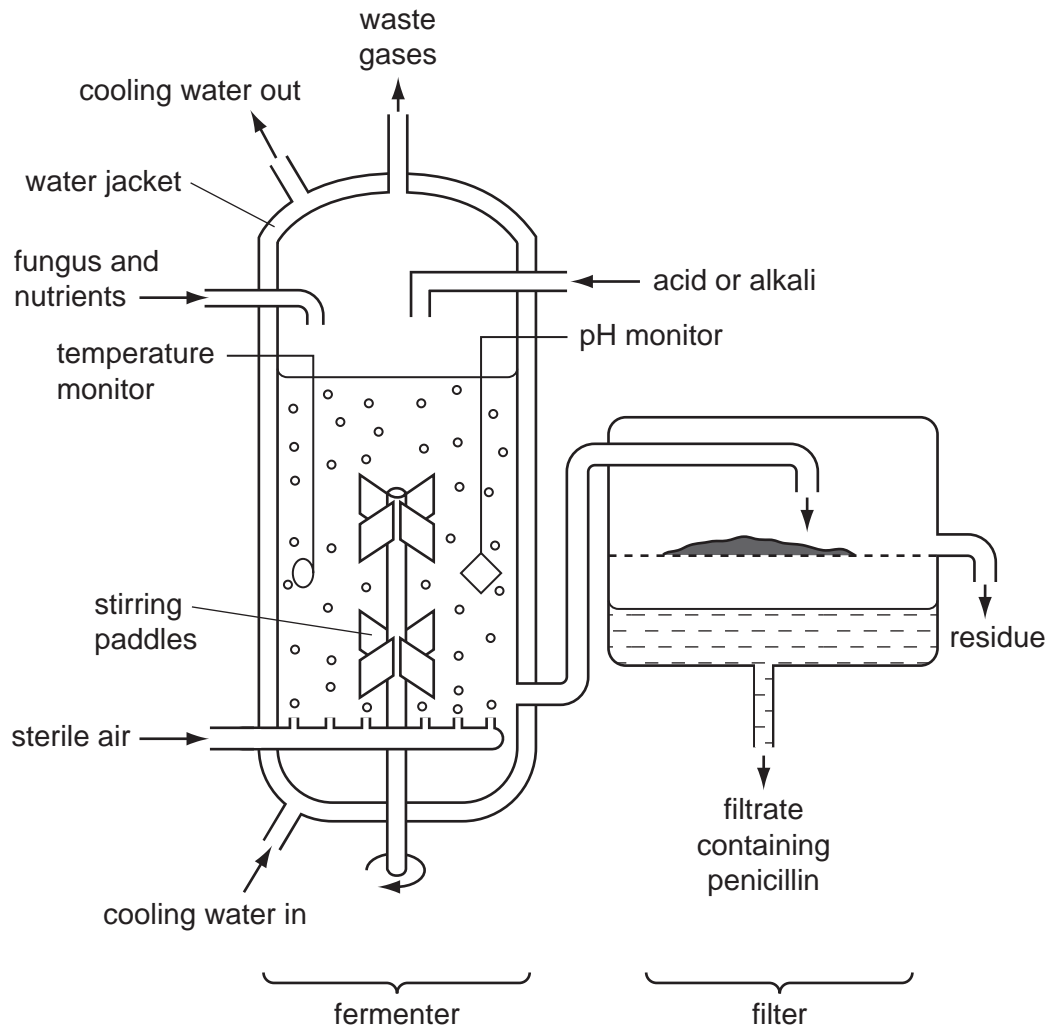


1 Penicillin is an antibiotic produced by the fungus *Penicillium chrysogenum*.

Fig. 4.1 shows the process used to produce penicillin.



**Fig. 4.1**

(a) Enzymes in the fungus are used to make penicillin.

Explain why there is a water jacket around the fermenter **and** why acids or alkalis are added to the fermenter.

*water jacket*

.....

.....

.....

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.....

.....

*addition of acids or alkalis*

.....

.....

