity 3: 10 marks**
Post-video:	**Activity 4:** Further investigations • **4.1** Students individually (I) read content from both resources (Dr Allison McCarthy and Dr Derek Long), highlighting key points on how drones can assist with providing yield predictions, irrigation, and crop management for cotton growers. Use the questions below to help with answers. • **4.2** Students individually (I) use the Venn Diagram to display their knowledge and understanding about the use of technology and how agriculture is benefiting from these advancements (I). • **4.3** Teacher and students discuss findings as a whole class (WC).	**15-20 mins**	**Activities 4.1: 2 marks** **4.2: 5 marks** **4.3: 4 marks**
Further learning (optional)	**Industry Resources:** • These resources further extend a student's knowledge and understanding with relevant information provided by external organisations.	**N/A**	

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Answers: Identify & Match The Key Terms

Activity 1: Prior to viewing the Farmer Time | Experts In The Field video, complete the following activity:

Identify & Match The Key Terms

Precision farming	**Field planning**	**Time management & efficiency**
UAS	**Aerial monitoring**	**Crop yield assessment**
Pest & disease monitoring	**Accessibility & flexibility**	**UAV**

Crop yield assessment	Drones can assist in estimating crop yields by collecting data on plant height, canopy density, and biomass. This information helps farmers evaluate the success of different crops within the rotation cycle and make informed decisions for subsequent planting seasons.
Pest & disease monitoring	Drones equipped with specialised cameras and sensors can detect early signs of pest infestations or disease outbreaks. This knowledge enables targeted interventions, such as timely pesticide application or implementing preventative measures.
Accessibility & flexibility	Drones can access areas that are challenging to reach with traditional ground-based machinery, such as steep or uneven terrain.
UAS	Uncrewed Aerial System - includes the systems that supports controls the UAV.
Aerial monitoring	Drones equipped with cameras and sensors can capture high-resolution aerial imagery of fields throughout the growing season. These images provide farmers with a comprehensive view of crop growth and health.
Field planning	Farmers can use this mapping data to divide their fields into different zones or sections, each designated for specific crops in the rotation cycle.
UAV	Uncrewed Aerial Vehicle is a drone.
Time management & efficiency	Drones in agriculture can assist farmers with the accessibility & flexibility on their properties. Aerial monitoring, precision farming, field planning, pest & disease monitoring, and crop yield assessment can significantly help farmers manage their time effectively.
Precision farming	Drones can fly over fields at low altitudes, spraying herbicides directly onto the weeds. This allows for more comprehensive coverage of the affected areas.

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Answers - Drones On Farms Top Ten

Activity 2: Fill in your answers

1.

Wiradjuri Country

2.

Narromine, NSW

3.

- Rugby Union
- The Olympics
- Commonwealth Games

4.

Cotton farming

5.

- Flood irrigation (siphons)
- Sprinkler irrigation (pivots and laterals)

6.

Time management
Time efficiency

7.

- TOCAL College
- NSW Farmers

8.

Crop management strategies - Go to Activity 3 - Snapshot Summary

9.

Contractual work – using drones.
(Drone pilot on farms, data & analysis).

10.

- 500Ha - cotton
- 4500-5000Ha - grains

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Answers: Snapshot Summary

Activity 3: During the Farmer Time | Experts In The Field video, take notes in the space below, then write a comprehensive summary answering the statement.

Note Taking	Key Points
Drones can assist farmers in implementing and monitoring crop management strategies in several ways. Using the key points, write notes from the video that support this statement. **Note taking activity: students take notes from Pat's dialogue using key points as a guide (8-12 key points)**	**Choose *two points* from the list to take notes on:** • Precision farming • Crop yield assessment • Accessibility & flexibility • Time management & efficiency

Summary - Identify and explain the benefits of using drones to assist with farming practices.

Student answers will vary: Make on organised paragraph, sequence of key points and correct punctuation.

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Answers: Further Investigations -Articles 1&2

Activity 4:

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LW5 describe how scientific knowledge has influenced the development of practices in agriculture

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Article 1

- What does Dr Alison McCarthy research?
- How does VARIwise technology help provide yield predictions?
- How are drones assisting with crop management?

Article 2

- What do in-field sensors monitor?
- How are water advance rates being tracked?
- What technology was able to detect ground water?
- What drone is recommended?

