



From Field to Food

What goes into
making beef and why



By the end of the lesson you should be able to...

- Describe what cattle eat.
- Illustrate energy transfer by cows in a graph or pie chart.
- Create a flow chart showing the process of digestion in a cow.
- Explain what carbon and water footprints are.
- Prioritise approaches that can be taken by consumers, scientists and farmers to reduce the environmental impact of producing beef.

What goes into making a beef sandwich?



What goes into making a beef sandwich?

- Bread: wheat, salt, yeast
- Butter
- Beef

And what went into making the beef?



Can you name the breeds of these five cows?

Do you think they are used for beef or dairy?



Aberdeen Angus Beef



Ayrshire Dairy



Jersey Dairy



British White

This is a trick... It's dairy and beef!



Belted Galloway Beef



What do beef cattle eat?

- Cattle eat different amounts of grass, silage and concentrate food
- Their diets have two main parts

Grass

including silage
(fermented grass)



Pellets of concentrated plant-material

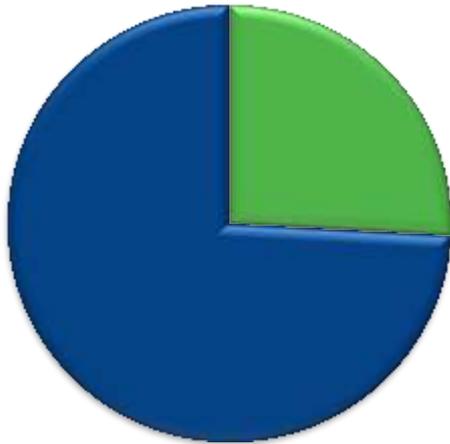
contents include grains,
oilseed rape and minerals



What are cattle fed in the UK?

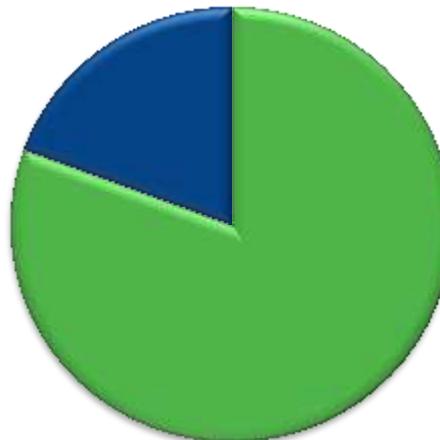
There are three common methods that use different ratios of feed when raising the cattle:

- Grass, including silage
- Concentrated feed pellets



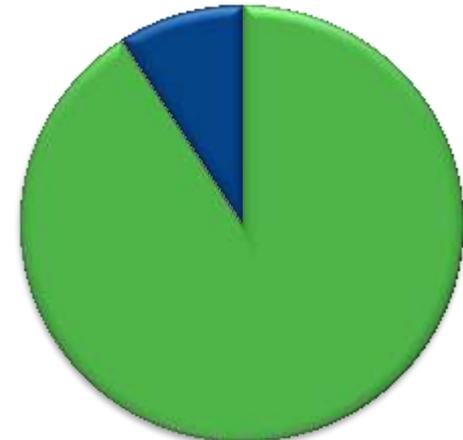
Intensive Beef Production:

- Fed high concentrate levels
- Silage or straw added to mainly aid digestion
- This production is fastest



18 Month Beef Production:

- Developed so that male calves from dairy herds could be used for meat
- Growth depends on having high-quality silage