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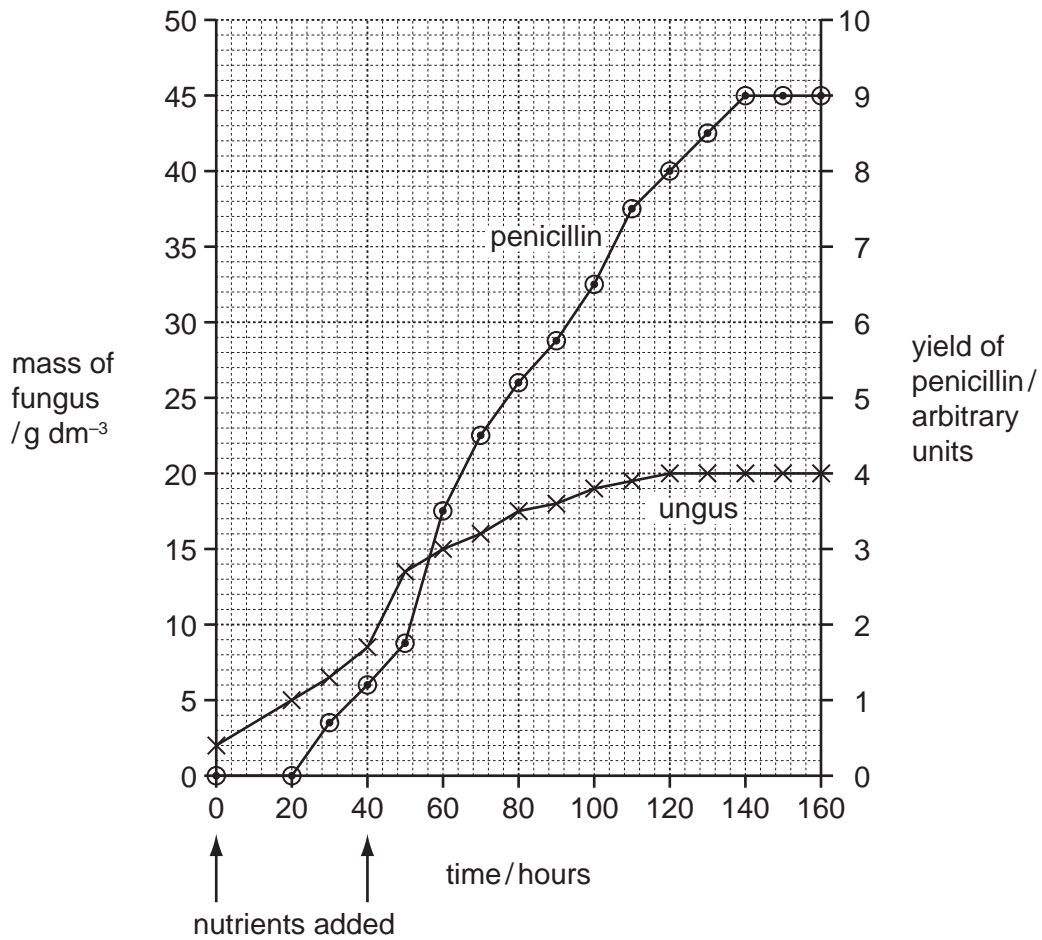
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.....

[6]

Fig. 4.2 shows the mass of fungus and the yield of penicillin during the fermentation process.



**Fig. 4.2**

(b) State the time interval over which the fungus grew at the maximum rate.

..... [1]

(ii) As the fungus grows in the fermenter, the nuclei in the fungal hyphae divide.

State the type of nuclear division that occurs during the growth of the fungus in the fermenter.

..... [1]

(iii) Explain why the growth of the fungus slows down and stops.

.....  
.....  
.....  
.....  
.....  
..... [3]

(c) Penicillin is not needed for the growth of *P. chrysogenum*.

(i) State the evidence from Fig. 4.2 that shows that penicillin is not needed for this growth.

.....  
.....  
.....  
..... [2]

(ii) The people in charge of the penicillin production emptied the fermenter at 160 hours.

Use the information in Fig. 4.2 to suggest why they did **not** allow the fermentation to continue for longer.

