



SESSION 4

How can we use simple machines to improve air quality in the dairy shed?



What is going on here?



Ventilation - the provision of fresh air to a room or building

- Why is **ventilation** important for us?
- Why do you think that **ventilation** is important for cows?

air

oxygen

carbon dioxide

mixture

fresh

temperature

stale

hygiene

harmful

breathe

humidity

water vapour

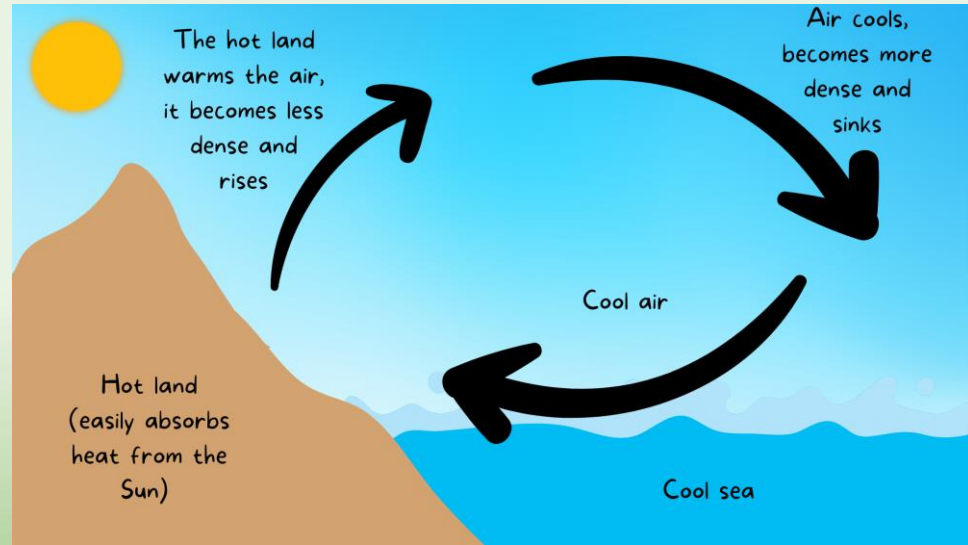
essential

flow

health

Why does air move around?

- Air is a **mixture** of gases that are always on the move.
- When gases have a **higher temperature** the particles are moving around quickly and they are more spread out.
- When gases are **cooler**, the particles move more slowly and are **closer together**.
- Warm air is less **dense** and rises. Cooler air is more **dense** and sinks.



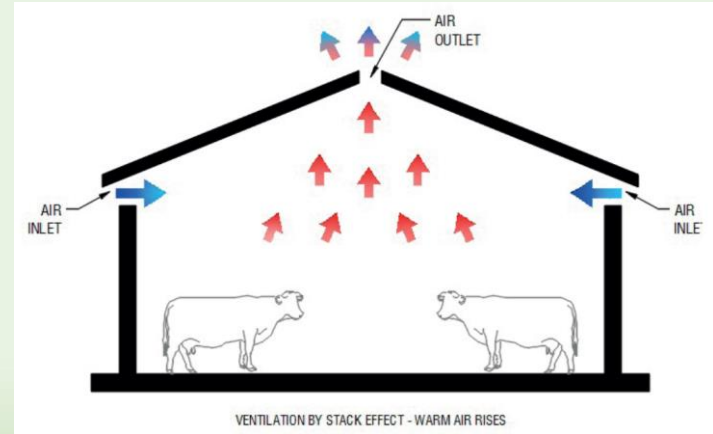
This is why we have sea breezes and why there is wind.



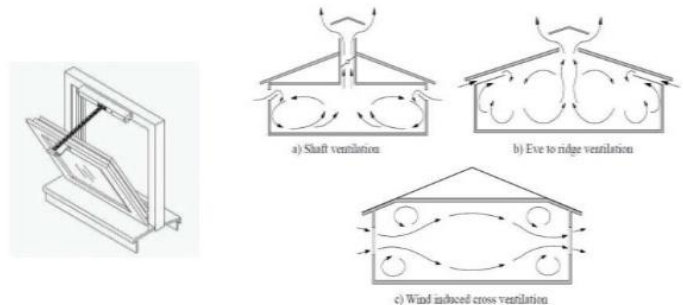
What is natural ventilation?

