

# OBJECTIVES

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- × Know the structures found in prokaryotic cells, their functions and the differences from eukaryotic cells
- × Be able to understand some factors relating to the causes and prevention of cholera

## Success criteria

- Be able to annotate diagram with correct adaptations
- Be able to answer worksheet questions on function of small intestine

# STARTER

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- ✘ In 5 minutes – sketch down as much as you can about the structure and function of an animal or plant cell

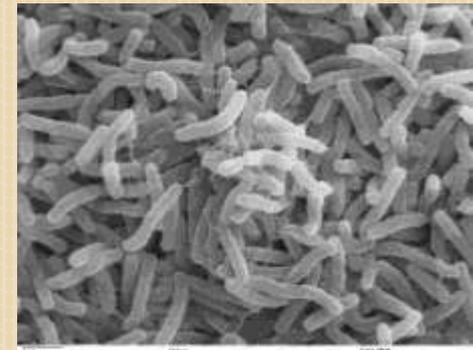
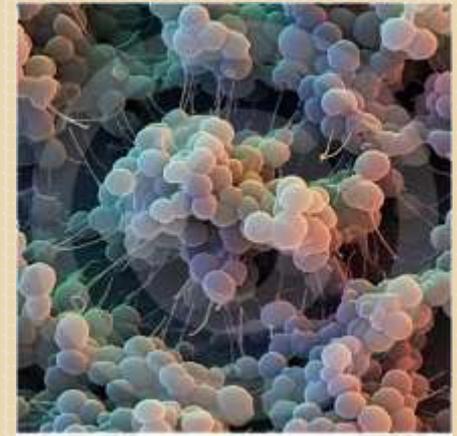
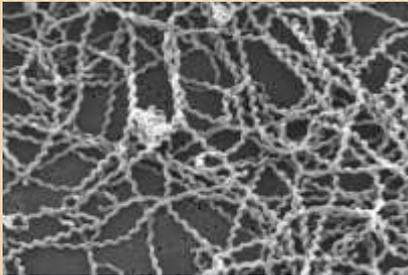
# Eukaryotic and prokaryotic cells

