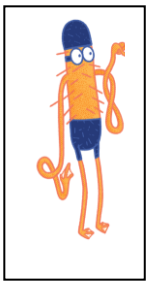
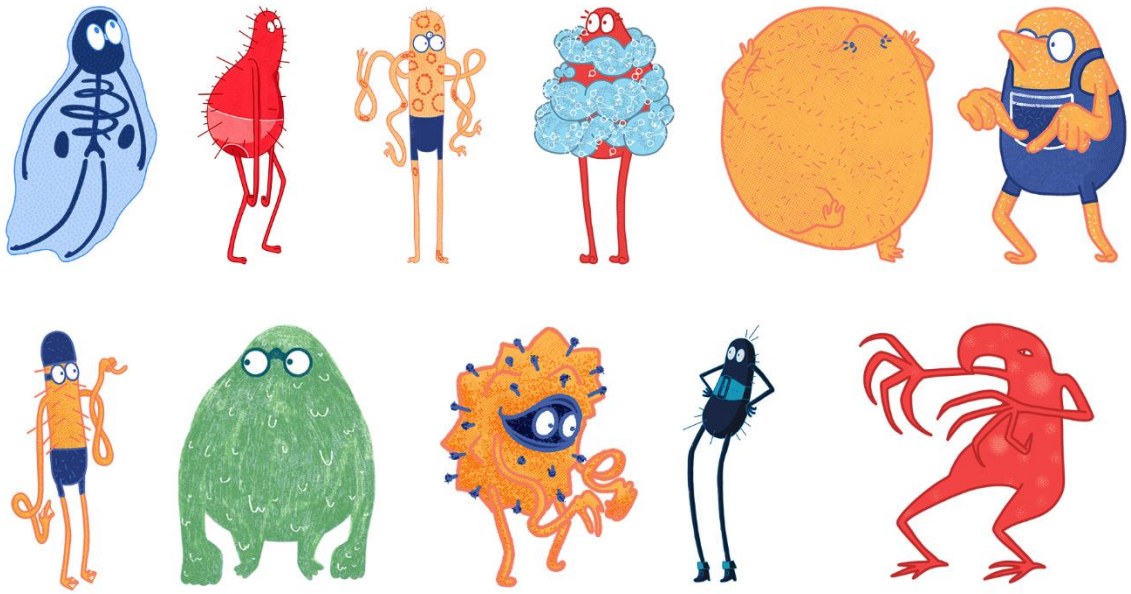
GermBugs Workbook



Welcome to the GermBugs. The GermBugs resource has been designed by clinical microbiologists, supported by experts in medical resource development. GermBugs is a resource specifically designed for medical students to make learning microbiology very very easy. In fact, the only problem is you might find it too easy to learn. We know… medical school should be serious, but for once, you have the option to do it the easy way.

About the GermBugs

The GermBugs are a set of bacterial characters whose adventures we follow to learn about microbiology and infection.



If you haven't met the GermBugs before, check out these webpages which we hope will explain a bit more and demonstrate how it works.

https://time.leeds.ac.uk/resources/germ-bugs/germbugs-about/

https://time.leeds.ac.uk/resources/germ-bugs/getting-started/

https://time.leeds.ac.uk/resources/germ-bugs/the-germbugs/

This workbook supports learning after using the GermBug resource

One bug at a time

The Green Bacteria Present

Alan aureus

Do you know what kind of bacteria Staphylococcus aureus is?

Do you know:

- **Where on the body it lives?**
- **What kind of infections it causes?**
- **How to stop it spreading?**
- **What antibiotics should be used to treat infections by S. aureus?**

These are the learning objectives for the Alan Aureus story.

To help you learn about S. aureus we have created a character called Alan aureus. He is one of the Green bacteria. These bacteria who live in the nose are turned green by all that snot! So, now you know S. aureus lives in the nose. We've made a story about Alan, to help you learn about the kind of infections S. aureus causes**.**

Before you go to the stories, we want to tell you there are two versions of the story. First there is just the story, here you will learn about Staphylococcus aureus. Read this one first. Second, we give the story again, but we add in the science. Read this one second.

