Postharvest 101 for fruit and vegetables

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Postharvest principles – harvest and cooling

TODAY

- Fruit and vegetable physiology
- Effects of temperature
- What is cooling?

NEXT TIME

- Cooling methods
- The importance of cooling rate
- Controlling relative humidity
- Case study – avocado
- Case study - broccoli

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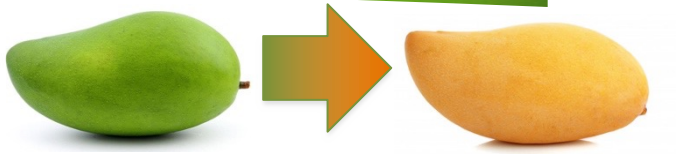
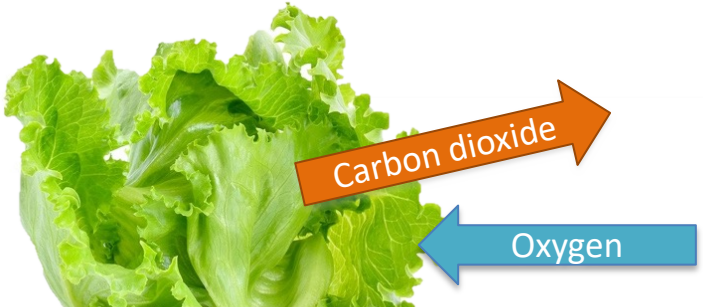
Fruit and vegetables are **ALIVE!**

After harvest, fruit and vegetables continue to:

- Ripen (change colour, texture and flavour)
- Heal damage and fight disease
- Respond to their environment
- Respire (use oxygen, release CO_2)

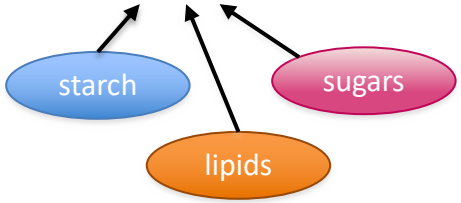


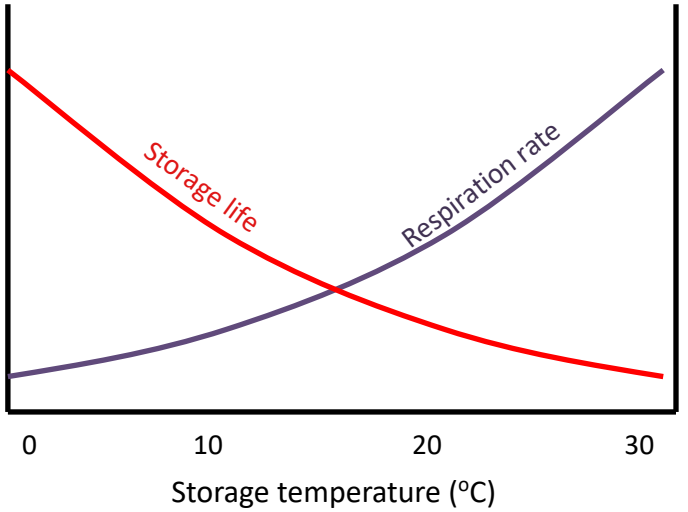


Fruit and vegetables are **ALIVE!**

Respiration provides the fuel that keeps fruit and vegetables alive

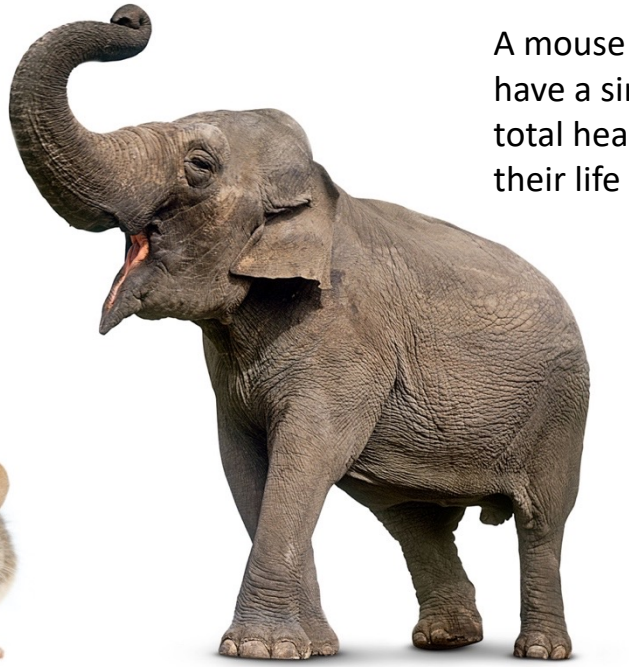
Carbohydrates + Oxygen → Energy + Carbon dioxide + Water





The faster fruit and vegetables use their stored energy reserves, the faster they will die

Respiration = Life



A mouse and an elephant have a similar number of total heartbeats during their life

Respiration rate can indicate how long a fruit or vegetable will live

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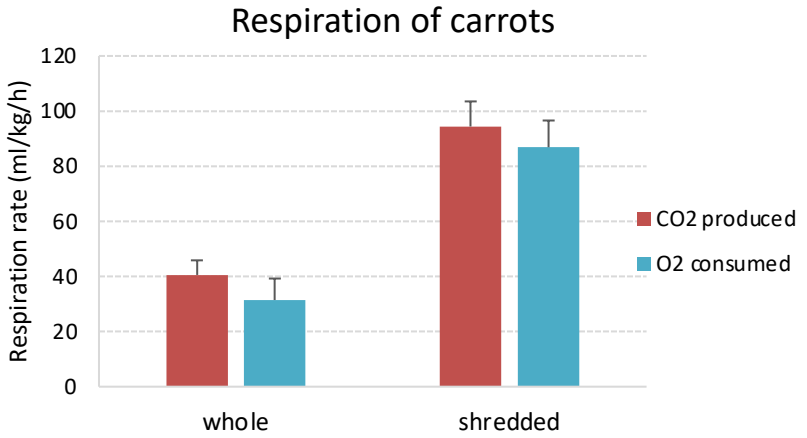
Damage also increases respiration rate