.....  
..... [1]

- (d) Downstream processing refers to all the processes that occur to the contents of the fermenter after it is emptied. This involves making penicillin into a form that can be used as a medicine.

Explain why downstream processing is necessary.

.....

.....

.....

.....

.....

.....

..... [3]

- (e) Explain why antibiotics, such as penicillin, kill bacteria but not viruses.

.....

.....

.....

.....

..... [2]

[Total: 19]

2 The human immunodeficiency virus (HIV) infects white blood cells. The virus is reproduced inside these white blood cells.

(a) Describe what may happen to viruses that leave infected white blood cells.

.....  
.....  
.....  
..... [2]

(b) Describe the possible long-term effects of HIV on the immune system.

.....  
.....  
.....  
.....  
.....  
..... [3]

(c) People with HIV may be treated with a variety of drugs.

(i) Define the term *drug*.

.....  
.....  
..... [1]

(ii) Explain why antibiotics cannot be used to control HIV.

.....  
.....  
.....  
..... [2]

[Total: 8]

**3** Bacteria can be grown on nutrient agar in Petri dishes. The main nutrients in the agar are glucose and amino acids. The bacteria reproduce asexually to form colonies. Each colony is formed from one bacterium.

**(a) (i)** Explain why glucose and amino acids are included in the agar medium.

glucose .....

.....

amino acids .....

.....

[2]

**(ii)** Describe how bacteria reproduce asexually.

.....

.....

.....

.....

.....

[2]

A microbiologist collected bacteria from a kitchen which was suspected to be responsible for an outbreak of food poisoning.

The microbiologist spread the bacteria on nutrient agar and let them reproduce to form colonies. The bacterial colonies were transferred onto new nutrient agar that contained high concentrations of antibiotics **S** or **T**, as shown in the flow diagram in Fig. 5.1.