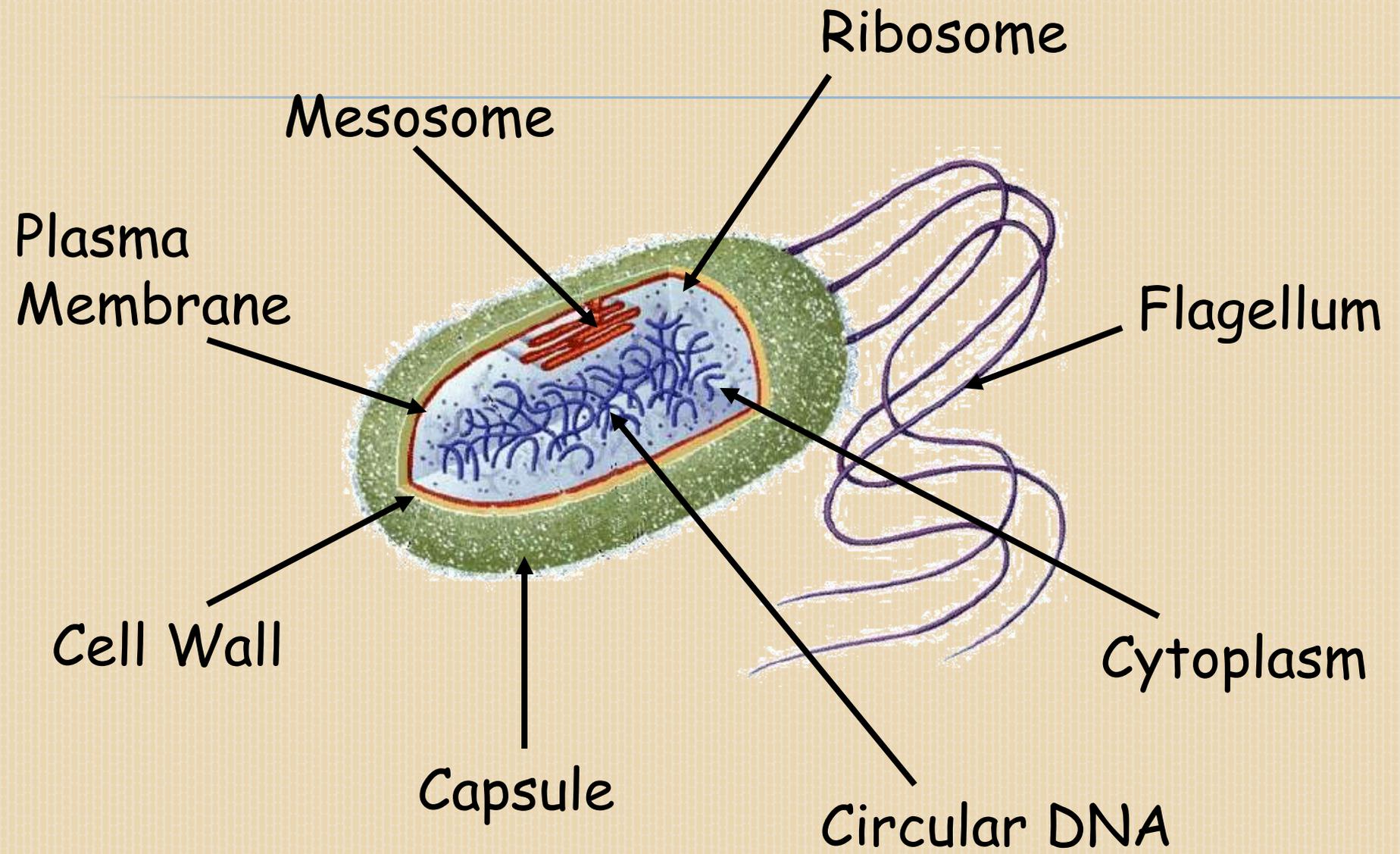
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- × Eukaryotic – animals, plants, fungi, protocista
- × Prokaryotic - bacteria

# PROKARYOTIC CELLS - BACTERIA

- ✘ Bacteria occur in every habitat in the world, they are versatile, adaptable and very successful.





# Bacterial cell structures (1)

Cell structure	Function of structure
<b>Capsule (slime layer)</b> A thick polysaccharide layer outside of the cell wall.	<ul style="list-style-type: none"><li>• Sticks cells together</li><li>• Food reserve</li><li>• Protection against desiccation and chemicals</li><li>• Protection against phagocytosis</li></ul>