EXERCISE

Bagged product is more likely to become anaerobic if it has been processed



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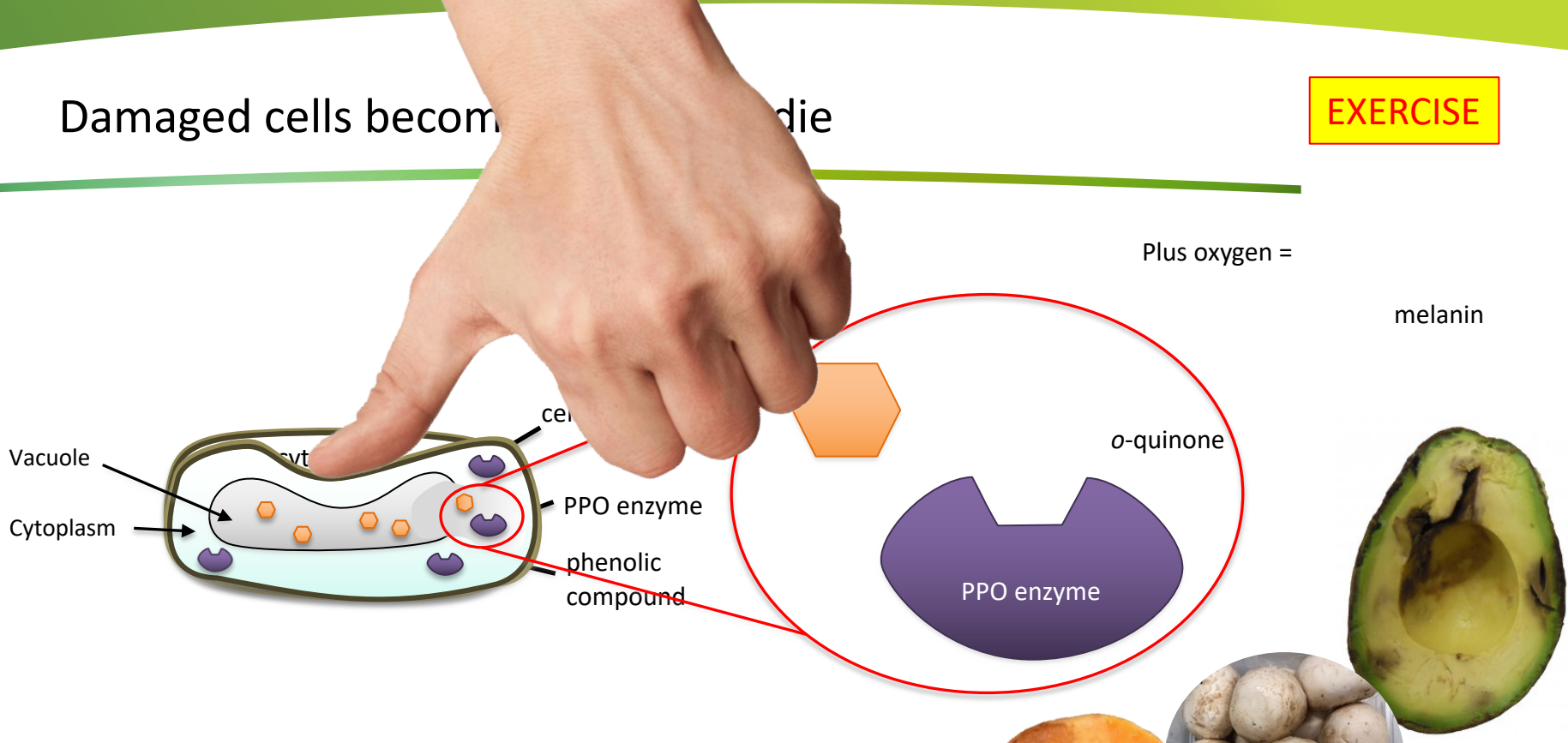
When cells are damaged….

- The pressure inside cells, and the connections between them, are what give fruit and vegetables their freshness and texture
- If cell walls are broken the contents leak out
  - Compounds in the vacuole mix with those in the cytoplasm
  - Turgidity is lost
  - Cell contents leak out, react and oxidise

Damaged cells becom die

EXERCISE



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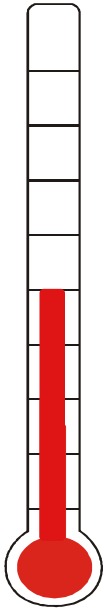
Temperature increases respiration

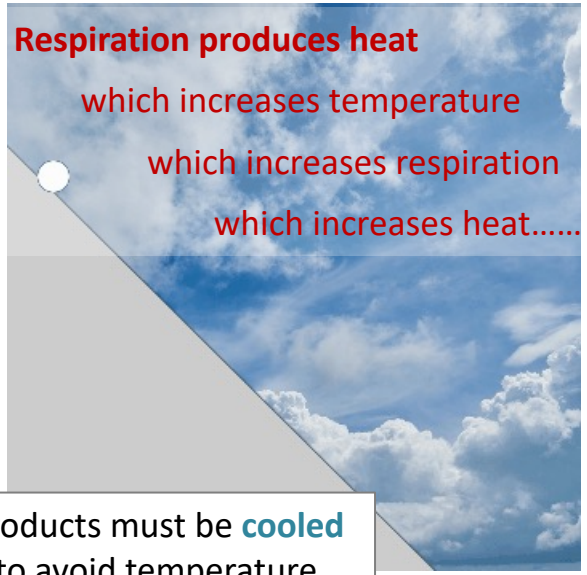
The "Q_{10}rule"….

