



Apples Along the Supply Chain

TEACHER GUIDE

LESSON 2

YEAR 9–10

This resource has been developed by:



Primary Industries Education
Foundation Australia



Hort
Innovation

LESSON 2

Apples Along the Supply Chain

➤ LEARNING AREA

Design and Technologies (Year 9–10)

➤ AUSTRALIAN CURRICULUM CONTENT

Analyse and make judgements on the ethical, secure and sustainable production and marketing of food and fibre enterprises (**AC9TDE10K04**)

Analyse the impact of innovation, enterprise and emerging technologies on designed solutions for global preferred futures (**AC9TDE10K02**)

Analyse how people in design and technologies occupations consider ethical, security and sustainability factors to innovate and improve products, services and environments (**AC9TDE10K01**)

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➤ LESSON OBJECTIVE

Students will learn about the features of Australian apples and value-added products and their function in addressing food security challenges. Students will explore the stages of the value supply chain for Australian apples and the occupations relating to apple production.

➤ LESSON OVERVIEW

Activity 2.1 – Australian Apple Supply Chain (60 minutes)

Activity 2.2 – What If...? (40 minutes)

Activity 2.3 – Value-Added Apples (60 minutes)

Activity 2.4 – Rootstocks for Resilience (60–90 minutes)

Resources and Equipment

➤ **ACTIVITY 2.1 – Australian Apple Supply Chain**

1. [The Savio family know their Apples!](#) (1:00)
2. **PIEFA Food and Fibre Card Game | Australian Apple Supply Chain Game Cards**
3. **Instructions PIEFA Food and Fibre Card Game | Australian Apple Supply Chain**
4. **Worksheet 2.1a – Supply Chain Additional Game Cards**
5. Access to computer/digital devices

➤ **Activity 2.2 – What If...?**

1. **Worksheet 2.2a – What If...?**
2. [Aussie Apples – Cold Storage](#)
3. Access to computer/digital devices

➤ **Activity 2.3 – Value-Added Apples**

1. **Worksheet 2.3a – All-Purpose Apples**
2. [Apple in a Bottle: A world-first fruit drink](#) (11:00)
3. **Worksheet 2.3b – Value-Added Apples Case Studies**
4. [Growth in diversification – value-added products](#)
5. [Converting food waste into nutritious ingredients](#)
6. Access to computer/digital devices

➤ **Activity 2.4 – Rootstocks for Resilience**

1. **Worksheet 2.4a – Rootstocks for Resilience**
2. [Get Grafting](#) (6:11)
3. Optional: [Lesson 2 – Growing and Grafting](#)
4. Optional: Grafting practical task materials or grafting modelling task materials
5. **Worksheet 2.4b – Grafting and Budding Sentence Sort**

Lesson Guide

➤ ACTIVITY 2.1 – Australian Apple Supply Chain

Students will play a card game ordering the marketing and supply chain of apples. They will research sustainable practices and technologies relevant to the marketing and supply chain of apples and design cards using either digital technology and design software, or paper and markers to complement the supply chain.

1. Facilitate a class discussion to review what students have learned about the Australian apple industry. Encourage students to share the innovations and occupations involved in apple production learned in **Lesson One: Apples – Unlocking Orchard Opportunities**.
2. View [The Savio family know their Apples!](#) (1:00) to observe the different processes and technologies involved in the supply chain of Australian apples.
3. Print and distribute **PIEFA Food and Fibre Card Game | Australian Apple Supply Chain Game Cards**, cut into individual cards and preferably laminated.
4. Students follow the instructions from the **Instructions PIEFA Food and Fibre Card Game | Australian Apples Supply Chain**:
 - Place all the step and arrow cards face up and sort them into two piles:
 - Step cards, and arrow cards
 - Remove and reserve the careers, technology, and QR code cards.
 - Collaborate and organise the cards into a supply chain by placing the step cards in their sequential order and arranging the arrow cards between each step to create a supply chain flowchart.

Answers

5. Students place the provided technology card (Robotic Harvester) adjacent to the relevant step in the completed supply chain flowchart.
6. Distribute **Worksheet 2.1a – Supply Chain Additional Game Cards**.
7. Students design two new cards (**Instructions PIEFA Food and Fibre Card Game | Australian Apple Supply Chain** Extension 1 and 2) to add to the deck (two technology cards).