# Bacterial cell structures (2)

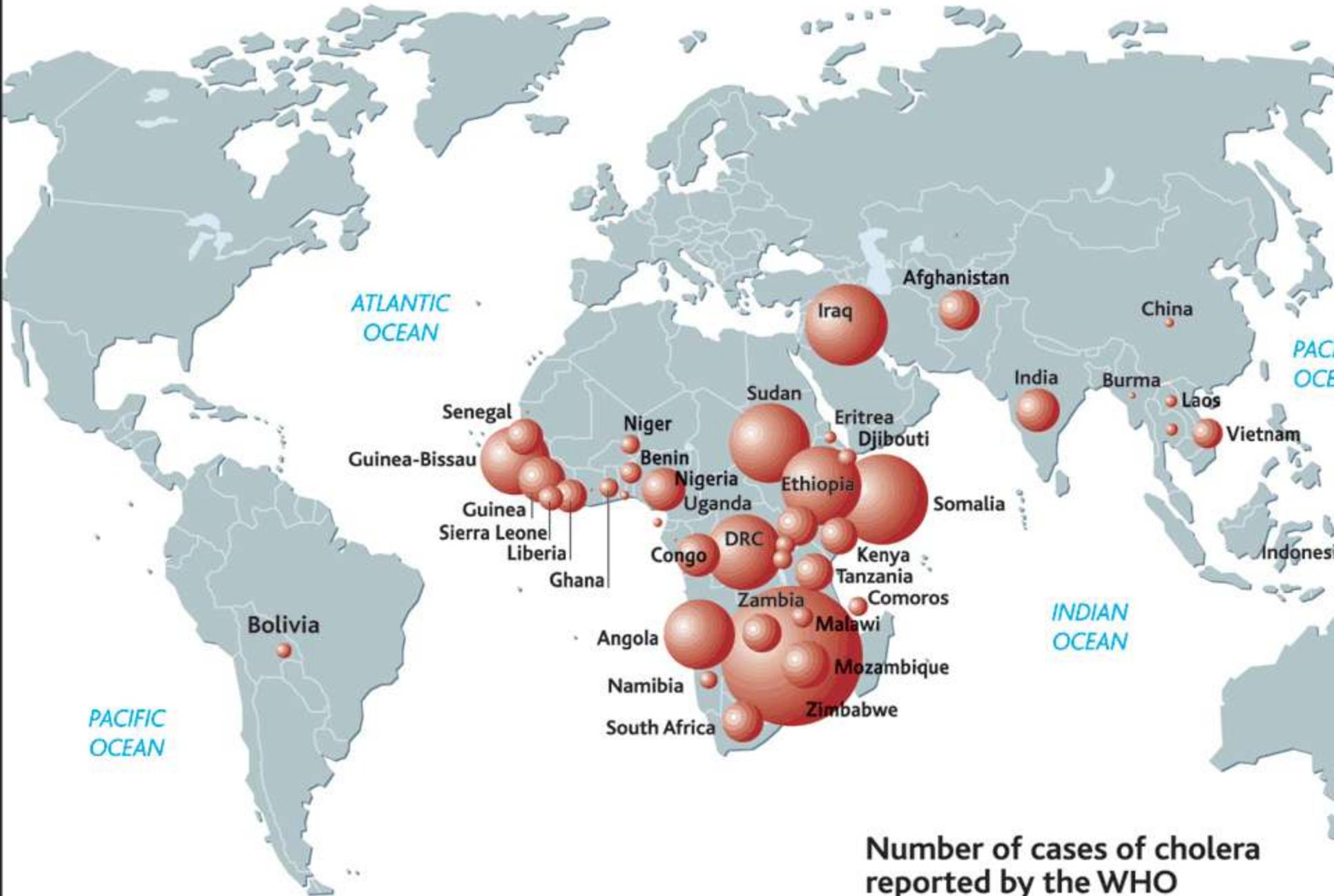
Cell structure	Function of structure
<b>Ribosomes</b> A smaller type (70S) The difference between prokaryotic (70s) and eukaryotic (80s) ribosomes allows <b>antibiotics</b> to selectively target the prokaryotic ribosomes while sparing eukaryotic ribosomes.	<ul style="list-style-type: none"><li>• Protein synthesis</li></ul>
<b>Circular strand of DNA (nucleoid DNA)</b> Diffuse area of DNA – no nuclear envelope <b>[THERE IS NO NUCLEUS]</b>	<ul style="list-style-type: none"><li>• Codes the genetic information for replication of cells</li></ul>
<b>Plasmid</b> Smaller circular pieces of DNA	<ul style="list-style-type: none"><li>• Plasmids can reproduce themselves independently</li><li>• Give bacterium resistance to harmful substances e.g. Antibiotics</li><li>• Used as vectors (i.e. Carriers of DNA) in genetic engineering</li></ul>
<b>Pilus</b> (pili – pl) ( <b>frimbria</b> / fimbriae)	<ul style="list-style-type: none"><li>• Allow bacterium to stick to other cells</li></ul>

# HOMEWORK

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- × Prepare a table of comparison of eukaryotic and prokaryotic cells
- × P. 65 of textbook
- × Out of what we have learnt so far this term:
  - + Write down on a small piece of paper 3 things (in order of importance) that you'd like to revise again in class
  - + Write down anything you feel you definitely don't want extra help with revising

# Cholera across the world



Number of cases of cholera reported by the WHO between 2007 and 2009

# WHAT DOES IT DO?

- ✘ The primary symptoms of cholera are profuse painless diarrhoea and vomiting of clear fluid, which leads to dehydration.
- ✘ An untreated person with cholera may produce 10–20 litres of diarrhoea a day with fatal results.
- ✘ For every symptomatic person there are 3 to 100 people who get the infection but remain asymptomatic.



