STUDENT WORKSHEETS

WORKSHEET 1: GROWTH STAGES

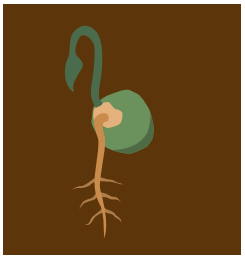
In this task you are required to label each stage of cucumber growth on the diagram below. Use *Appendix 1: Cucumber Growth Stages* to research each stage. Write a brief description (1–2 sentences) for each stage, focusing on what happens and what the plant needs at that time.

Name:

1

2

3



4

5

6

WORKSHEET 2: ETHICAL, SECURE AND SUSTAINABLE PRODUCTION CASE STUDY

Read *Appendix 2: Case Study - Family Fresh Farms.*

Evaluate how management practices adopted by Family Fresh Farms allow them to produce cucumbers in a way that is ethical, secure and sustainable. Provide a response for each of the questions below.

Name:

1. Identify one management practice adopted by Family Fresh Farms to improve the sustainability of their production system.

2. Explain how Family Fresh Farms manages food safety, and how this contributes to the ethical production of cucumbers on their farm.

3. Describe how growing cucumbers in high-tech glasshouses helps to ensure secure, year round production to meet consumer demands.

WORKSHEET 2: ETHICAL, SECURE AND SUSTAINABLE PRODUCTION CASE STUDY

4. Justify how the marketing of cucumbers produced by Family Fresh Farms appeals to consumers.

5. Evaluate how the production of cucumbers in high-tech glasshouses contributes to the ethical, sustainable and secure production of this horticultural crop.

WORKSHEET 3: SUSTAINABLE PRACTICES IN CUCUMBER FARMING

Name:

After completing your research in your group, read the information provided and answer the questions.

Water Conservation

Water conservation in growing vegetables, like cucumbers, means using water more carefully and efficiently to help the plants grow without wasting it. Cucumbers need a lot of water to grow well, but using too much water can lead to waste and strain on the environment. Farmers can use techniques to make sure cucumbers get the right amount of water without overusing it.

One common method is drip irrigation, where water is delivered directly to the roots of the plant. This helps prevent water from evaporating in the air or running off the ground. Another technique is collecting rainwater to use for watering crops, which can reduce the need for tap water. By managing water better, farmers can grow cucumbers more sustainably and reduce the impact on local water supplies, especially in areas where water is scarce.

1. Explain water conservation in your own words.

2. Why do you think water conservation is important for commercial farming?

3. What are some of the advantages of implementing drip irrigation systems?

4. What might stop farmers from implementing drip irrigation systems?

WORKSHEET 4: CUCUMBER CONSUMPTION

Name:

PART A – CUCUMBER SENSORY ANALYSIS

Tick or comment on the cucumber's properties after tasting it.

Taste: ☐ Mild ☐ Sweet ☐ Bitter ☐ Fresh

Texture: ☐ Crunchy ☐ Soft ☐ Juicy

Appearance: ☐ Bright green ☐ Pale inside ☐ Glossy skin

Water content: ☐ High ☐ Medium ☐ Low

Anything else you noticed: _____

_____

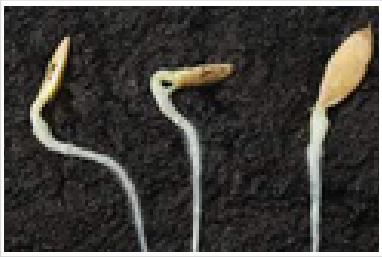
_____

PART B – YOUR CUCUMBER-BASED CREATION

1. Name of the snack/salad.
2. Ingredients used.
3. Which of the five food groups are included in the dish?
4. How did you consider sustainability?
5. How do the cucumber's sensory or functional properties help in this dish?

APPENDIX 1:
CUCUMBER GROWTH STAGES

Cucumbers progress through growth stages: germination (3–10 days), seedling (10–14 days), vegetative (vine growth) (18–23 days), floral (the development of male/female flowers) (7–9 days), fruit formation (11–13 days), and harvest (50–70 days). The optimal soil temperature is 15-35°C, with trellising improving yield.