Natural ventilation is a method of supplying fresh air to a building by making use of the wind or differences in air temperature inside and outside the building.

There needs to be **inlets** to draw in cool, clean air from outside. There also needs to be **outlets** so the less dense, warmer stale air that rises upwards can escape.



Natural ventilation





- What are important things to think about when thinking about ventilation in a barn?
- Why is poor ventilation bad for the dairy cows?



Mechanisms for living Challenge

What's the farmer's problem?

"I need to improve the air quality in my barn as there is no where for the stale air to escape in the roof."

Available resources:

- Shoe box (representing the barn)
- Additional cardboard
- Wooden skewers/chopsticks/cocktail sticks/lolly sticks
- plastic tubes/cotton reels
- string/splitpins
- scissors/ tape/ craft knife/ cutting board

The engineering design task

Can you create a simple mechanism to allow the farmer to open and close outlets on the roof to improve natural ventilation?

Good ventilation is essential for the health and well being of dairy cows housed in a barn. Keeping clean air circulating helps keep the cows comfortable and helps to prevent the spread of infection. Natural ventilation methods are low cost and more sustainable.

Top tips to get started:

Will your outlet vents be opaque or transparent to also let in light?

Think about the simple machines you have I would be most useful for transferring a force

How could turning cams be used to lift and lower would they need to be positioned in the dairy farmer turn the cams?

How could a pulley be used to lift and lower structures might need to be added to make

What is the design brief?

Create a working prototype of a mechanism that incorporates simple machines such as pulleys, cams and levers to open and close ventilation outlets in the roof of the dairy barn.

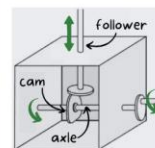
The mechanism should:

- be able to be **operated by one person** who is **stood at floor level** in the dairy barn.
- the operator should be able to **apply a force** to the mechanism to both **open and close** outlet vents or windows in the roof of the building.
- The mechanism should use **cams and/or pulleys** to lift and lower the outlet vents or windows.
- the prototype should work in collaboration with **well positioned inlet vents** in the dairy barn design that draws in clean, cooler air.

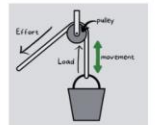
Create a prototype of a simple mechanism to open and close outlets in the roof of a dairy barn.

Mechanisms for living Challenge

Background information:

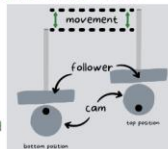


A cam changes a **rotating movement** into an **up and down movement**. If an **effort force** is applied to turn the cam, the follower will apply a force to lift and lower the load that rests on the top.



A single **pulley** changes the direction of force, making pulling down easier than lifting up. It doesn't increase the effect of the effort force but it can make it easier to apply a force when it is needed in a difficult to reach location.

A **cam** mechanism has two main parts: a **cam**, attached to a **crankshaft** or **axle**, which rotates and a **follower** which touches the cam and follows the shape, moving up and down. Changing the shape of the cam changes the way the follower moves.



Glossary:

Outlet - a vent installed in buildings to allow stale air to leave the building.

Inlet - a vent installed in buildings to allow fresh air to be drawn into the building.

cam - a rotating piece in a mechanism that can turn rotating movement into linear movement.

follower - a piece of a mechanism that follows the movement of a cam.

axle - a rod or spindle passing through the centre of a wheel or cam.

pulley - a simple machine made from a wheel with a string or cord passed around the rim. It changes the direction of a force and is used to lift weights.

ventilation - the provision of fresh air into a room or building.

prototype - a first version of a device or mechanism from which other forms are developed.

More information and inspiration!

Take a look at this [video from NUSIEM](#) that shows different ways cams are used to make automata.

Want to take it further?

Can you adapt your design to be able to open the vent by different amounts to increase or decrease the flow of air?

The farmer should be able to fully open, partially open and close the outlet from the ground.

How well did you do?

Success Criteria	Score /5
Operated by one person	
Outlet vent can be opened and closed from the ground	
The outlet vent can be both opened and closed	
The mechanism uses cams and/or pulleys	
The design includes an inlet vent to draw in fresh air	