# Diarrhoea and world mortality statistics

Low-income countries	Deaths in millions	% of deaths
Lower respiratory infections	1.05	11.3%
Diarrhoeal diseases	0.76	8.2%
HIV/AIDS	0.72	7.8%
Ischaemic heart disease	0.57	6.1%
Malaria	0.48	5.2%
Stroke and other cerebrovascular disease	0.45	4.9%
Tuberculosis	0.40	4.3%
Prematurity and low birth weight	0.30	3.2%
Birth asphyxia and birth trauma	0.27	2.9%
Neonatal infections	0.24	2.6%

# SHORT CLIPS FROM KENYA & BANGLADESH

- Cholera is transmitted by food and water that is contaminated with infected faecal matter

## Why do you think cholera is such a problem in some parts of the world?

- × 1.1 billion people lack access to clean water i.e. 1 in 7
  - + .....something to think about next time you run a tap
- × Another 2.6 billion (over 1 in 3 people) don't have access to basic sanitation (e.g. toilet)
  - + ..... Something to think about next time you flush the toilet

<http://www.youtube.com/watch?v=h65tGO2tojQ> – min 0-1.5, minute 4.53 - -Kenya

[http://www.youtube.com/watch?v=skgZD\\_Bs5r4&feature=pyv&ad=8423691477&kw=water](http://www.youtube.com/watch?v=skgZD_Bs5r4&feature=pyv&ad=8423691477&kw=water)

- Min 0-1.5, min 7, min 8.27 - - Dhaka, Bangladesh

# WHAT IS RESPONSIBLE?



- *Vibrio cholerae*
  - A curved rod shaped bacterium with a flagellum.

# DEBATE.....Provision of bottle formula for babies

- × Why do you think breast-fed babies are less likely to get cholera even in unsanitary conditions?
- × “Bottle formula should be universally available to buy over-the-counter” Debate for and against
- × Key points:
  - + WHO - says there should be no general distribution - should be under medical supervision
    - When women stressed - can still breast feed
    - baby milk lacks antibodies
    - Often don't use enough powder to make last longer - under-nourishment
    - black market selling - problem with aid
  - + BUT what about:
    - People who can't afford medical attention
    - No mother or mother severely injured
    - mother has HIV though are drugs
    - Mother severely injured
    - Child cannot breastfeed
    - Mother's right to choose
  - Perhaps better awareness is necessary?

# PLENARY

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× In pairs:

- + Suggest three ways that the spread of cholera might be limited
- + Suggest why there may be problems implementing methods to limit the spread

# CHOLERA BACTERIA AND ORAL REHYDRATION

## × OBJECTIVES

- + Understand how the Cholera bacterium causes disease
- + Understand how oral rehydration therapy works

## × SUCCESS CRITERIA

- + Correctly answer questions relating to Cholera bacteria and cell water potential
- + Be able to describe action of oral rehydration solutions