A 10°C rise in temperature...



Doubles the rate of any reaction…

…including respiration and metabolic activity



Products must be **cooled** to avoid temperature increases

Temperature

is the most important factor affecting ...

Quality

Shelf life

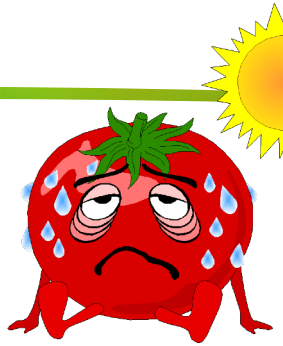
and Value

of fruit and vegetables

Cooling is value adding with electricity

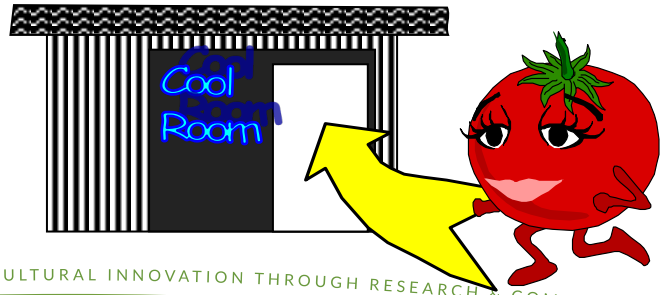
Harvest

Produce should ideally be harvested while it's cool



Keep harvested fruit and vegetables in the shade – never leave sitting in the sun

Transport to the packing shed and place in the cool room as soon as possible (or pack and then cool)



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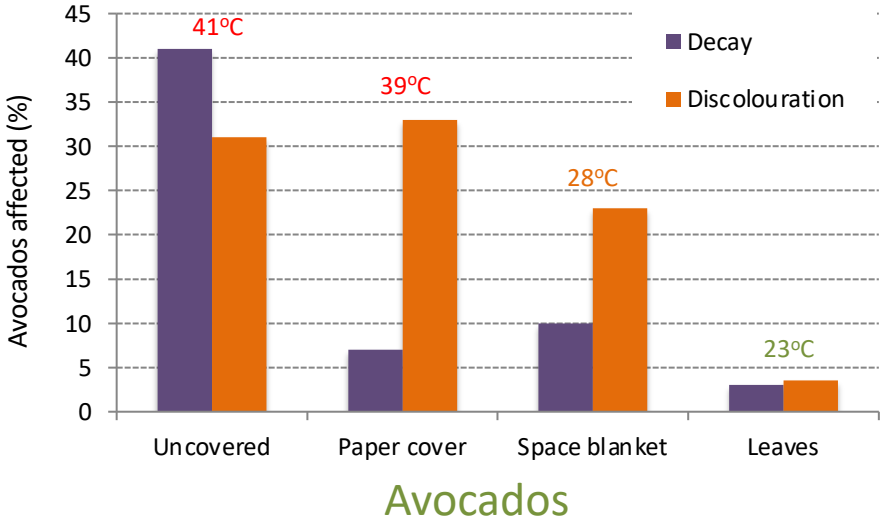
Harvest

Fruit left in the field have increased rots and discolouration



Broccoli left in the field can lose 6% weight in only a few hours

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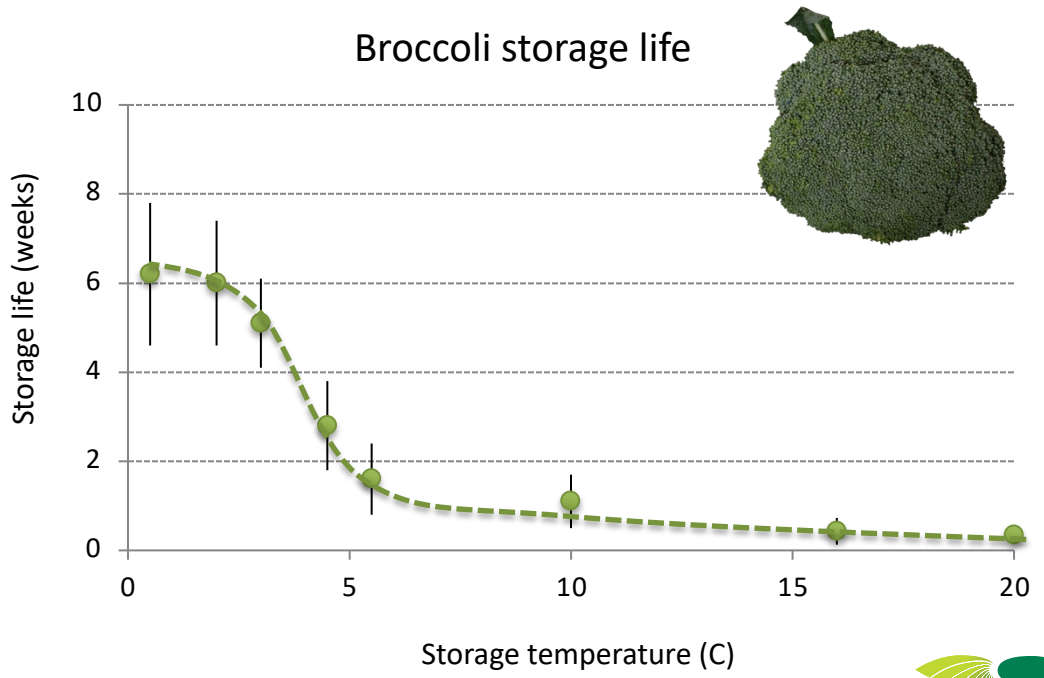
Temperature determines storage life

Temperatures below 5°C can have a big impact on storage life, especially if products are ethylene sensitive