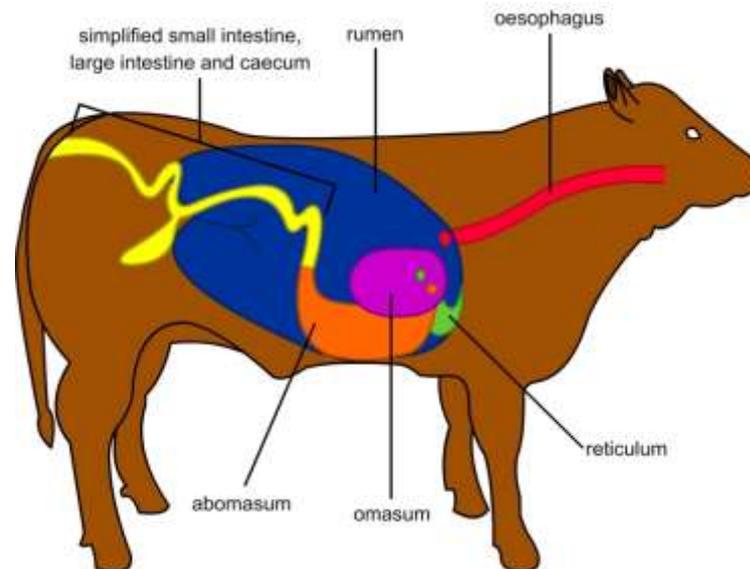


Grass Beef Production:

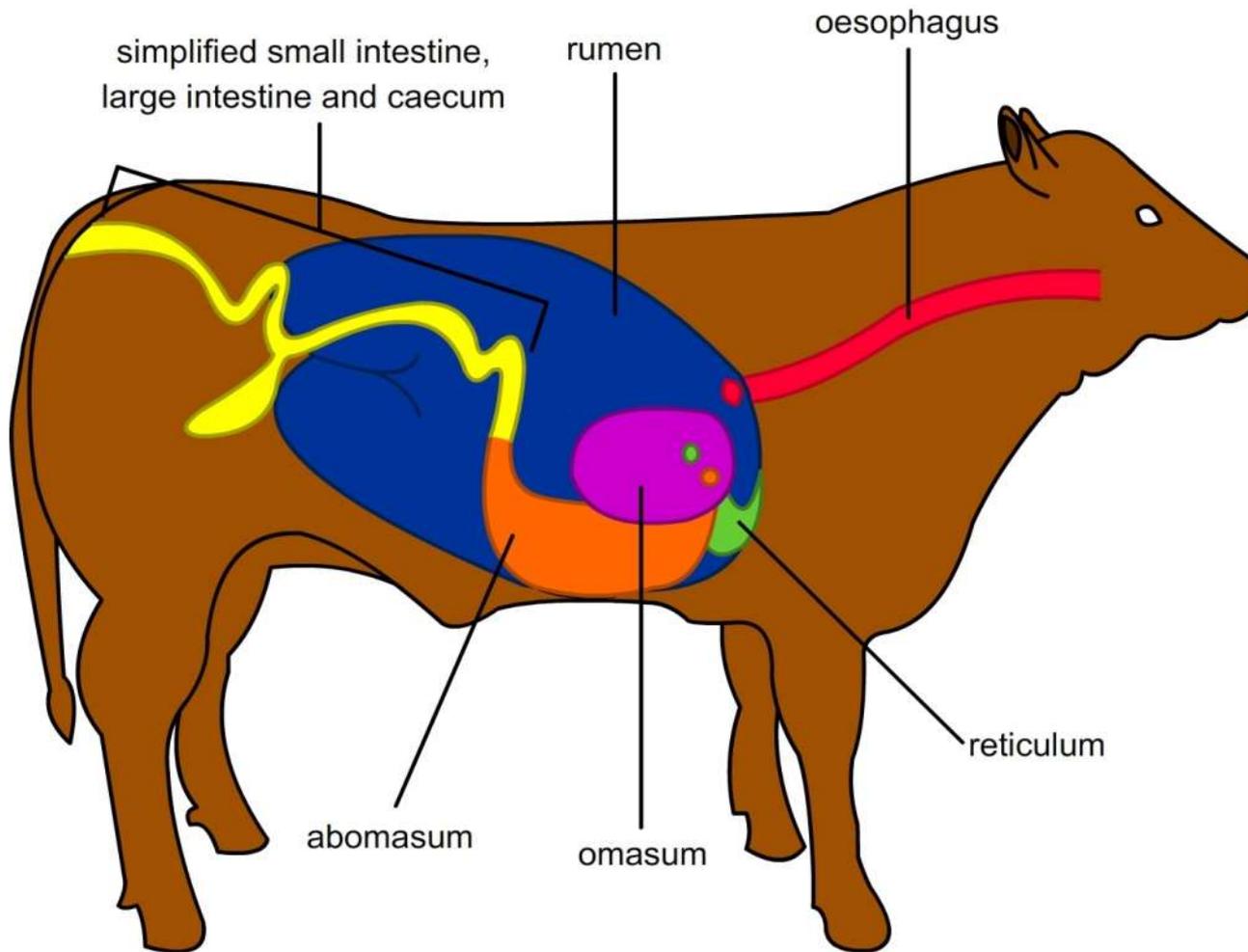
- These eat primarily grass to fatten them up in the summer
- This production takes a longer time