Image	Stage	Description	Example of Grower Practice
	Germination	The seed absorbs water and swells, then the root and shoot begin to emerge. Warm, moist soil is needed for this stage.	Growers irrigate immediately after planting to ensure uniform seed germination and may use seedling heat mats to maintain optimal soil temperature.
	Seedling	The seedling grows its first true leaves, which start photosynthesis and help the plant grow stronger. Adequate light and gentle watering are important now.	Growers thin out weak seedlings, leaving only the healthiest plants to ensure strong growth and reduce competition.
	Vegetative (vine growth)	The plant develops longer stems (vines) and more leaves, spreading out or climbing. Support and regular watering help growth at this stage.	Growers install trellises or supports to guide vine growth and apply balanced fertiliser to encourage healthy foliage.
	Floral	The plant produces male and female flowers. Pollinators like bees are needed for fertilisation, and fertiliser can support flower development.	Growers may encourage pollinators by planting companion flowers or, in greenhouses, hand-pollinate flowers to ensure fruit set.
	Fruit Formation	After pollination, the female flowers develop into cucumbers. The plant needs consistent moisture and nutrients to support fruit growth.	Growers mulch around the base of plants to retain soil moisture and suppress weeds, and maintain regular irrigation.
	Harvest	The cucumbers reach full size and are ready to harvest. Timely picking encourages more fruit and keeps the plant healthy.	Growers harvest cucumbers regularly using clean shears or knives to avoid damaging the plant and to promote further fruit production.

APPENDIX 2:
CASE STUDY - FAMILY FRESH FARMS

INDUSTRY INSIGHTS

The Australian cucurbits industry is a significant contributor to the country's agricultural sector, with production valued at $536 million in 2018-19. The industry produces approximately 435,000 tonnes of cucurbits annually with an estimated value of $330 million. Key production areas include the Burdekin region in north Queensland and the Murrumbidgee Irrigation Area in southern New South Wales for field production, while greenhouse cucumber cultivation is concentrated in outer metropolitan areas of Sydney and Adelaide.

Family Fresh Farms

Family Fresh Farms is based in Peats Ridge on the Central Coast of New South Wales.

Their high-technology farm grows mini snack cucumbers, also known as **Qukes®**, in large, fully controlled glasshouses.

Family Fresh Farm glasshouses are equipped with motorised vents, shades, and fogging machines that operate to keep the growing environment at optimum temperature and humidity.

All images sourced: (Family Fresh Farms | Peats Ridge NSW, n.d.)


WATER STORAGE


BIO-MASS BOILER


WOODCHIP MONITORING

Family Fresh Farm computerised irrigation system precisely delivers water and nutrients directly to plant roots, with any unused resources collected and recycled. The glasshouse environment is meticulously managed through motorised vents, humidity control, and temperature regulation using a bio-mass woodchip boiler.

They use advanced hydroponic methods with substrates like rockwool, coco-peat, and perlite, replacing traditional soil cultivation.

They employ integrated pest management, using beneficial insects to control pests without chemical sprays. Sensors and computers continuously monitor and analyse growing conditions, providing real-time data on water usage, nutrient application, and expected cucumber yields.

This sophisticated approach allows them to produce more cucumbers in a smaller space, with maximum efficiency and minimal environmental impact.

Commercial cucumber growers utilise several beneficaial insects and organisms for pest management, including predatory mites, ladybugs, wasps, midges and lacewings.

Family Fresh Farms

All images sourced: (Family Fresh Farms | Peats Ridge NSW, n.d.)

Cucumbers require sun for photosynthesis, and without it, plant growth and fruit production slow down. They are investigating LED lighting to provide artificial light on gloomy days, potentially boosting cucumber production even in cloudy conditions.

Glasshouses protects crops from most pests, diseases, and weather damage. This protected environment approach is likely to become more common among vegetable growers in the future.

All images sourced: (Family Fresh Farms | Peats Ridge NSW, n.d.)

Growing vegetables in high-tech glasshouses is always busy, with crops growing fast and constantly changing. **Family Fresh Farms** undertake crop rotation in each glasshouse every three months, planting new young plants when older plants reach three months old. For those who enjoy diverse, fast-paced work surrounded by motivated people, growing healthy snack cucumbers is ideal.

These little treats grow rapidly and require constant attention – including planting, shooting, clipping, lowering, deleafing, thinning, harvesting, grading, packing, and crop pull-out.