Students may use digital technology and design software (e.g. Canva) or design cards on paper (similar to the cards used in the supply chain flowchart) using pencils, markers, etc.

➤ ACTIVITY 2.2 – What If...?

Students will participate in a thought experiment to consider the role of apple production in global food security. They will conduct research to learn about methods of storage used by the Australian apple industry to ensure year-round product availability and meet consumer needs.

1. Record the question: “*What if... we needed to sustain the world’s population solely on apples?*” in a central area.
2. Allocate students into pairs and encourage them to discuss and record various perspectives by categorising them as Plus, Minus, and Interesting.

Suggested questions for students to consider:

- *How could we increase production to produce enough apples to feed the world?*
 - *Could apples be grown all year round to ensure a constant supply?*
 - *Where in the world could apples be grown? Would this impact the availability of the food source globally?*
 - *What methods could be used to preserve apples?*
 - *How would a diet of only apples meet people’s nutritional needs?*
4. As a class, allow students to share the ideas they have discussed with their partner. Record the advantages and disadvantages this scenario could pose in a central area. (*Note: there are no right or wrong answers for this activity*).
 5. Distribute a copy of **Worksheet 2.2a – What If...?** and provide students with access to computers/digital devices.
 6. Students read and view the information about the availability, selection, and storage of apples and respond to the questions on the worksheet.
 7. Reconvene as a class and facilitate a discussion about storage methods used by the apple industry to meet year-round consumer demand for apples. Ask students to consider the information they have learned in the context of the question: “*What if we needed to sustain the world’s population solely on apples?*” Discuss the impacts of storage methods on food security and how these might play a role in the What if...? scenario.

➤ ACTIVITY 2.3 – Value-Added Apples

Students will learn about value-added products produced from apples and how these products contribute to economic, environmental, and social sustainability in the industry.

1. Display **Worksheet 2.3a – All-Purpose Apples**.
2. Students observe the features of each product and consider the following questions:
 - Which of these products would be most appealing to consumers? Why?
 - Which products would have a longer shelf life than a fresh apple?
 - Why might producers want to use their apples to create products such as these?
3. Explain that value-added products in the apple industry refer to apples that have been processed or changed from their original, fresh form. The value-adding process creates uses for apples that do not meet market specifications in their fresh form. There are a diverse range of value-added products. Benefits such as extended shelf life, altered taste/texture, or consumer convenience can contribute to the appeal of these products for consumers.
4. View [Apple in a Bottle: A world-first fruit drink](#) (11:00) to gain an understanding of the role of value-added products in reducing food waste and providing additional revenue to apple producers.
5. As a class, identify the benefits of this value-added product for producers and consumers.

Suggested answers:

Producers: reducing food and financial waste, providing an additional source of revenue, building resilience to changes in consumer demand, etc.

Consumers: Offers a convenient and nutritious choice, providing more options for consuming the daily recommended servings of fruit, etc.

6. Distribute **Worksheet 2.3b – Value-Added Apples Case Studies** and provide students with access to computer/digital devices.
7. Students access the source materials and complete the case studies focused on value-added products in the apple industry.

Answers

(Activity 2.3 continued following page...)


8. Reconvene as a class and facilitate a discussion about the role of value-added products in the apple industry. Encourage students to consider how value-added products contribute to addressing the challenge of food insecurity posed by a growing population.

Suggested answers:

Reduced seasonal vulnerability if climatic conditions impact the annual yield of apples, increased shelf life could make some value-added apple products a valuable emergency food supply, value-added products provide a diversification of food sources in case the supply of fresh apples is impacted, etc.

➤ ACTIVITY 2.4 – Rootstocks for Resilience

Students will learn about the significance of rootstock selection in Australian apple production and understand how the choice of rootstock contributes to sustainability and food security in the apple industry.