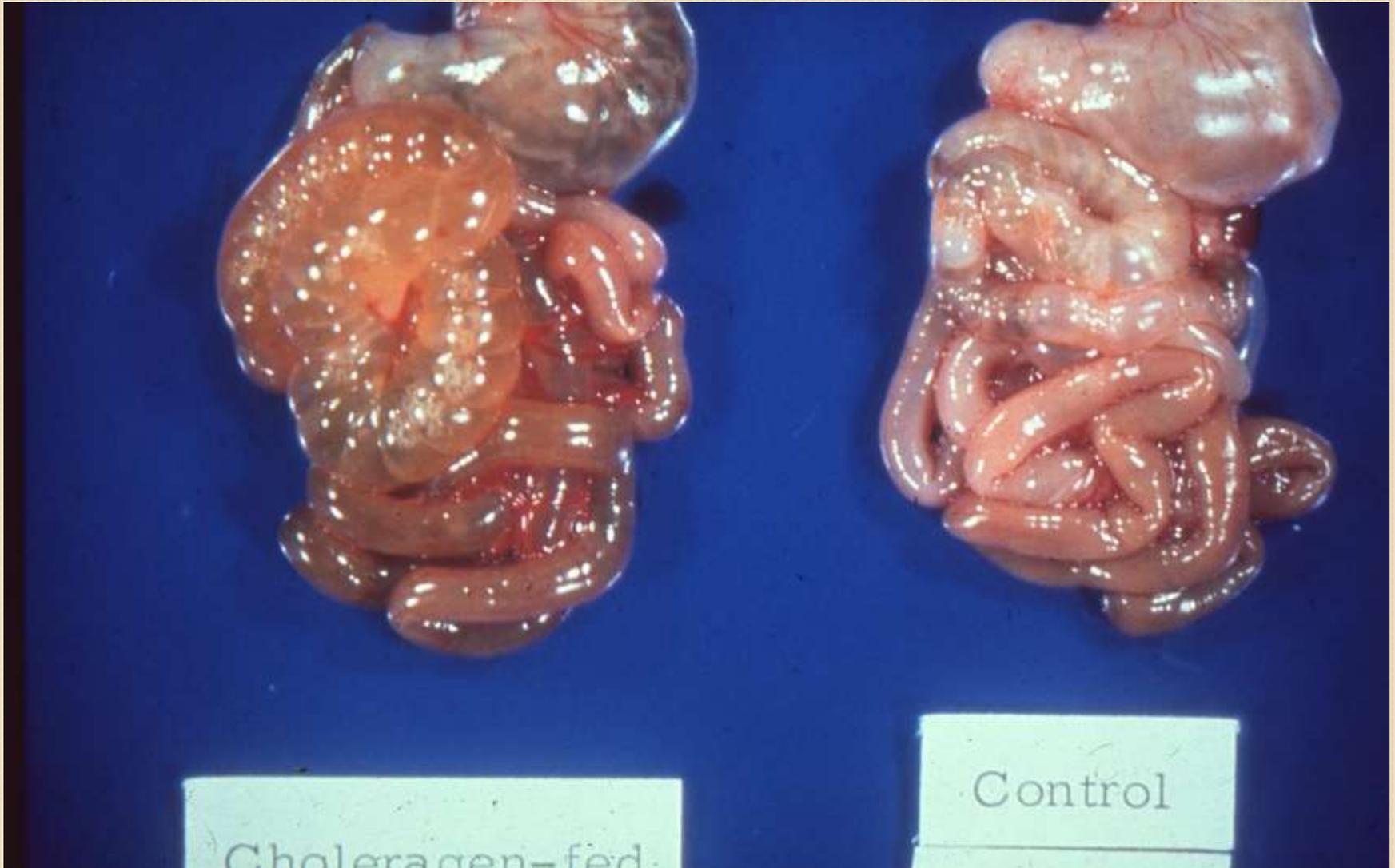
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- × Homework....tables – check.
  - × Development areas – hand in.

# STARTER

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- ✘ Write out in 3 points or less the co-transport process for the absorption of glucose involving the sodium-potassium pump.
- ✘ Start which parts are active and passive.
  - + 1) Sodium ions moves out of epithelial cells in exchange for potassium ions (active) on cell protein
  - + 2) This creates a concentration gradient between the lumen and inside of epithelial cells
  - + 3) Sodium ions bind to another transporter protein along with glucose which transports them into the cells down their concentration gradient, bringing glucose with them.