But colder is not *always* better

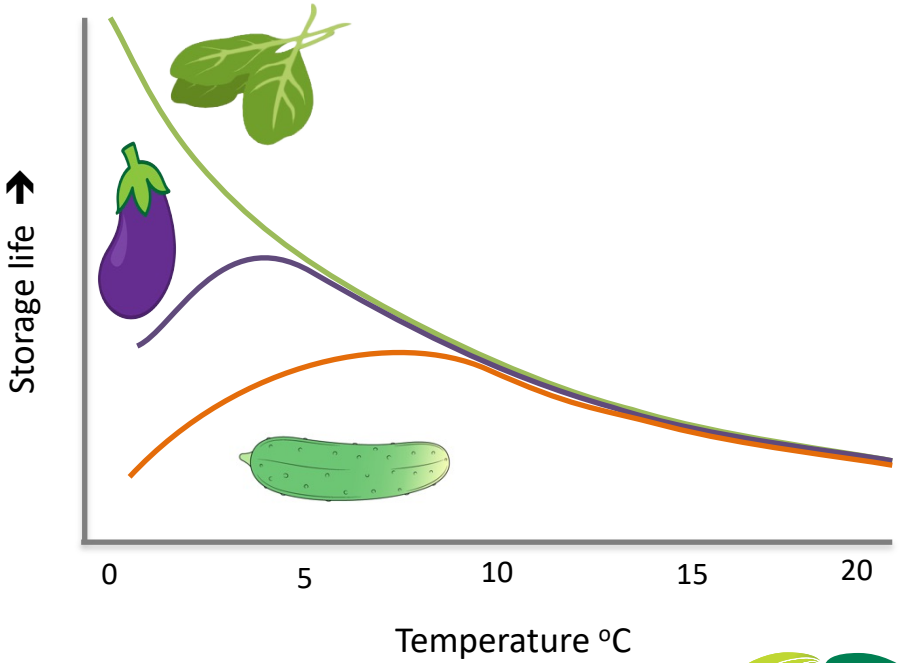
Many products from warm climates are damaged by cold temperatures

Chilling injury symptoms include

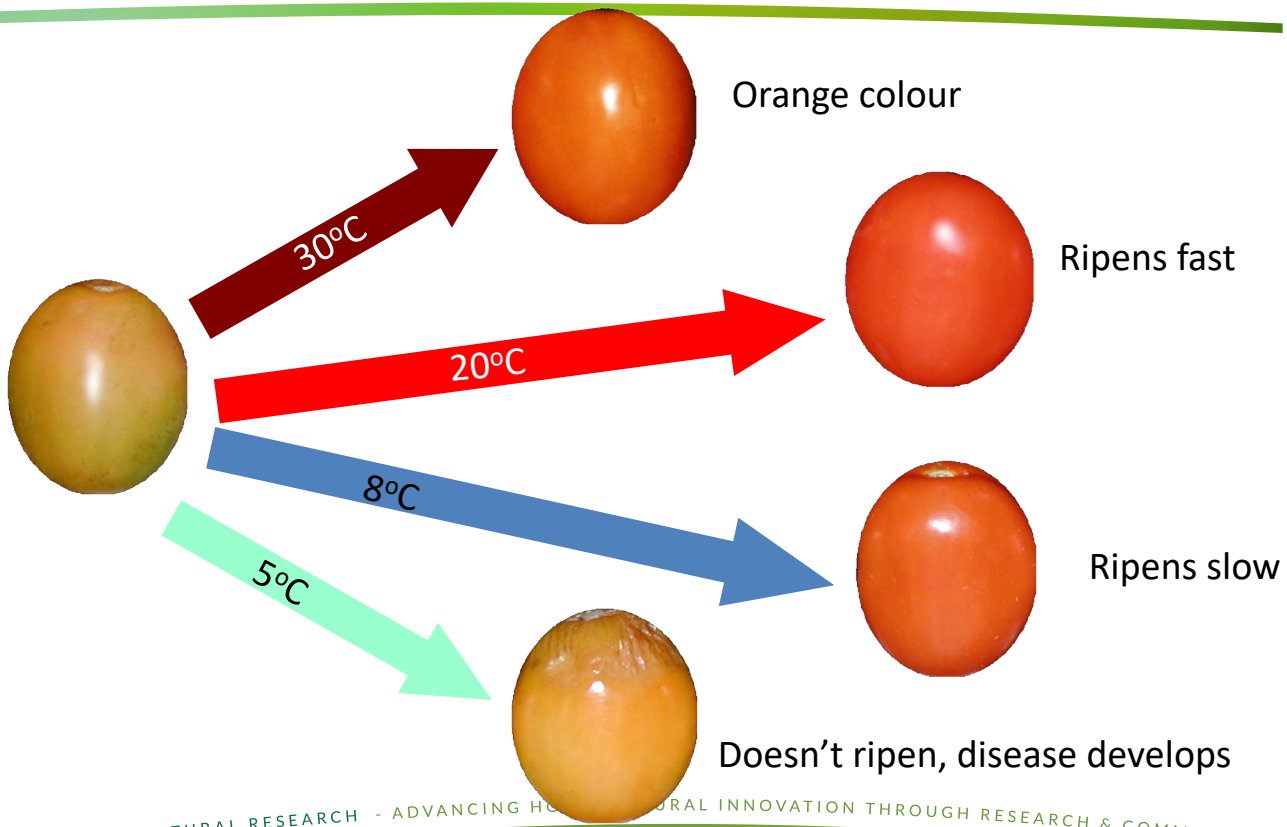
- Pitting
- Rots
- Water loss
- Discolouration