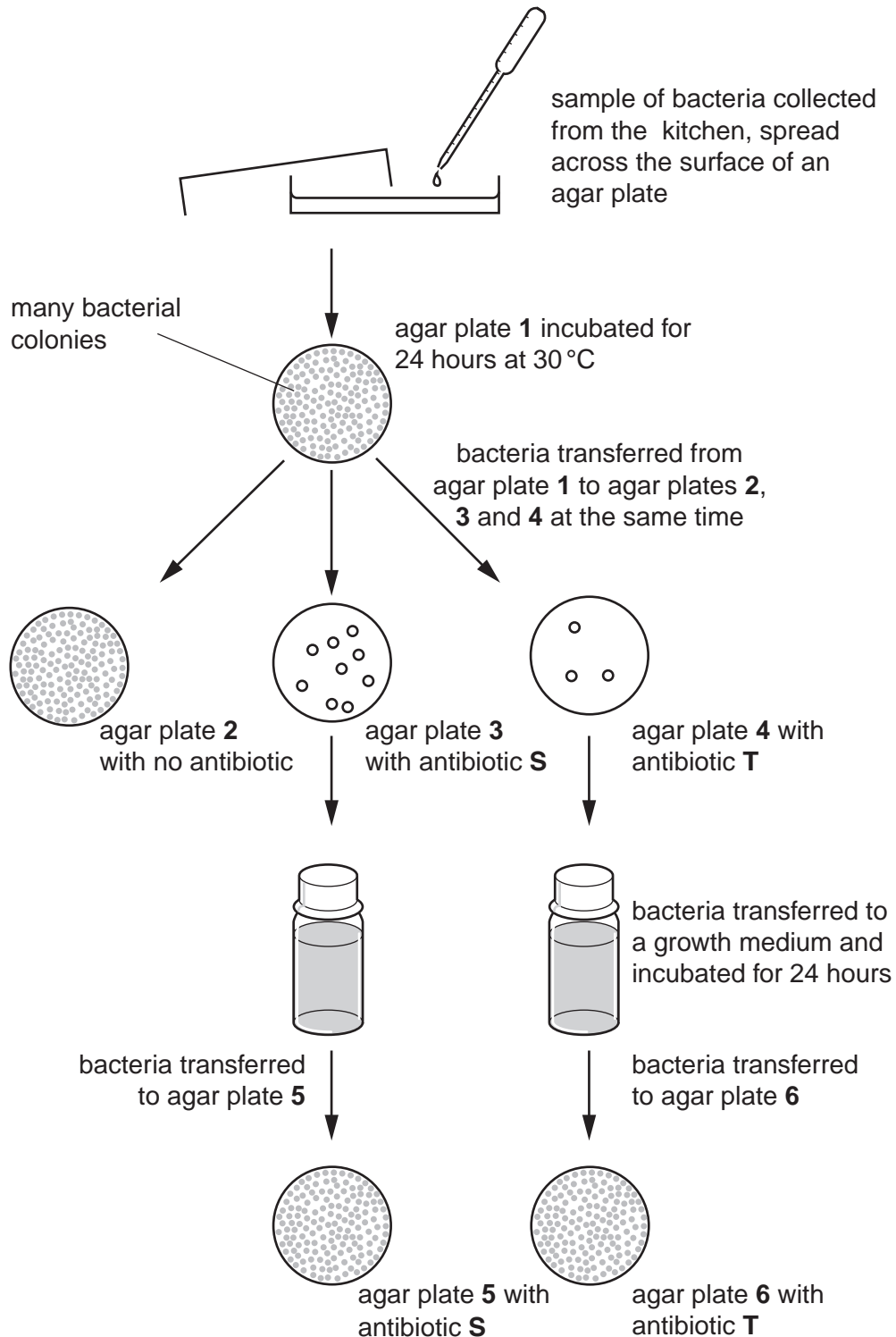


Fig. 5.1



(b) Explain the appearance of agar plates 3 and 4.

.....  
.....  
.....  
.....[2]

(c) Explain why many bacterial colonies were found on agar plates 5 and 6.

.....  
.....  
.....  
.....[2]

(d) Gonorrhoea is a sexually transmitted disease. It is caused by the bacterium, *Neisseria gonorrhoeae*. Many strains of this bacterium cannot be treated by common antibiotics.

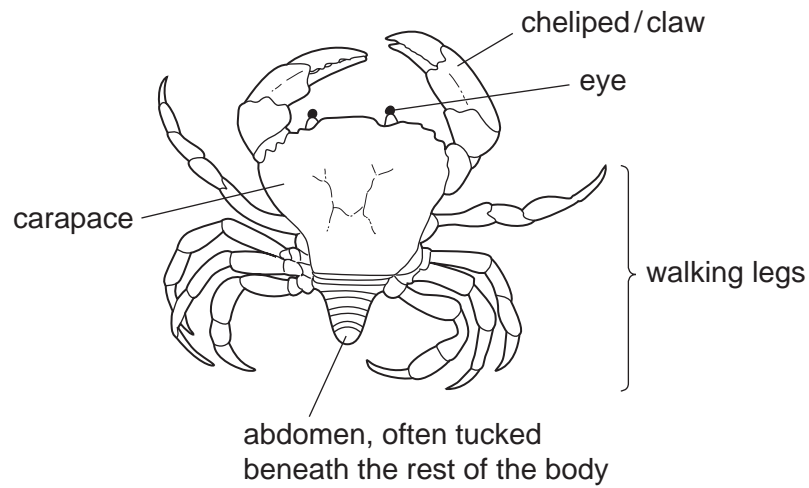
Explain how strains of antibiotic-resistant bacteria are formed **and** then spread.

.....  
.....  
.....  
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.....  
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.....  
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.....  
.....[5]

**[Total: 13]**

- 4 Crabs are classified, along with prawns, shrimps and lobsters, as crustaceans. Most crabs live in the sea, although some live in freshwater and there are a few land-dwelling crabs.

Fig. 1.1 shows the structure of a typical crab.