# WHERE DOES THE TOXIN TARGET?



Cholera toxin-fed

Control

# CHOLERA – HOW IT WORKS (Annotate handout)

- ✘ Almost all the bacterium ingested is killed by acid in the stomach. Some may survive!
- ✘ Once in the small intestine surviving bacteria used their flagella to propel themselves through the intestinal wall.
- ✘ There they produce a toxic protein which has 2 parts:
  - + One binds to specific carbohydrate receptors on the cell surface membrane
  - + The other enters the epithelial cells causing the ion channels on the cell-surface membrane to open so that chloride ions flood into the lumen.

## SO..IF IONS FLOW OUT INTO THE LUMEN, WHAT DO YOU THINK HAPPENS TO WATER BASED ON YOUR KNOWLEDGE OF WATER POTENTIAL?

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1. The loss of chloride ions raises the water potential of the epithelial cells, while the increase of chloride ions in the lumen lowers its water potential.
2. Water therefore flows from the cells and blood to the lumen.
3. Ions move into the epithelial cells from the blood and the cells, down a concentration gradient.
4. It is the loss of water from the blood and other tissues, into the intestine, that causes severe diarrhoea and dehydration.

# Lumen of the Small Intestine

Because of the drastically low

water potential

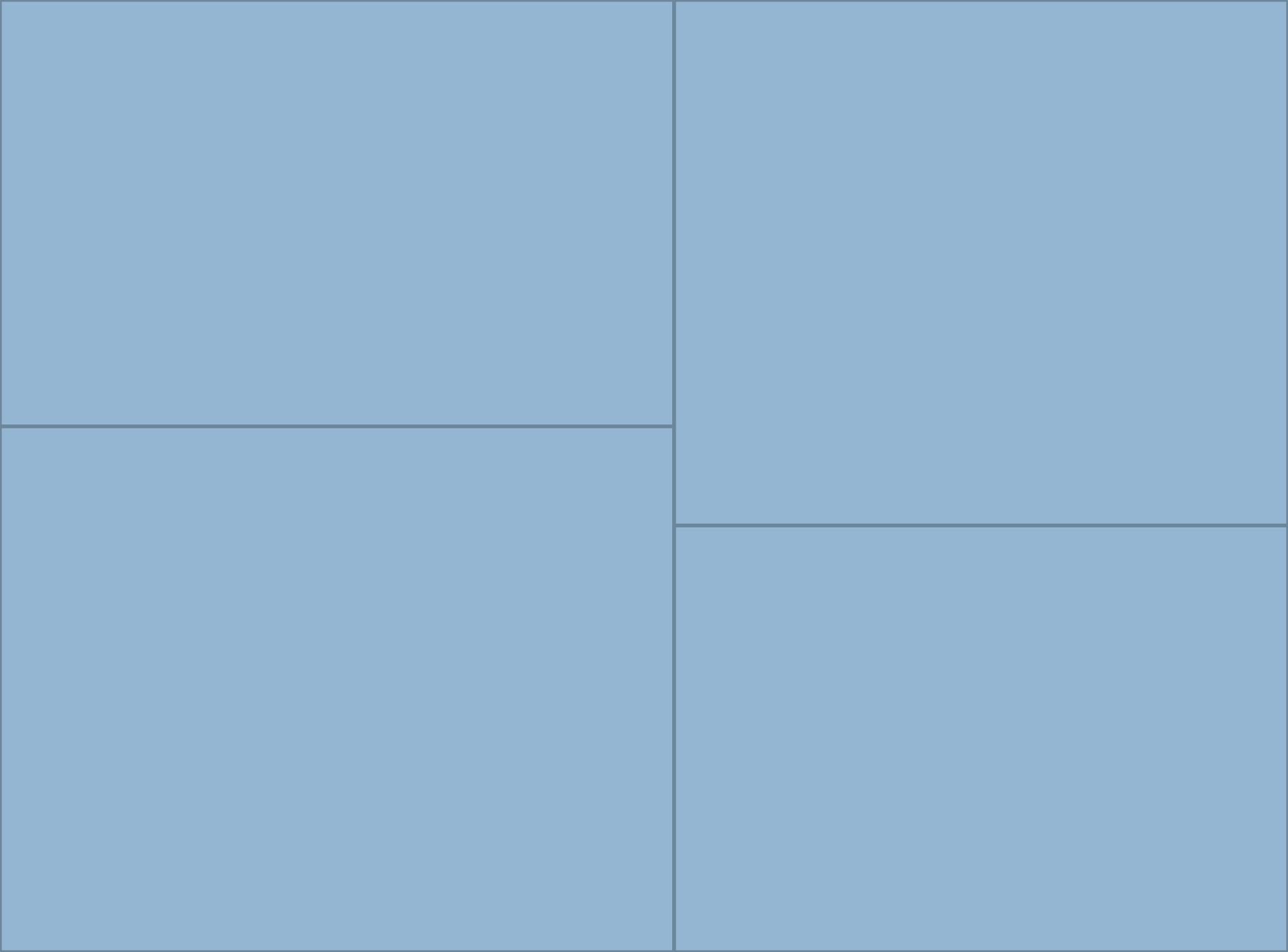
The massive increase in water secretion into the intestinal lumen leads to fantastic amounts of watery faeces (diarrhoea). This causes the body to become dehydrated.