Chilling injury is a function of both TIME and TEMPERATURE

- Short exposures to chilling temperatures won't affect quality



Optimum temperatures



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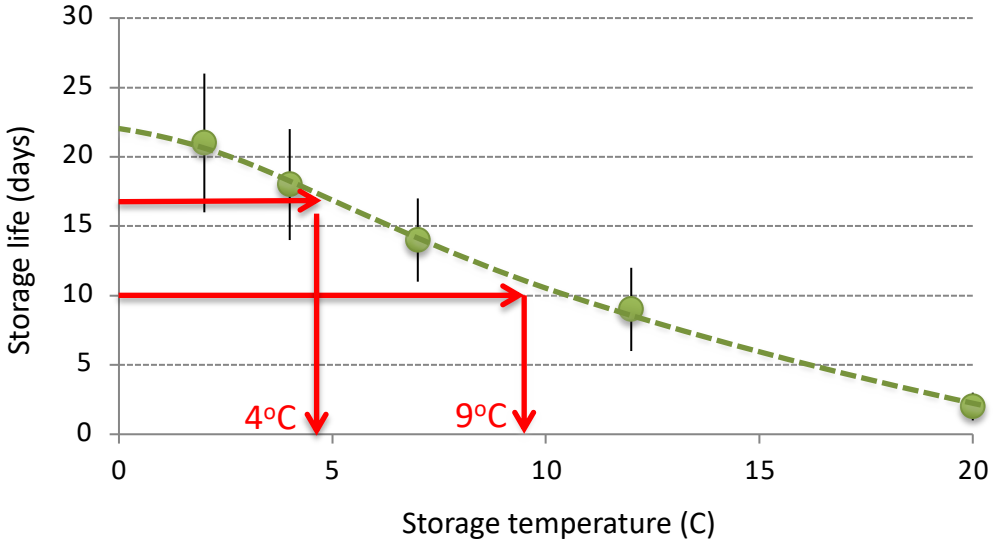
Temperature and storage life

Low temperatures extend storage life, but how much storage life do you need?

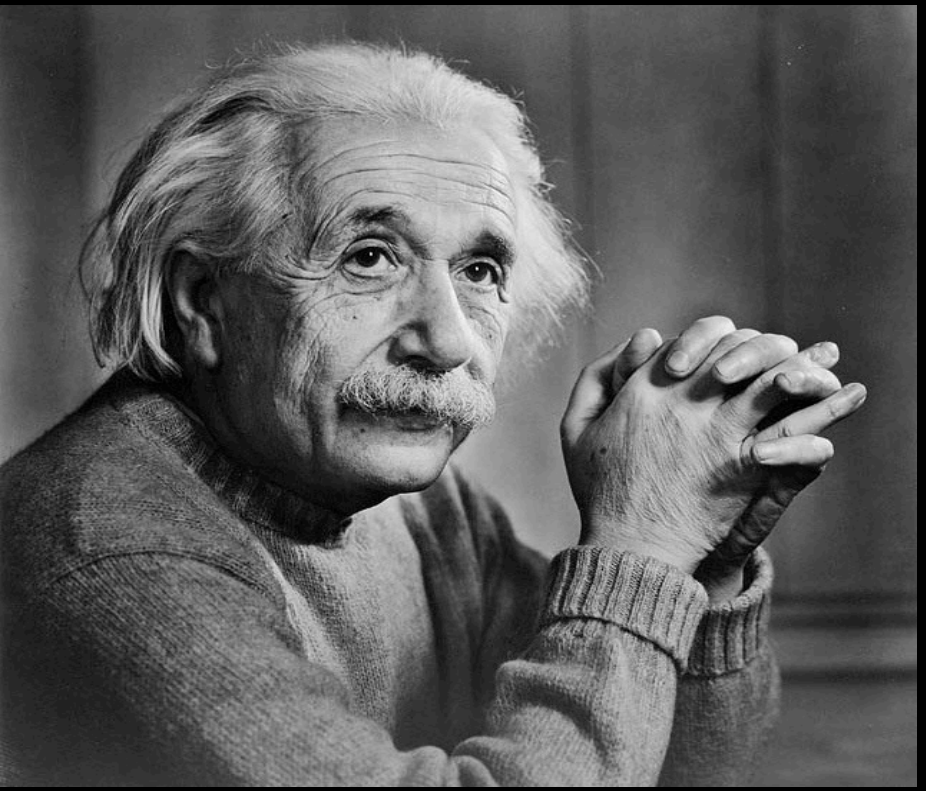
Temperature and storage life

Temperature determines storage life BUT there are often diminishing returns…

How long does storage life need to be???



What is cooling?



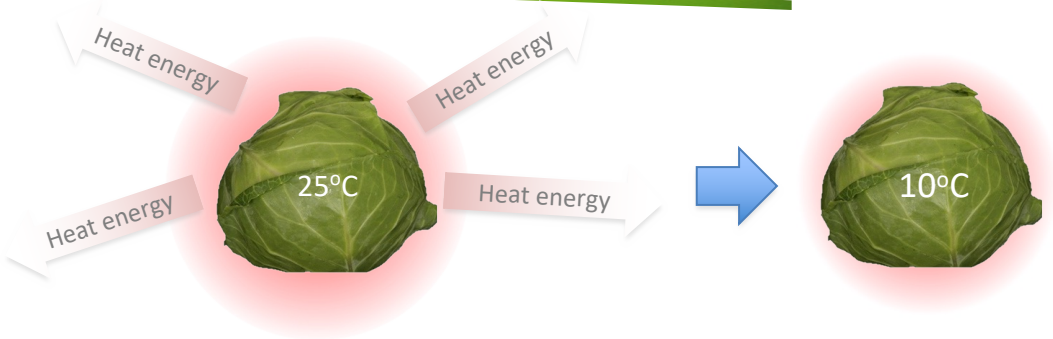
“Energy cannot be created or destroyed, it can only be changed from one form to another.”

What is cooling?