How do cattle digest food?

- Cattle have huge stomachs with four different areas - the rumen, reticulum, omasum and abomasum.
- The rumen is the first part of the stomach, where microorganisms digest cellulose from plant cell walls.
- Fermentation in the rumen produces methane which is released in burps. It is a greenhouse gas.
- The rumen can contain up to 100 litres of water!



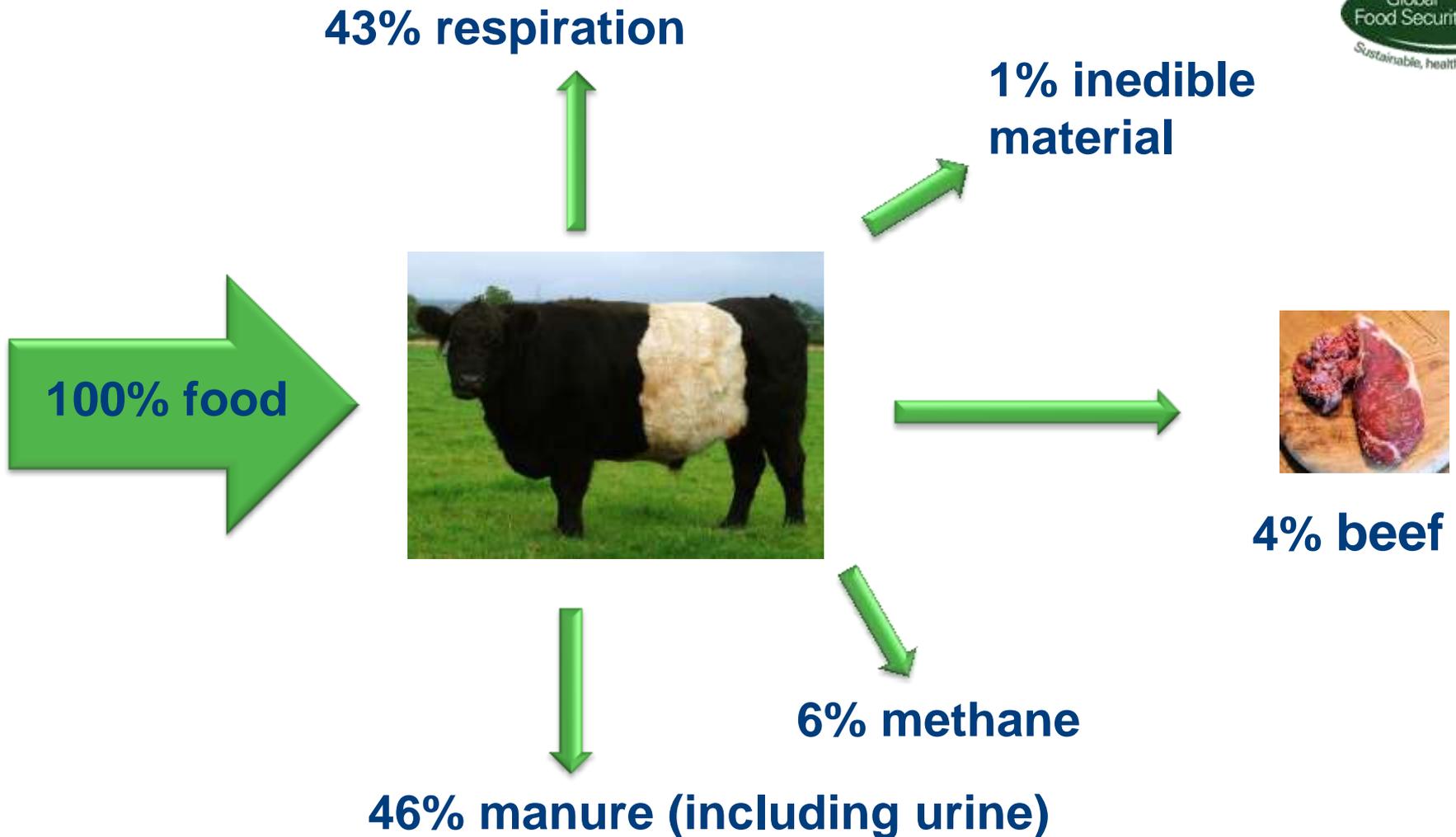
How do cattle digest food?