1. **Listen to the story about Alan aureus:**

https://resources.time.leeds.ac.uk/germbugs/Alan_Aureus_no_buttons/story.html

(the website doesn't work with Firefox; other browsers should be used e.g. Ecosia):

2. **Now you have the story in your head, go again. But this time we have added in some science. Click on the I buttons for Information, and click on the M buttons to see if you spotted the metaphors in the story: https://resources.time.leeds.ac.uk/germbugs/Alan_Aureus/story.html**

Want to test what you have learned?

For the following questions about *S. aureus*:

A- Try and answer them
B- Try and work out why it matters? How does this information help you stop patients suffering from infections? If you get stuck-just move on.

Questions

1. Why is S. aureus one of the few bacteria living in the nose?

A. Example. S. aureus can survive high salt concentrations in the nose that other bacteria cannot.

Why it matters: Example. Touching inside the nose increases the chances of spreading S.aurues.

2. How common is colonisation with S. aureus?

Answer:_____

Why it matters_____

3. What type of infection does S. aureus commonly cause?

Answer:_____

Why it matters_____

4. How does S. aureus commonly get into a surgical wound?

Answer:_____

Why it matters_____

5. If you take a swab from a patient's skin and you grow S. aureus, should you be worried or not?

Answer:_____

Why it matters_____

6. Are there medical devices which make infection by S. aureus more likely?

Answer:_____

Why it matters_____

7. Why is cellulitis painful and why does it cause the skin to change colour?

Answer:_____

Why it matters_____

8. Why should patients with S. aureus blood stream infections need treating with a minimum of two weeks of antibiotics?

Answer:_____

Why it matters_____

9. How long would it take 1000 bacteria replicating every 30 minutes before there were 1 million bacteria?

Answer:_____

Why it matters_____

10. What is the most common antibiotic used to treat Staphylococcus aureus infection? How does this antibiotic work?

Answer:_____

Why it matters_____

11. What does MSSA ad MRSA stand for? How is MRSA different to MSSA?

Answer:_____

Why it matters_____

12. Where on the body is it best to put the antibiotic mupirocin to help stop the spread of MRSA?

Answer:_____

Why it matters_____

What infections does S. aureus cause?

Explore the different infections that S. aureus does and does not cause?

https://onlinecourses.leeds.ac.uk/germbugs/revisiontool/revise-step2.html

List an infection S. aureus commonly causes.

_____

List an infection S. aureus does not commonly cause.

_____

Which antibiotics should you use to treat a S. aureus infection?

Explore the antibiotics we can use to treat patients with S. aureus infection here:
https://onlinecourses.leeds.ac.uk/germbugs/revisiontool/revise-step3.html

Use the questions below to direct your exploration about which antibiotics are good at treating S. aureus infection.

List 5 antibiotics that are highly effective at treating S. aureus infections

_____

_____

List 5 antibiotics that have a low efficacy at treating S. aureus infections.

_____

_____

Which is the narrowest spectrum antibiotic for treating S. aureus infection?

_____

(hint, the narrowest spectrum antibiotic is the one that that kills the least species of bacteria)

Can you think why a narrow spectrum antibiotic is of benefit?

_____

Flucloxacillin is a penicillin antibiotic, can you think of another antibiotic that can be used to treat penicillin allergic patients? Note, penicillins names end with "illin". (Note-10% of adults are penicillin allergic. Flucloxacillin has within it a beta-lactam ring, so all beta-lactam antibiotics might be problem in patients with penicillin allergy. Beta-lactams include cephalosporins e.g. cefuroxime, and carbapenems e.g. meropenem)

_____

What type of antibiotics are highly active against MSSA, but not MRSA?

_____

List two antibiotics that are highly effective against MRSA

_____

_____

Clinical scenarios

Terminology

PO=Per Os=Orally taken medicine, QDS=4 times a day, BD=twice a day, Pyelonephritis=kidney infection.