They work with sensors, computers, and data, making mathematics practical and relevant for those interested in the sector. Indoor growing allows continuous work regardless of external weather conditions, keeping workers dry and comfortable.

Family Fresh Farms

Family Fresh Farms undergoes Freshcare, HARPS, and SEDEX audits annually, where auditors examine their training, personnel, processes, and procedures to ensure FOOD SAFETY remains a priority.

All employees at their farm receive training on personal hygiene, food safety, foreign objects, allergens, and proper sanitation practices. They have installed wash stations with disinfection machines at the packhouse and glasshouse entrances. These machines automatically clean people's shoes and hands, preventing entry until sterilization is complete. Inside the packhouse, staff handling mini snack cucumbers wear gloves, hairnets, and beard nets (if applicable) to prevent hair contamination in the punnets.

Before leaving the farm for supermarkets, all punnets undergo inspection by a metal detector, check weigher, and quality officer. This ensures the cucumbers are of top quality and free from foreign objects. Their goal is to prevent any instances of caterpillars, leaves, or flies inside the punnets.

Family Fresh Farms employs a diverse workforce including harvesters, graders, packers, forklift drivers, machine operators, quality officers, accountants, payroll staff, trainers, security guards, cooks, cleaners, mechanics, electricians, irrigation technicians, and gardeners.

All images sourced: (Family Fresh Farms | Peats Ridge NSW, n.d.)

Qukes®

Family Fresh Farms states that growing mini snack cucumbers feels special because they provide healthy, nutritious snacks for children and adults. These versatile vegetables can be eaten directly, used in smoothies, or applied to skin for beauty routines. Moreover, the business provides respectful employment, helping families support themselves by earning income for food, education, clothing, and housing.

All images sourced: (Family Fresh Farms | Peats Ridge NSW, n.d.)

APPENDIX 3:
DRIP IRRIGATION SYSTEMS

Drip irrigation systems have greatly enhanced cucumber production in Australia by improving both water efficiency and crop yield. Unlike traditional irrigation methods—such as flood irrigation or overhead sprinklers, which apply water across the entire field surface—drip irrigation delivers water and nutrients directly to the root zone of each plant through a network of tubes and emitters.

Traditional Irrigation Methods

Traditional methods like flood irrigation involve channeling water across the field, allowing it to soak into the soil. Overhead sprinklers spray water above the plants, mimicking rainfall. Both approaches can result in significant water loss through evaporation, runoff, and watering areas where plants do not grow, making them less efficient, especially in Australia's often dry climate.

Water Conservation Benefits

One of the main advantages of drip irrigation is its ability to conserve water. Research shows that drip irrigation can use 30–50% less water than traditional irrigation methods (Food and Agriculture Organization of the United Nations, 2021). By applying water directly where it is needed, drip systems minimise evaporation and runoff, making every drop count—an essential benefit for Australian farmers facing water scarcity.

Improved Yield and Quality

Drip irrigation also supports increased yields and better-quality cucumbers. The precise and consistent delivery of water and nutrients ensures that plants receive optimal care, reducing the risk of water stress or nutrient deficiencies. This targeted approach can lead to healthier plants, more uniform growth, and higher-quality produce.

Other Benefits

Drip irrigation also helps improve plant health by keeping the foliage dry, which significantly reduces the risk of fungal diseases. For crops like cucumbers which are particularly vulnerable to fungal infections such as powdery mildew and downy mildew, this is a crucial benefit. By preventing water from coming into contact with the plant's leaves, drip irrigation helps to minimise the conditions in which fungi thrive, ensuring healthier plants and higher-quality yields.

Drip irrigation is also adaptable to various terrains, making it ideal for irregularly shaped fields. This flexibility allows farmers to make better use of available land, which can be particularly beneficial for farmers working with diverse or challenging landscapes. The ability to tailor irrigation systems to suit the specific contours and layout of the land helps maximise efficiency and productivity.

Energy savings are another key benefit of drip irrigation systems. These systems operate on low pressure, which reduces energy costs. Since the system uses less energy to transport water through the pipes, farmers save money on electricity and fuel, contributing to overall cost reductions in production. This makes drip irrigation not only a sustainable practice in terms of water conservation but also an economically efficient method of farming.