How do cattle digest food?

- Once digestion has started in the rumen, cows regurgitate larger food particles and '**chew the cud**'.
- This **breaks open cells** in the plants eaten by the cow, giving a bigger surface area for the microbes to act on.
- Food is returned to the rumen for the bacteria to carry out more **fermentation of the cellulose** and other carbohydrates.
- This produces fatty acids, and these are **absorbed** to supply the cow with most of its energy.
- The food then moves through the **other three regions** of the stomach.
- When the food reaches the **small intestine** digestion and absorption of nutrients is completed.

What happens to the energy?



Cattle need food, but what else?

Water
Shelter
Land
Medicine
Transport



Do cattle need friends?

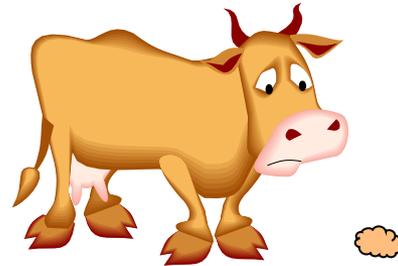
Yes! Scientists at Northampton University showed that when a cow was separated from a herd companion, their heart rate and stress levels increased, but then returned to normal when reunited with their companion.

What is a carbon footprint?

- Carbon Footprint: measures the total greenhouse gas (GHGs) emissions caused directly and indirectly by a person, organisation, event or product.
- Measured in tonnes or kilograms of carbon dioxide equivalent.
- This is the equivalent concentration of the CO₂ needed to cause the same atmospheric damage as a corresponding unit of another gas, such as methane.

What contributes to the carbon footprint of beef?

- Farm machinery
- Making pesticides and fertilisers for crops
- Methane emissions from burps



- Processing, refrigeration and cooking of meat
- Transport of crops, feed, animals, meat

What is the carbon footprint of 1kg of beef?

1 kg beef



12.65 kg CO₂
equivalent

What is a water footprint?

Water Footprint: total volume of water needed to make a product or is consumed in a process.