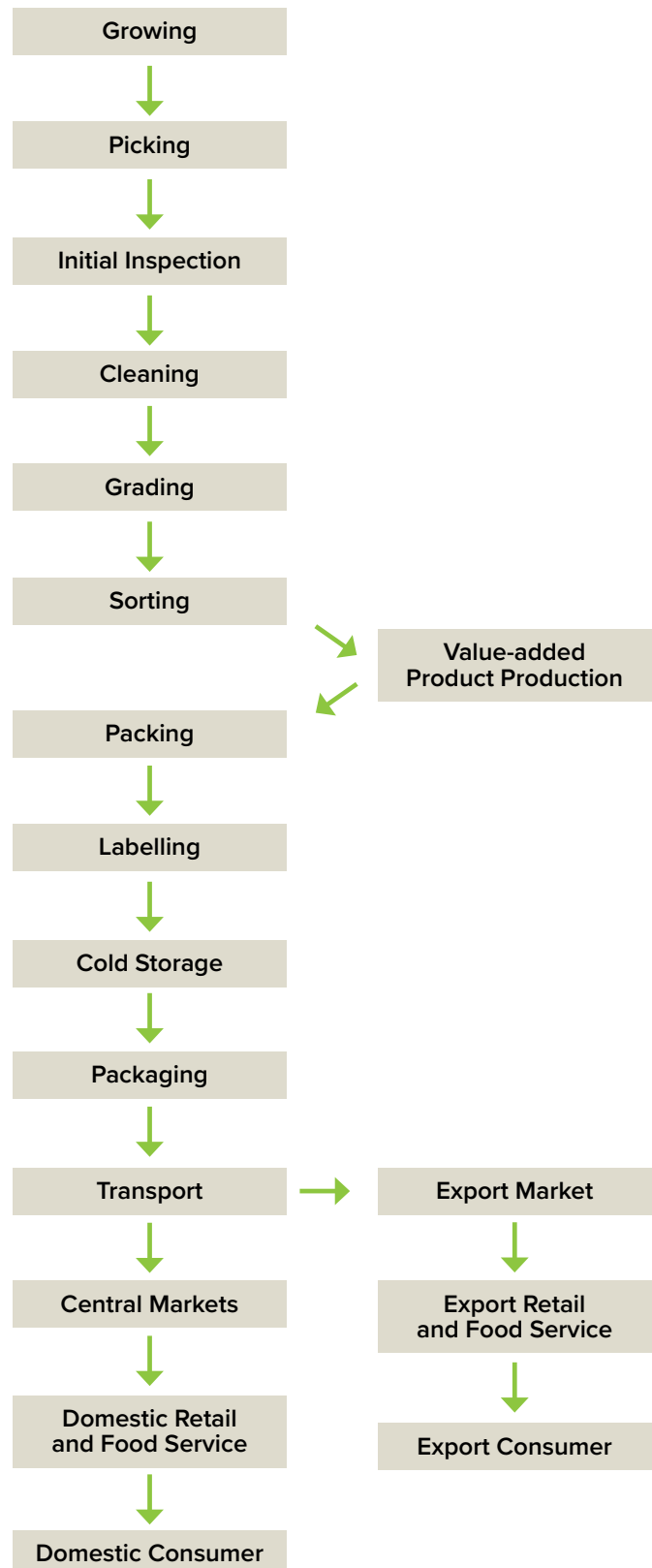
1. Distribute a copy of **Worksheet 2.4a – Rootstocks for Resilience** and read the information as a class.
 2. Facilitate a class discussion about the role of rootstock selection in improving sustainability in the apple industry. Brainstorm how rootstock selection contributes to the sector’s environmental, economic, and social sustainability. Record students’ ideas in a central area.
 3. Students complete the questions on **Worksheet 2.4a – Rootstocks for Resilience**.
- Answers** 
4. Reconvene as a class and view the [Get Grafting](#) (6:11) video to observe different methods of grafting and budding.
 5. Optional: Access **Activity 2.4 – Grafting Practical or Modelling Task** from [Lesson Two – Growing and Grafting](#) learning resource and follow the steps to complete the grafting modelling task or grafting practical activity with students (see the Resources and Equipment section of [Lesson Two – Growing and Grafting](#) for required materials).
 6. Distribute a copy of **Worksheet 2.4b – Grafting and Budding Sentence Sort** and allow students to cut out and sequence the sentences correctly to show the method for grafting and budding.