Scenario 1: A 54 year old man with a chronic ulcer on their left shin presents to a clinician for their annual blood pressure check. The clinician decides to take a swab from the leg ulcer and send it to the microbiology laboratory to see what they grow, just in case. Otherwise, the ulcer has not changed appearance recently. Three days later the microbiology laboratory sends a report back to the GP saying it has grown S. aureus susceptible to clarithromycin and flucloxacillin. The patient does not have a penicillin allergy. Should you as the patient's clinician:

1. Arrange for a prescription to be collected for flucloxacillin 500mg QDS PO
2. Arrange for a prescription to be collected for clarithromycin 500mg BD PO
3. Ignore the result
4. Check the patients' medical notes to see if there was clinical evidence of infection?
5. Call the patient back to the GP practice for an urgent review of the ulcer?

Scenario 2-Part A: A 70 year old women presented to hospital with a painful red and swollen right thigh. She has been treated by her GP with two courses of flucloxacillin at 500mg QDS PO. You diagnose cellulitis. You take blood cultures and start antibiotics, what would be the right antibiotics to start?

1. Flucloxacillin 2grams intravenously QDS.
2. Clindamycin 300mg TDS PO
3. Doxycycline 200mg stat then 100mg daily PO
4. Teicoplanin 800mg Once daily after 3 800mg loading doses
5. Linezolid 600mg BD PO

Scenario 2-Part B: After 48 hours the microbiology laboratory confirms the patient had an MRSA bacteraemia detected in her blood cultures taken at admission. You examine the patient and determine there is no other source of infection such as endocarditis or osteomyelitis. The patient is much better after antibiotic treatment with IV teicoplanin for 5 days. What should you as the patient's clinician do now?

1. Stop antibiotics and discharge the patient
2. Continue antibiotics until 7 days are complete, then stop antibiotics and discharge the patient.
3. Switch to oral antibiotics, such as clindamycin or doxycycline, to complete a total of 14 days antibiotics
4. Continue IV teicoplanin for 14 days intravenously
5. Step down to PO flucloxacillin 1 gram QDS PO

Scenario 3-Part A: An 80 year old female patient comes into hospital with sepsis and back pain, she is treated with piperacillin-tazobactam for suspected pyelonephritis. On admission she had blood cultures collected. After two days the blood cultures are reported as growing MSSA. She is feeling much better after the antibiotics, and she is being prepared for discharge home. What should you do now?

1. Stop antibiotics, she is feeling better
2. She has got better on the antibiotics, confirming the diagnosis of pyelonephritis, she should go home on oral antibiotics to complete a 7 day course of antibiotics, the standard duration for pyelonephritis
3. Re-view the diagnosis, S. aureus is an uncommon cause of pyelonephritis
4. Switch her to oral flucloxacillin and send home on 14 days of antibiotics.
5. Change her antibiotics to IV teicoplanin to complete 14 days of antibiotics.

Scenario 3-Part B: After two days the blood cultures are reported as growing MSSA. She felt much better after the antibiotics and was sent home to complete a further 5 days of antibiotics. Three weeks later she represents to hospital with severe sepsis. What happened?

1. Elderly patients commonly get recurrent UTIs and so she probably had a relapse of her kidney infection
2. She developed a new infection that she caught in hospital, probably hospital acquired pneumonia
3. She never had a kidney infection but had osteomyelitis of her spine. She wasn't assessed properly on her first admission, as she didn't have an MRI scan of her spine. Spinal bone infection needs 4 weeks of antibiotics
4. She probably has an underlying cancer like bowel cancer which hasn't been diagnosed.
5. She had a delayed allergic reaction to her antibiotics

The Red Bacteria present

Pav Pyogenes

Do you know what kind of bacteria Streptococcus pyogenes is?

Do you know:

- **Where on the body it lives?**
- **What kind of infections it causes?**
- **How to stop it spreading?**
- **What antibiotics should be used to treat infections by S. pyogenes and how surgery is needed to manage some S. pyogenes infections?**

These are the learning objectives for the S. pyogenes story

To help you learn about S. pyogenes we have created a character called Pav pyogenes. He lives in the throat where it can cause red and hot sore throats. We've made a story about Pav, to help you learn about the kind of infections S. pyogenes causes**.**

Before you go to the stories, we want to tell you there are two versions of the story. First, there is just the story, here you will learn about S pyogenes. Read this one first. Second, we give the story again, but we add in the science. Read this one second.