DEMONSTRATION

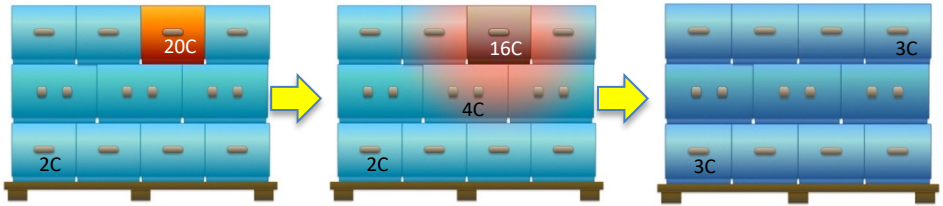
HEAT is thermal energy

COOLING involves moving thermal energy elsewhere



Into air

Into water



Into other products

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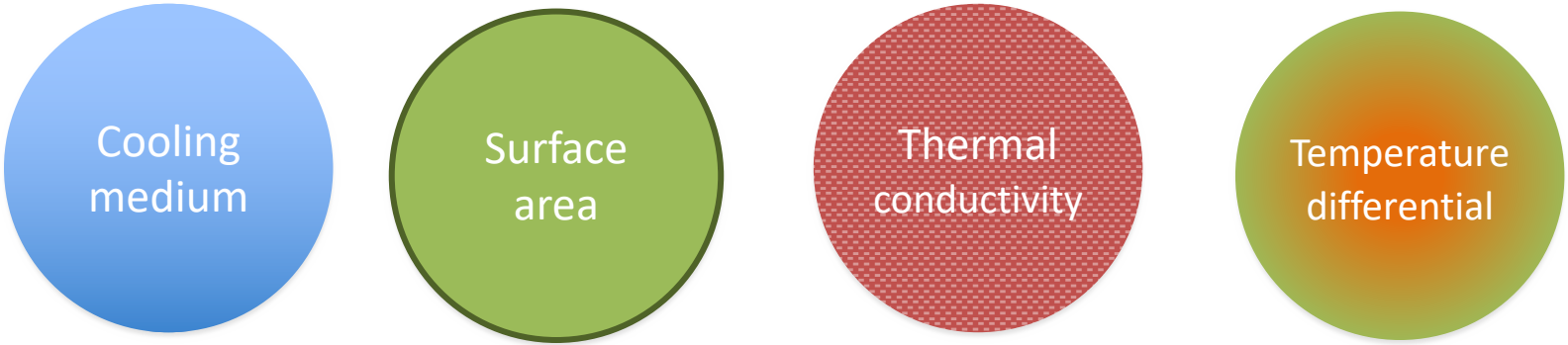
Cooling

How quickly products cool depends on:



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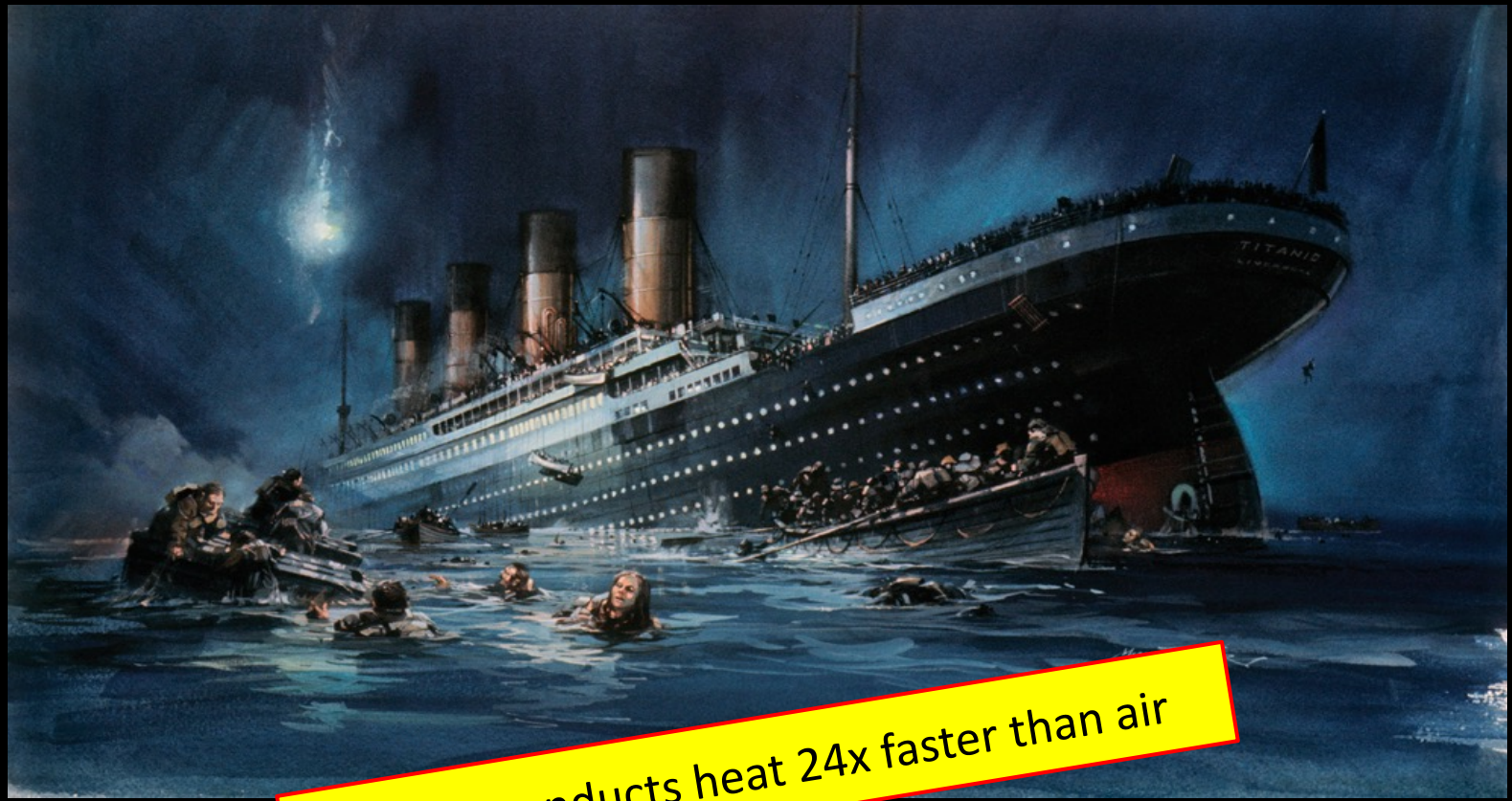
Air is a poor conductor of heat