Drip irrigation promotes good soil health by preventing waterlogging and ensuring proper soil aeration. When water is delivered directly to the root zone, the surrounding soil remains dry and loose, allowing for better air circulation. This prevents the soil from becoming overly saturated, which can lead to root rot and other issues that affect plant health. The resulting optimal growing conditions support strong, healthy plants and contribute to higher-quality produce. Many commercial cucumbers in Australia are grown in protected cropping systems, such as polyhouses (plastic greenhouses) or glasshouses. This system has allowed for earlier cropping, simpler weed management, and the ability to harvest during irrigation, all of which have improved production.

APPENDIX 4:
WATER CONSERVATION

Water conservation is a critical practice in commercial farming because it directly influences the profitability of farms, the health of the environment, and the ability to produce enough food for the future.

ECONOMIC EFFICIENCY

Cost Reduction:

Efficient water use reduces the costs associated with irrigation, pumping, and water purchases. By using less water, farmers save money on energy and resources.

Risk Mitigation:

Conserving water helps protect farms from the financial risks of water shortages or droughts. When water is used wisely, farms are less vulnerable to fluctuating water prices or supply restrictions.

Higher Yields:

Proper water management ensures that crops receive the right amount of moisture at the right time, leading to healthier plants and better harvests. This can lead to higher profits and more consistent production.

ENVIRONMENTAL PROTECTION

Soil Health:

Overwatering can lead to soil erosion, nutrient leaching, and waterlogging, which harm soil structure and fertility. Water conservation helps maintain healthy, productive soils.

Water Quality:

Reducing excessive irrigation minimises runoff, which can carry fertilisers and pesticides into rivers and groundwater. This protects local water sources and aquatic ecosystems.

Resource Preservation:

By conserving water, farmers help preserve local water supplies for other uses, such as drinking water, wildlife, and future agricultural needs.

CLIMATE RESILIENCE

Drought Adaptation:

With more frequent and severe droughts due to climate change, efficient water use helps farms stay productive even in dry years.

Reduced Carbon Footprint:

Efficient irrigation systems (like drip irrigation) use less energy, which lowers greenhouse gas emissions associated with pumping and distributing water.

REGULATORY AND SOCIAL COMPLIANCE

Avoiding Penalties:

Many regions have regulations on water use. By conserving water, farms can avoid fines and legal issues related to overuse or pollution.

Consumer Demand:

Consumers are increasingly aware of environmental issues and often prefer to buy from farms that use sustainable practices, including water conservation.

GLOBAL FOOD SECURITY

Water scarcity is a growing threat to agriculture worldwide, especially for water-intensive crops like cucumbers. By conserving water, commercial farms help ensure a stable and reliable food supply, both locally and globally.

GROWING CUCUMBERS

Water conservation is crucial for growing cucumbers in Australia because cucumbers require a steady and significant supply of water for healthy growth, but water resources can be limited or variable depending on region and climate. Australian growers use a range of strategies and technologies to use water efficiently and sustainably:

- **Drip and Trickle Irrigation:** Most commercial cucumber growers use drip or trickle irrigation systems, which deliver water directly to the plant roots in controlled amounts. This method reduces evaporation and runoff compared to overhead watering, ensuring water is used efficiently and consistently.
- **Automated and Computerised Watering:** Advanced greenhouse operations often use computerised systems that monitor plant weight, soil moisture, and environmental conditions to calculate and deliver the precise amount of water needed each day. This approach minimises waste and optimises plant health.
- **Capture and Reuse of Drain Water:** Greenhouse cucumber farms in Australia frequently install systems to capture, treat, and reuse nutrient-rich drain water. This prevents runoff into nearby waterways, reduces total water use, and recycles valuable nutrients, leading to significant cost savings and improved environmental outcomes.
- **Water Quality Management:** Cucumbers are sensitive to salty water. Growers test and treat irrigation water to ensure low salt content, sometimes using reverse osmosis if necessary. Maintaining proper water quality is essential for both plant health and efficient water use.
- **Mulching and Soil Health:** Applying mulch around cucumber plants helps retain soil moisture, reduce evaporation, and suppress weeds. Encouraging healthy soil microbes can also improve water retention and reduce the need for frequent watering.
- **Timing and Targeted Watering:** Watering early in the morning and directing water at the base of plants helps reduce evaporation and disease risk, making water use more effective.

By combining these methods, Australian cucumber growers can produce high yields while minimising water use, protecting local water resources, and enhancing the sustainability of their operations.