- Measured in litres, where 1 litre is 1000ml

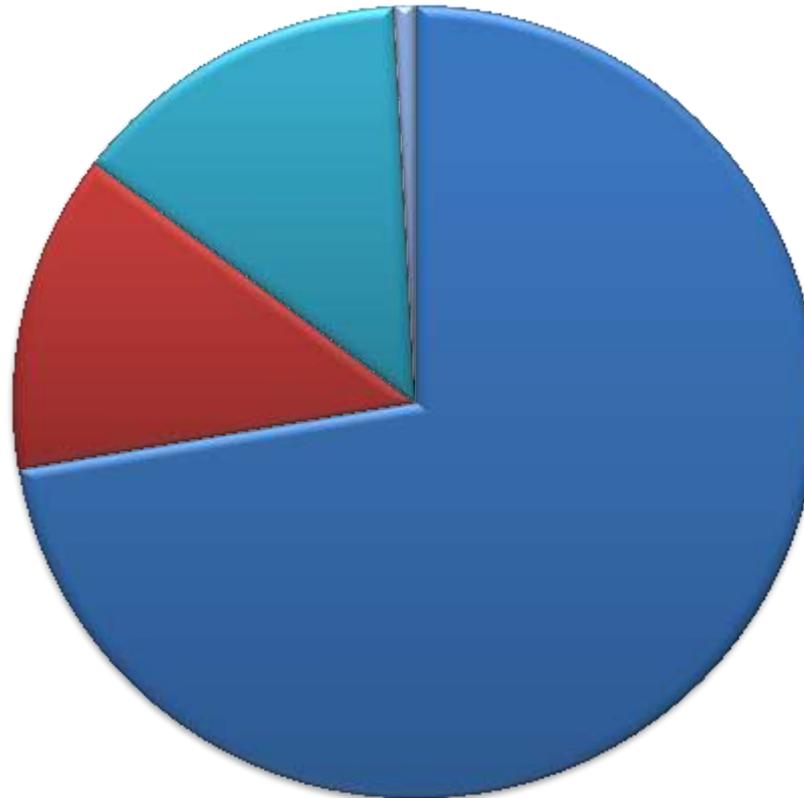
What makes up a water footprint?



Water in plants that cattle eat
Water for the cattle to drink
Water to irrigate crops
Water for mixing or making feed



What makes up the water footprint of beef?

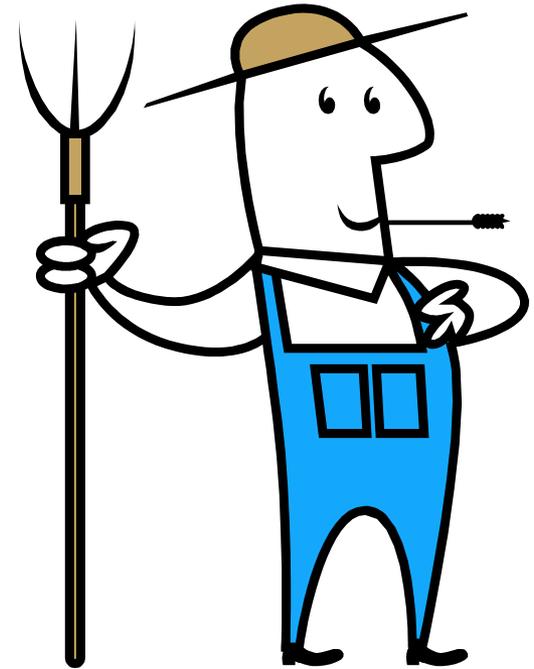


- Grass including silage
- Concentrate
- Other feed crop components
- Water for feed mixing
- Drinking water

**Total
water =
13,000
litres per
kg of beef**

How can these figures be reduced by farmers?

- Selectively breed for desirable characteristics in cattle, such as producing less methane.
- Good animal husbandry and farm management, such as maintaining water pipes so they don't leak, controlling their feed supply and feeding efficiently.



How can these figures be **reduced** by scientists?

- Designing new animal concentrate feed that reduces methane emissions.
- Plant breeding to improve crops for cattle to eat (including grass and clover).
- Work with farmers to ensure that new technologies are put into use.
- Design production systems which provide consumers with products they want.



How can these figures be reduced by us, the consumers?