Answers 

Answers

▶ ACTIVITY 2.1 – Australian Apple Supply Chain

The Australian Apple Supply Chain card game stages:



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➤ ACTIVITY 2.2 – What If...?

WORKSHEET 2.2a – What If...?

1. January, February, March, April, May
2. To ensure year-round availability
3. **Cold storage** – A sophisticated refrigeration system that controls the temperature and humidity of the cool store.

Controlled atmosphere storage – Controls the temperature and humidity of the cool store while reducing oxygen levels and increasing carbon dioxide levels to reduce the rate of apple ripening.

SmartFresh™ – A product applied to apples pre-storage to prevent the over-ripening effects of ethylene and to keep the apples fresh until they are ready to be sold.

➤ ACTIVITY 2.3 – Value-Added Apples

WORKSHEET 2.3a – Value-Added Apples Case Studies

Case Study One: Growth in diversification – value-added products

1. Freeze-dried apples are made by washing, cutting, and freezing them within five minutes to lock in the nutrients, flavours, and colours. The apples are then placed in a vacuum chamber to draw out moisture.
2. Student answers will vary. Possible answers include: Freeze-dried apples have a longer shelf life than fresh apples. They can also be stored without refrigeration, etc.
3. Student answers will vary. Possible answers include: To provide them with an additional source of revenue. To reduce waste of apples that do not meet market specifications, etc.
4. Student answers will vary. Possible answers include: **Environmental** – Reducing food waste in the industry. **Social** – Providing greater food and nutrition security for consumers. **Economic** – Providing an additional source of revenue for producers.

(Answers for Activity 2.3 continued following page...)

Case Study Two: Converting food waste into nutritious ingredients

1. Apple pomace is an edible, highly nutritious byproduct produced when making apple juice. Apple pomace has been stabilised to create a versatile ingredient that can be used in various applications.
2. Student answers will vary. Possible answers include: The stabilised apple pomace ingredient is highly nutritious and versatile, adding nutritional value to diverse dishes.
3. Student answers will vary. To provide them with an additional source of revenue. To reduce waste of apples that do not meet market specifications, etc.
4. Student answers will vary. Possible answers include: **Environmental** – Reducing food waste in the industry. **Social** – Providing greater food and nutrition security for consumers. **Economic** – Providing an additional source of revenue for producers.

➤ ACTIVITY 2.4 – Rootstocks for Resilience

WORKSHEET 2.4a – Rootstocks for Resilience

1. Selecting disease-resistant rootstock can reduce the need for chemical application to treat pests and diseases in an orchard, improving the environmental sustainability of the production system.
2. Selecting appropriate rootstocks can improve orchard productivity, increasing annual revenue. Pest and disease-resistant rootstocks can reduce the need for chemical application to treat pests and diseases in an orchard, lowering the cost of farm inputs. The use of dwarf rootstocks can make orchard maintenance easier, reducing labour costs.
3. Selection of rootstocks that are compatible with climate and soil conditions can build orchard resilience to extreme weather events. Selection of pest and disease-resistant rootstock can build resilience to threats from pests and diseases that may have a resistance to chemical treatments, allowing the continued production of fruit.
4. Selection of rootstocks that are compatible with climate and soil conditions can build orchard resilience to climate change, reducing supply chain impacts from extreme weather events and providing greater food security for consumers. Pest and disease-resistant rootstocks provide greater resilience against biosecurity threats that could impact apple production and the availability of apples to consumers.

WORKSHEET 2.4b – Grafting and Budding Sentence Sort

1. Slice the top of the rootstock into a V-shape by making two 2.5–3cm sloping cuts.
2. Slice the scion to make two corresponding cuts of the same length, creating a pointed end.
3. Fit the sliced end of the scion into the V-shaped wedge of the rootstock. Use grafting tape to secure the two pieces together.
4. Prune back the scion, leaving only 2–3 buds on the plant.
5. When your scion begins to shoot, remove the grafting tape.


References

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Supply Chain Additional Game Cards

Research technologies relevant to the marketing and supply chain of apples. Design two additional cards using either digital technology and design software, or paper and markers to complement the supply chain.