1. **Listen to the story about Pav pyogenes:**
   https://resources.time.leeds.ac.uk/germbugs/Pav_the_pyogenes_no_buttons/story.html

(the website doesn't work with Firefox; other browsers should be used e.g. Ecosia):

2. **Now you have the story in your head, go again. But this time we have added in some science. Click on the I buttons for Information, and click on the M buttons to see if you spotted the metaphors in the story:**
   https://resources.time.leeds.ac.uk/germbugs/Pav_the_pyogenes/story.html

Want to test what you have learned?

For the following questions about *S. pyogenes*:

A- Try and answer them
B- Try and work out why it matters? How does this information help you stop patients suffering from infections? If you get stuck-just move on.

Questions

1. Where on the body is Streptococcus pyogenes (also called group A streptococcus) most commonly found?

Answer:_____

Why it matters_____

2. When you find S. pyogenes on the human body-is it always going to cause an infection?

Answer:_____

Why it matters_____

3. How does Streptococcus pyogenes transfer from person to person?

Answer:_____

Why it matters_____

4. What is the most common bacterial cause of pharyngitis (sore throat)?

Answer:_____

Why it matters_____

5. What immunological complications can follow Streptococcal pharyngitis?

Answer:_____

Why it matters_____

6. Which antibiotic is commonly used to treat bacterial pharyngitis caused by S. pyogenes?

Answer:_____

Why it matters_____

7. Which two bacteria are the most common causes of skin and soft tissue infection?

Answer:_____

Why it matters_____

8. Name two types of hospital patient particularly at risk of S. pyogenes infection?

Answer:_____

Why it matters_____

9. How can patients catch S. pyogenes infection?

Answer:_____

Why it matters_____

10. What is a serious skin and soft tissue complication of Streptococcal infections?

Answer:_____

Why it matters_____

11. Why might antibiotics not work for this infection?

Answer:_____

Why it matters_____

12. What type of enzymes does S. pyogenes make that contribute to infection?

Answer:_____

Why it matters_____

13. What type of antigens can cause S. pyogenes infection to result in an excessive inflammatory response?

Answer:_____

Why it matters_____

14. In addition to antibiotics, what is needed to treat necrotising fasciitis?

Answer:_____

Why it matters_____

What infections does S. pyogenes cause?

Explore the different infections that S. pyogenes does and does not cause?

https://onlinecourses.leeds.ac.uk/germbugs/revisiontool/revise-step2.html

List one infection S. pyogenes commonly causes?

_____

List three infections S. pyogenes does not commonly cause?

_____

Which antibiotics should you use to treat a S. pyogenes infection?

Explore the antibiotics we use to treat patients with here:
https://onlinecourses.leeds.ac.uk/germbugs/revisiontool/revise-step3.html

Use the questions below to direct your exploration about which antibiotics are good at treating S. aureus infection.

List 5 antibiotics that are highly effective at treating S. pyogenes infections.

_____

_____

List 5 antibiotics that have a low efficacy at treating S. pyogenes infections.

_____

_____

Which is the narrowest spectrum antibiotic for treating S. pyogenes infections?

(hint, the most narrow spectrum antibiotic is the one that that kills the least species of bacteria)

_____

Why is flucloxacillin used to treat cellulitis, not penicillin?

_____

If a patient is being treated with piperacillin-tazobactam for urinary tract infection, would you add in flucloxacillin if you thought they had cellulitis as well?

_____

Flucloxacillin is a penicillin antibiotic, can you think of another antibiotic that can be used to treat a penicillin allergic patient with S. pyogenes infection?

_____

Should you use oral penicillin to treat a patient with cellulitis caused by S. pyogenes?