- Reduce the amount of red meat we eat – we should only have 70g a day as part of a healthy diet
- Store and use meat correctly to minimise waste
- Eat other meats, such as chicken, that have smaller water and carbon footprints



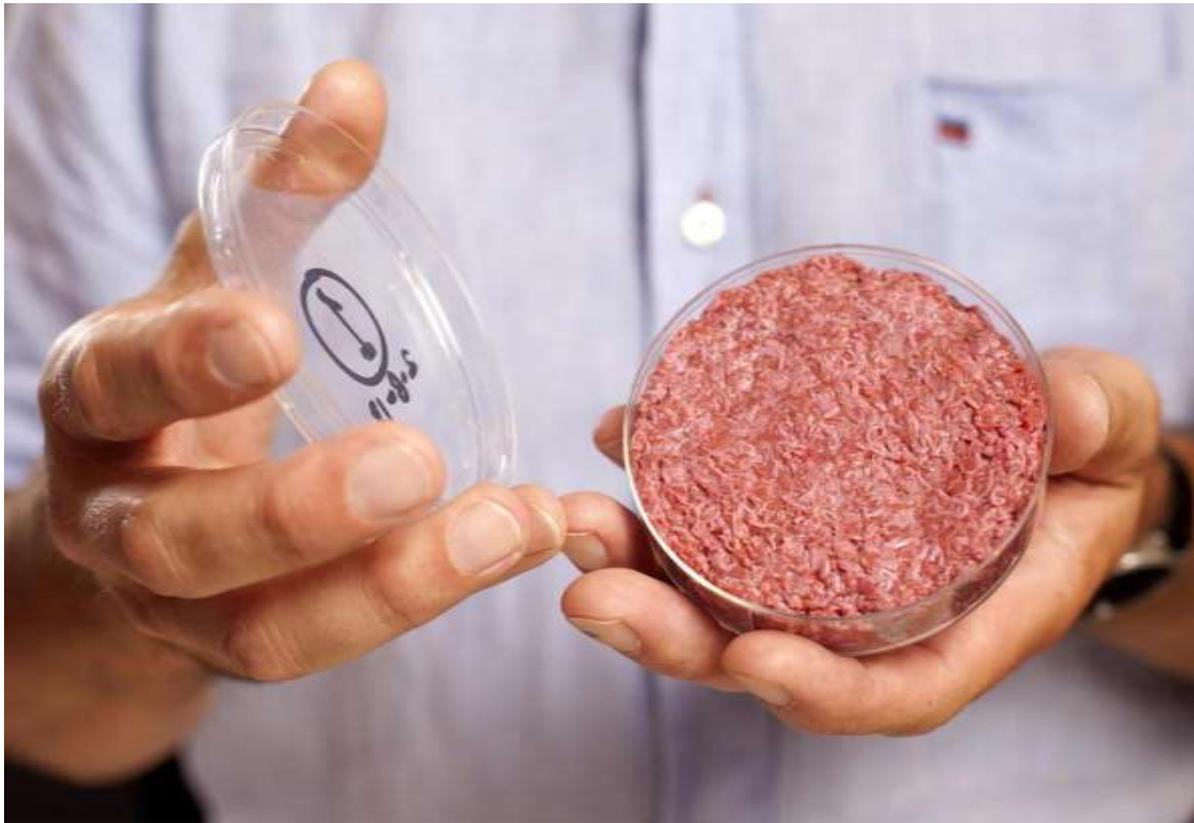
Water footprint:
4,300 litres per kg
Carbon footprint:
6.9 CO₂e



Water footprint:
6,000 litres per kg
Carbon footprint:
12.1 CO₂e



Water footprint:
2,497 litres per kg
Carbon footprint:
2.7 CO₂e



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Is this the future of beef production?

Synthetic meat

Cells extracted from two cows were used to grow 20,000 new muscle cells. These were moulded together, cemented with breadcrumbs and binding agents, coloured with saffron and beetroot juice, and made into a burger costing 250,000 euros.



- Could this be more efficient than slaughtering cattle one day?
- Is this the solution to reducing the resources used to produce beef?
- Where should scientists stop – could we grow larger cuts to whole animals in the lab?
- What are the ethical issues surrounding this?

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