Name of technology/innovation:

Description:

Picture or drawing:

Considerations:



Name of technology/innovation:

Description:

Picture or drawing:

Considerations:

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What If...?

Scan the QR code or click on the [link](https://www.aussieapples.com.au/about/#coldstorage) to access the Aussie Apples Cold Storage Information page. Read the information and view the videos to learn about the picking and storage of apples.

▶ Aussie Apples – About:
<https://www.aussieapples.com.au/about/#coldstorage>



Image source: Montague Orchards

Record your findings below:

1. Identify months of the year when Australian apples are picked.

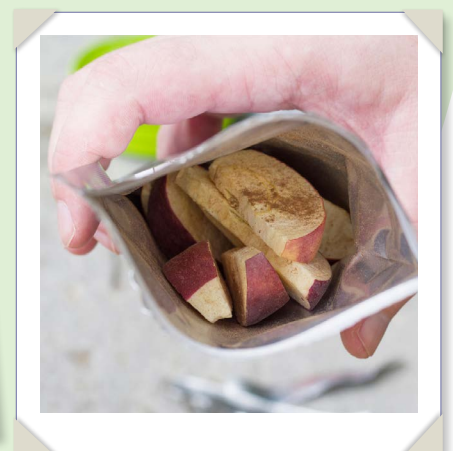
2. Explain why apples are stored throughout the year.

3. Identify and describe two apple storage methods.

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All-Purpose Apples



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Value-Added Apples Case Studies

Value-added products in the apple industry refer to items made from fresh apples that have been processed or transformed to create a new marketable product. This process enhances the features of the apples, extends their shelf life, or creates new uses for them. Value-added products come in different forms and aim to provide additional sources of revenue for producers while offering greater choice to consumers.



1.

Scan the QR code or click on the [link](#) to read the source material about diversification in apple production.

▶ Growth in diversification – value-added products
<https://apal.org.au/growth-in-diversification/>



2.

Scan the QR code or click on the [link](#) to read the source material about diversification in apple production.

▶ Converting food waste into nutritious ingredients
<https://www.csiro.au/en/research/production/food/converting-food-waste-into-nutritious-ingredients>



3.

Select one of the value-added product case studies and respond to the questions on the following page.

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Value-Added Apples Case Studies (cont'd)



Case Study 1: Growth in diversification – value-added products

Answer the following questions after researching Case Study 1.

1. Identify the name of the value-added product and describe how it is made.

2. Justify why consumers would purchase this product.

3. Justify why apple producers would diversify their production system to produce this value-added product.

4. Describe how this product improves economic, environmental, or social sustainability in the apple industry.

Value-Added Apples Case Studies (cont'd)



Case Study 2: Converting food waste into nutritious ingredients

Answer the following questions after researching Case Study 2.

1. Identify the name of the value-added product and describe how it is made.

2. Justify why consumers would purchase this product.

3. Justify why apple producers would diversify their production system to produce this value-added product.

4. Describe how this product improves economic, environmental, or social sustainability in the apple industry.

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Rootstocks for Resilience

Read the information below to learn about the role of rootstock selection in orchard management and apple production. Use the information to answer the questions on the following page.

In apple production, grafting occurs when the stem (scion) of one apple tree variety is joined with the lower portion of a different variety of apple tree that has roots or has the capacity to develop roots (rootstock). Grafting allows the positive characteristics of two apple tree varieties to work together to create a specialised tree.

Apple growers in Australia consider various factors, such as climate, soil type, pest and disease risks, and desired tree size, when selecting rootstocks to plant. This selection process enables them to tailor their production systems to different conditions and consistently yield top-quality apples across various regions of the country.



Pest and disease resistance:

Pest and disease resistance plays an important role in rootstock selection in apple production. To address changing consumer attitudes about the use of chemicals in production and to lower the cost of their orchard inputs, apple growers can reduce the need for chemical treatments to manage pests and diseases and improve the overall health of the orchard by selecting rootstocks that have pest and disease-resistant traits.



Improved productivity:

Different rootstocks can affect fruit size, flavour, and colour. By grafting, growers can combine the desirable traits of two varieties to create consistent, high-quality apples. Using dwarf rootstock can also improve productivity by allowing more trees to be planted in smaller blocks, increasing the overall yield of apples.