capillaries by osmosis, across the epithelial cells and into the lumen



move into the lumen of the small intestine. This lowers the water potential of the lumen.

Blood



# ORAL REHYDRATION THERAPY

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- × Diarrhoea can be fatal (2<sup>nd</sup> biggest cause of death worldwide) – death from dehydration
- × Oral rehydration has 2 functions:
  - + Replace water lost
  - + Replace ions lost (electrolytes)
- × In pairs...given what you know about absorption in the small intestine, write a list of what you think oral rehydration solutions need to contain

# REHYDRATION SOLUTIONS CONTAIN

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- + Water – to rehydrate tissues
- + Sodium – To replace sodium lost from epithelium and to make optimum use of sodium-glucose carrier proteins
- + Glucose – To stimulate uptake of sodium ions & provide energy
- + Potassium – To replace lost potassium & stimulate appetite
- + Other electrolytes (e.g. Chloride ions)

## BUT HOW IS THIS ABSORBED IF SMALL INTESTINE IS NOT ABSORBING WATER?

- × Solutions are specially developed to target a specific alternative sodium ion carrier protein
- × Sodium levels inside the cells increase .....

  - + How does this help rehydration?

- × Answer: More sodium ions inside the cells cause an osmotic gradient. Water then travels across via osmosis.

# DEVELOPMENT OF REHYDRATION TREATMENTS

## × Early development problems

- + 1) Side effects from too much sodium
- + 2) Too high glucose content – lowered the water potential in the lumen...what do you think happened?
- + 3) Glucose lowered but then didn't provide much energy
- + 4) Starch used to replace glucose – has no osmotic effect and broken down to glucose steadily (rice starch commonly used (common in tropical areas/provides other nutrients which help uptake)

# QUESTIONS

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- × It is sometimes recommended that banana be added to the mixture. Give 3 reasons.
  
- × Sports drinks contain a high level of glucose. Explain why these would be inappropriate to use as a rehydration solution for people with diarrhoea?

# DRUG TRIALS

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Usually four stages:

- ✘ Small no. healthy people given drug to test for side-effects (not its efficacy)
- ✘ Drug given to larger group (c.100-300) of people with the condition to test for efficacy
- ✘ Trial involving 1000s people. Some given placebo. Often double-blind (neither the patients nor the scientists know who has the placebo)
- ✘ Results of trials published in peer-review journals e.g. Lancet

# ETHICAL CONSIDERATIONS

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- × How should people be recompensed?
- × How can participants be made fully aware of dangers?
- × Who is responsible if things go wrong (e.g. thalidomide, 1950s – morning sickness drug)

# PLENARY

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- × Draw a mind-map or diagram/list of your choice which highlights the topics covered under exchange of substances, small intestine and cholera.
- × Highlight any areas you feel you need to work on a lot more.