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Answers: Article 1-Dr Alison McCarthy

Article 1: Dr Allison McCarthy - USQ researcher wins international award for CRDC-supported research

"USQ researcher wins international award for CRDC-supported research
Published
October 26, 2021

Cotton irrigation researcher Dr Alison McCarthy of the University of Southern Queensland has received the International Commission on Irrigation and Drainage (ICID) Irrigation Young Professionals WatSave Award (2021) for her work on VARIwise.

The VARIwise technology **combines in-season cotton crop imagery** (collected from drones or in-field cameras) with **crop production models** to **provide yield predictions** for cotton growers **throughout the season.**

Knowing the yield prediction in-season **helps growers make improved management decisions**, like the **timing of irrigations**, plus **plan for the sale of crops**. Up until now, **yield has been estimated using rules of thumb and manual boll counts.**

Alison's research is being conducted as a part of the Smarter Irrigation for Profit Phase 2 project, led by CRDC and supported by funding from the Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program."

For more on Alison's research, see page 7 of our Autumn 2021 Spotlight magazine.

(Cotton Research And Development Corporation, 2021)

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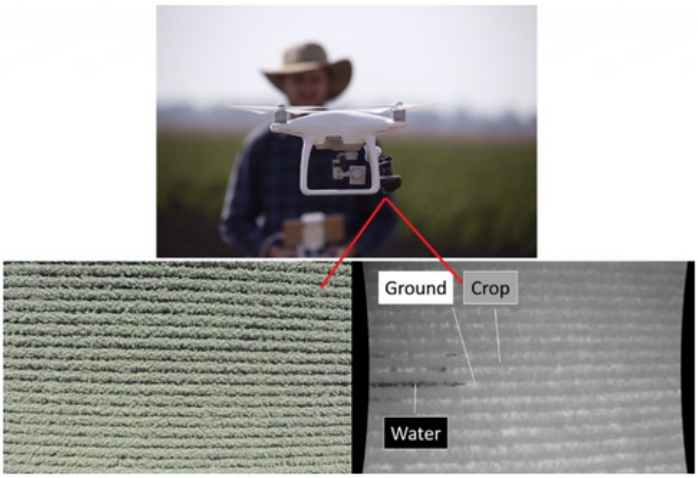
Answers: Article 2- Dr Derek Long

Article 2: Dr Derek Long - Research: Drone monitoring of cotton surface irrigation

"Water application efficiency for surface irrigation systems can be as low as 50 to 80%. Non-uniform field topography and soil properties can change the rate at which water is applied both across the field and down into the soil profile. **Water advance rate variability** is currently monitored with **in-field sensors**, which **are static** and thus **require multiples to cover a large field**.

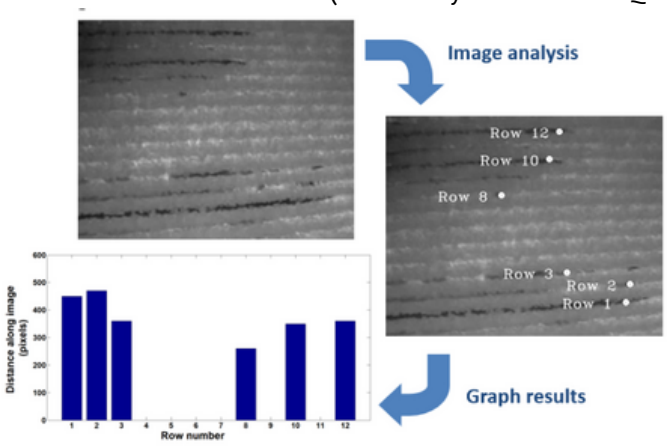
Through CRDC, SRA, Dairy Australia and Rural R&D for Profit funding, this project developed a **prototype unmanned aerial system (UAS)** and **processing software** to enable water advance rates to be tracked from a **mobile aerial sensor.** A **thermal infrared camera** was used which is capable of **detecting ground water** even the canopy would otherwise prevent line-of-sight as seen below.



Colour (left) and thermal (right) images from a UAS over an irrigation.

The developed processing software **logged and georeferenced** the **water advance position of each furrow.** Field trials were performed in the 2017-18 cotton season which showed that the **mobile aerial sensor readings** closely **matched the readings from ground sensors.** Recently released consumer-grade drones with integrated thermal sensors such as the **DJI Mavic Enterprise Dual** would be the ideal hardware to use with the image analysis software".