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Rootstocks for Resilience (cont'd)



Adaptation to soil and environmental conditions:

Selecting rootstocks that are compatible with the climate and soil type of the growing region is an important factor in apple production. By choosing rootstocks that are resistant to harsh weather conditions such as heatwaves or frosts, growers can enhance the resilience of their orchards to better manage the challenges of a changing climate.



Orchard management:

Using dwarf rootstocks that reduce the overall height and width of the trees can make orchard maintenance tasks such as pruning, spraying, and harvesting easier and reduce labour costs.



Answer the following questions.

1. Explain how selecting appropriate rootstocks can improve the environmental sustainability of the Australian apple industry.

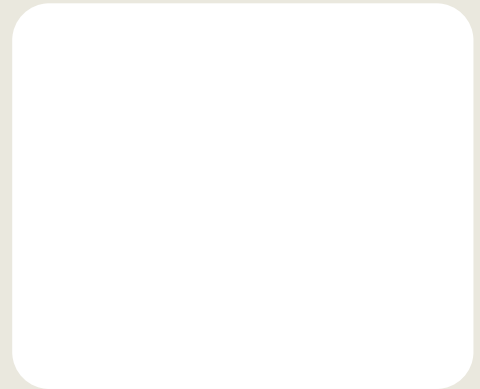
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Grafting and Budding Sentence Sort

After completing the grafting practical task, cut the sentences and glue them into a workbook in the correct sequence to show the grafting procedure. Draw a diagram to accompany each of the stages of the process.



Fit the sliced end of the scion into the V-shaped wedge of the rootstock. Use grafting tape to secure the two pieces together.

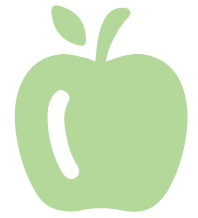


When your scion begins to shoot, remove the grafting tape.

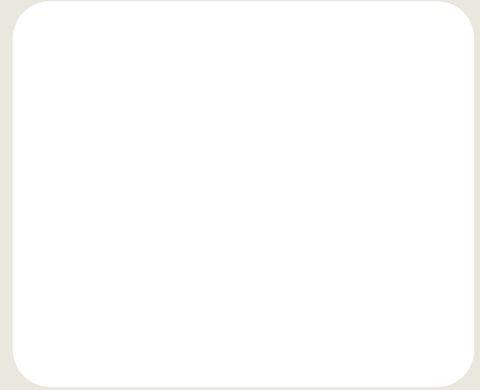


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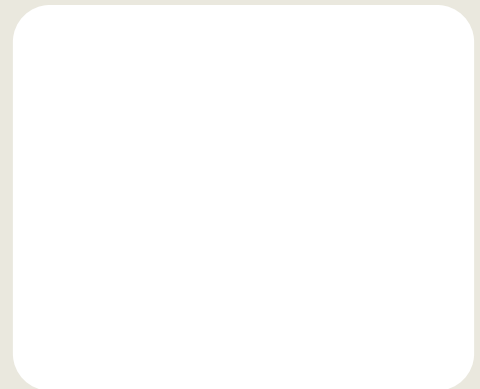
Grafting and Budding Sentence Sort (cont'd)



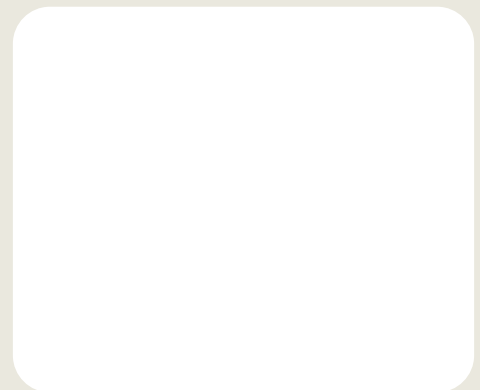
Slice the scion to make two corresponding cuts of the same length, creating a pointed end.



Slice the top of the rootstock into a V-shape by making two 2.5–3 cm sloping cuts.



Prune back the scion leaving only 2–3 buds on the plant.



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