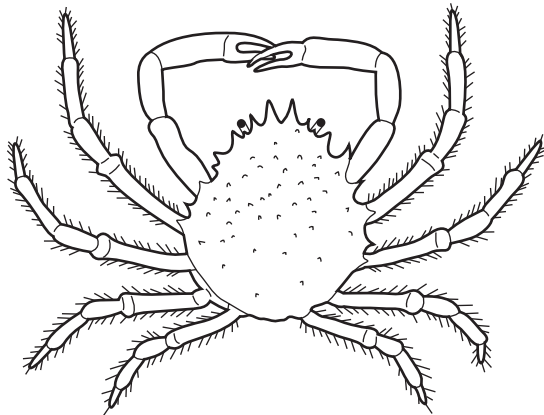


**Fig. 1.1**

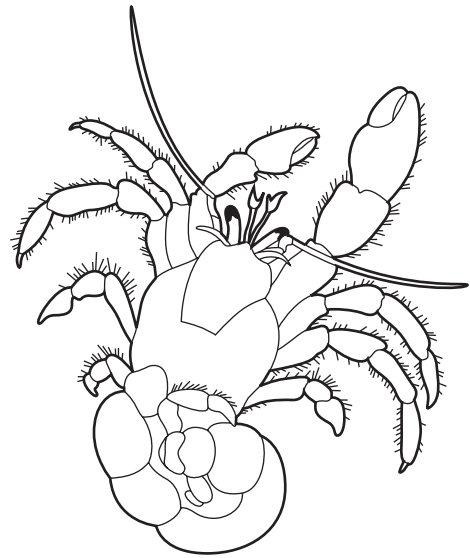
- (a) State the group of animals that includes crustaceans, insects, arachnids and myriapods.

..... [1]

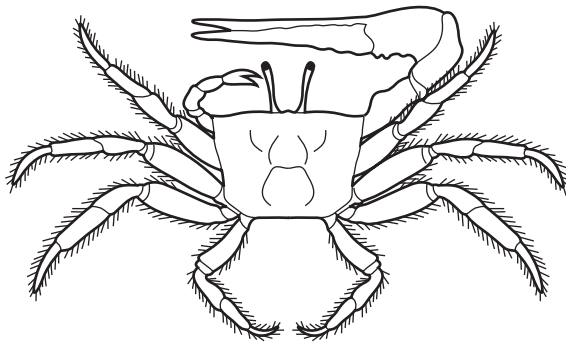
Fig. 1.2 shows four different species of crab.



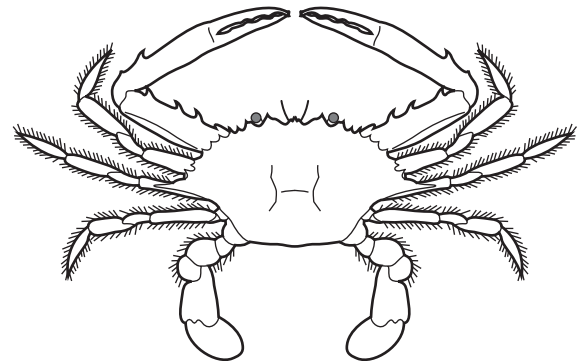
**A** spiny spider crab  
*Maia squinado*



**B** hairy hermit crab  
*Pagurus hirsutiussculus*



**C** West African fiddler crab  
*Uca tangeri*



**D** sand crab  
*Portunus pelagicus*

**Fig. 1.2**

(b) Biologists use dichotomous keys to identify different species.

Use Fig. 1.1 and Fig. 1.2 to state **one visible** feature of each species of crab **A**, **B**, **C** and **D**, that could be used in a dichotomous key to identify crabs.

**A** .....

.....

**B** .....

.....

**C** .....

.....

**D** .....

..... [4]

(c) Crabs show variation in many features.

(i) State **one** feature of crabs that shows **continuous variation**.

..... [1]

(ii) Describe how you would measure variation in the feature you have given in (i).

.....

..... [1]

(d) Crabs produce huge numbers of offspring, but their populations remain fairly constant from year to year.

Explain why.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(e) Emergency medical packs contain bandages made from chitosan.

Chitosan comes from the exoskeleton of crustaceans and has a positive charge to attract red blood cells. It helps blood clot quickly and also has antibacterial properties.

Explain the benefits of using bandages made from chitosan.

.....

.....

.....

.....

.....

.....

.....

..... [3]

**[Total: 13]**