(University of Southern Queensland, 2019)



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Further Investigations

Answers: Teacher Notes

Activity 4: Use the Venn Diagram to display similarities and differences between the two articles.

- **Article 1: Dr Allison McCarthy - USQ researcher wins international award for CRDC-supported research**
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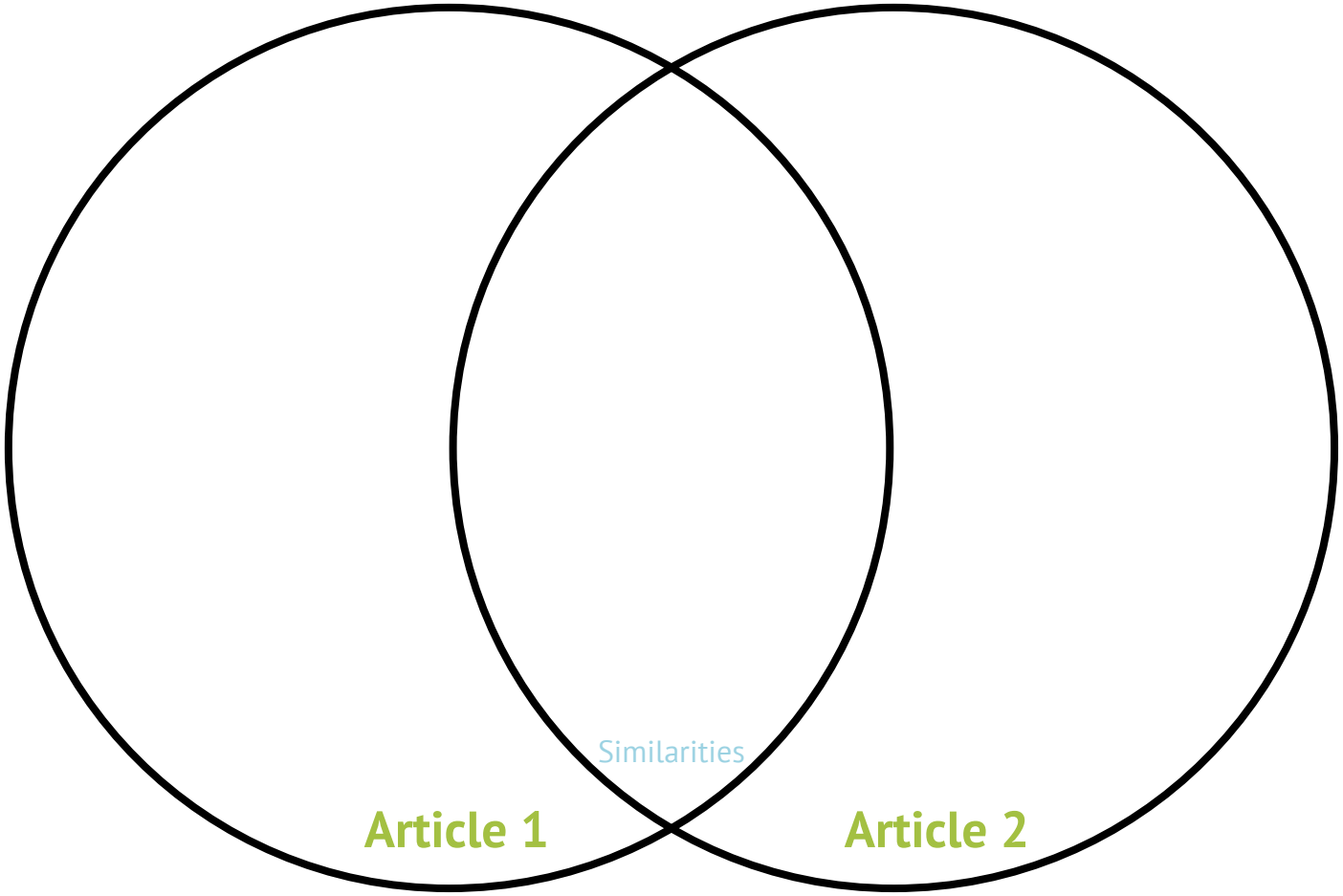

Class Discussion

Participate	Be polite	Take notes
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