-20°C

Water is a better conductor of heat



Water conducts heat 24x faster than air

Energy transfer

Heat is transferred from the surface of the product into the cooling medium

Slowly, if you are a walrus

Quickly, if you are a desert fox

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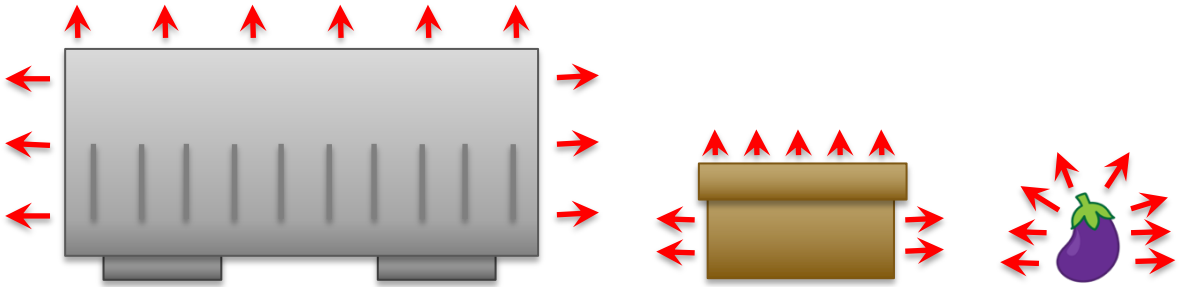
Surface area

- The surface area is the area of contact between the cooling medium and the product
  - Packed in a bin – effective surface area is the outside of the bin; compared to volume it's **small**
  - Packed in a carton – effective surface area is the outside of carton
  - Single item – surface area relative to volume is **large**

Forced air cooling systems increase the effective surface area



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Thermal conductivity

- Thermal conductivity determines how quickly heat can be removed from a fruit or vegetable
  - Structure
  - Physical properties

Which product will cool the **fastest**?
Which one will cool the **slowest**?

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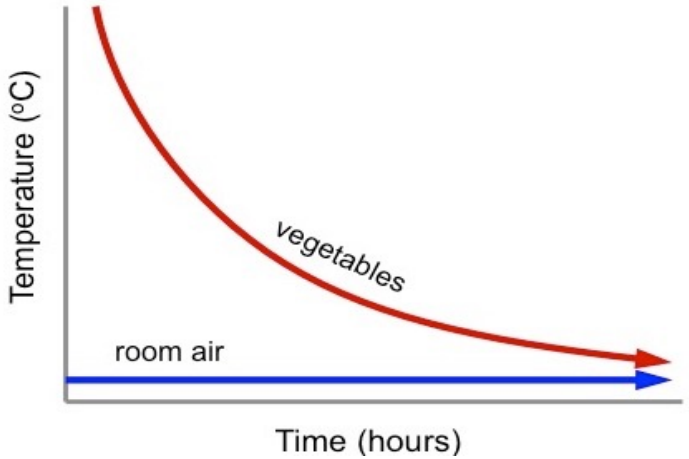
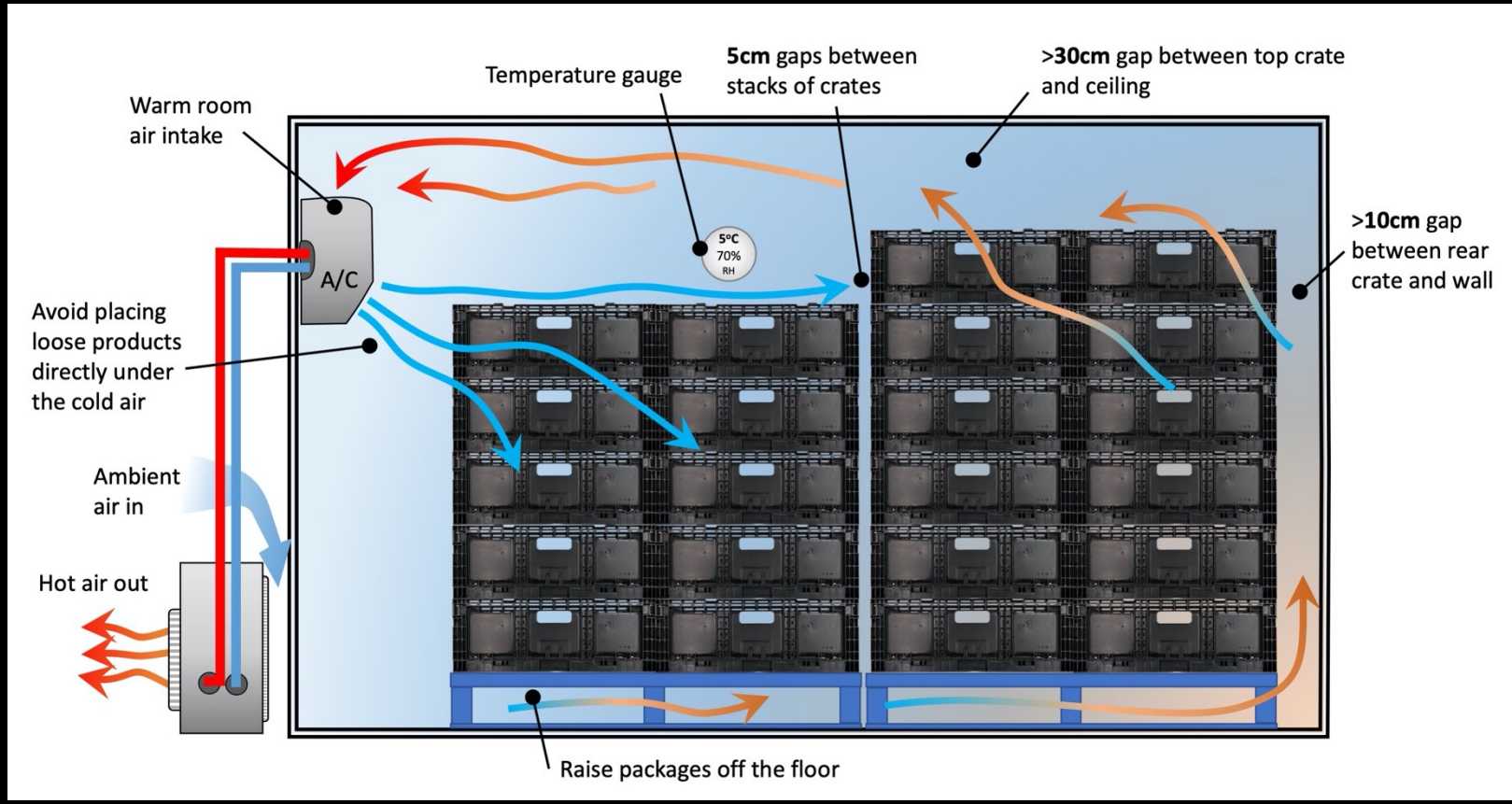
Temperature differential

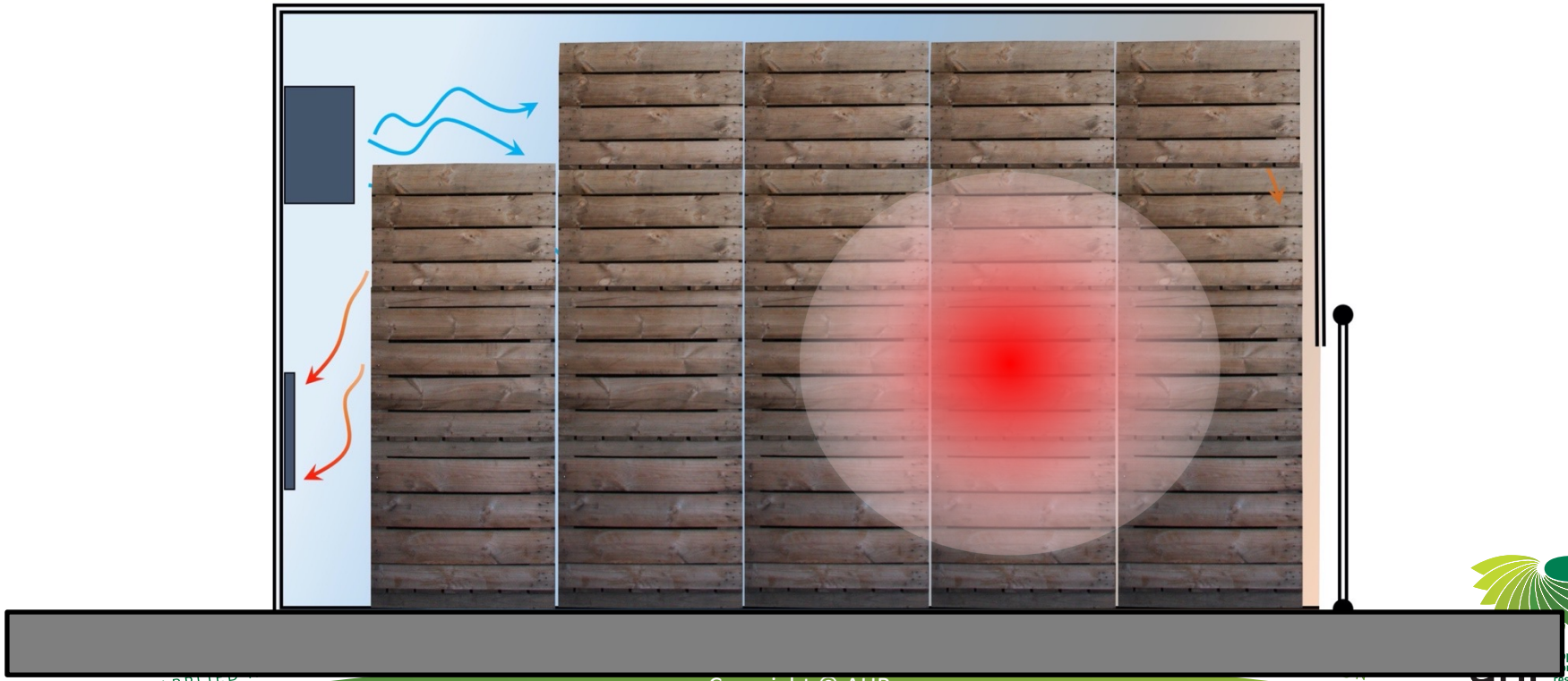
- Products cool fastest when there is a big differential between them and the cooling medium
  - As they approach the setpoint they cool more slowly
  - This makes it hard to determine exactly when a product has fully cooled



For cool rooms to operate effectively, there needs to be good air circulation around and through the product



Air needs to remove respiration heat



In summary

Fruit and vegetables are **ALIVE**

They respond to, and interact with, their environment

Avoiding damage during harvest is essential for good quality

Temperature is the most important factor affecting storage life

Cooling involves moving heat energy into air or water

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