_____

Clinical scenarios

Scenario 1: A 54 year old man with a chronic ulcer on their left shin presents to a clinician for their annual blood pressure check. The clinician decides to take a swab from the leg ulcer and send it to the microbiology laboratory to see what they grow, just in case. Otherwise, the ulcer has not changed appearance recently. Three days later the microbiology laboratory sends a report back to the GP saying it has grown S. pyogenes susceptible to clarithromycin and flucloxacillin. The patient does not have a penicillin allergy. Should you as the patient's clinician:

1. Arrange for a prescription to be collected for flucloxacillin 500mg QDS PO
2. Arrange for a prescription to be collected for clarithromycin.
3. Ignore the result.
4. Check the patients' medical notes to see if there was clinical evidence of infection?
5. Call the patient back to the GP practice for an urgent review of the ulcer?

Scenario 2-Part A: A 70-year-old women presents to hospital with a painful red and swollen right thigh. She has been treated by her GP with two days of flucloxacillin orally at 500mg QDS PO. You diagnose cellulitis. You take blood cultures and start antibiotics, what would be the right antibiotics to start?

1. Flucloxacillin 2grams intravenously QDS.
2. Clindamycin 300mg TDS PO
3. Doxycycline 200mg stat then 100mg daily PO
4. Teicoplanin 800mg Once daily after 3 800mg loading doses
5. Linezolid 600mg BD PO

Scenario 2-Part B: After 48 hours the microbiology laboratory confirms the patient had a S. pyogenes bacteraemia detected in her blood cultures taken at admission. You examine the patient and determine there is no other source of infection such as osteomyelitis. The patient is much better after antibiotic treatment with IV flucloxacillin 2 grams QDS for 3 days. What should you as the patient's clinician do now?

1. Switch to teicoplanin 800mg OD IV
2. Switch to gentamicin 5mg/kg OD IV
3. Switch to flucloxacillin 1 gram QDS PO
4. Switch to trimethoprim 200mg BD PO
5. Switch to aztreonam 1 gram TDS IV

The Red Bacteria present

Poppy the pneumococcus

Do you know what kind of bacteria Streptococcus pneumoniae is?

Do you know:

- **Where on the body it lives?**
- **What kind of infections it causes?**
- **How to stop it spreading including the role of vaccination?**
- **What antibiotics should be used to treat infections by Streptococcus pneumoniae?**

These are the learning objectives for the Streptococcus pneumoniae story.

To help you learn about **Streptococcus pneumoniae** we have created a character called Poppy the Pneumococcus. It is one of the RedCaps. It lives quietly in the throat, only causing a problem if it moves elsewhere e.g. to go the lung or ear. Now you know Streptococcus pneumoniae lives in the throat, as do the other red bacteria.

Before you go to the stories we want to tell you there are two versions of the story. First, there is just the story, here you will learn about Streptococcus pneumoniae. Read this one first. Second, we give the story again, but we add in the science. Read this one second.

1. **Listen to the story about Poppy the pneumococcus**
   https://resources.time.leeds.ac.uk/germbugs/poppy-the-pneumococcus-no-buttons/story.html

(the website doesn't work with Firefox, other browsers should be used e.g. Ecosia):

2. **Now you have the story in your head, go again. But this time we have added in some science. Click on the I buttons for Information, and click on the M buttons to see if you spotted the metaphors in the story:**
   https://resources.time.leeds.ac.uk/germbugs/poppy-the-pneumococcus/story.html

Want to test what you have learned?

For the following questions about *Streptococcus pneumoniae*:

A- Try and answer them
C- Try and work out why it matters? How does this information help you stop patients suffering from infections? If you get stuck-just move on.

Questions

1. Where on the body is Streptococcus pneumoniae (also called pneumococcus) most commonly found? When you find pneumococcus on the human body-is it always going to cause an infection

Answer:_____

Why it matters_____

2. How can pneumococcus protect itself from the immune system?

Answer:_____

Why it matters_____

3. What is the most common cause of bacterial pneumonia?

Answer:_____

Why it matters_____

4. What normally protects the lung from infection with S. pneumoniae?

Answer:_____

Why it matters_____

5. How does pneumococcus overcome the normal defences of the lung?

Answer:_____

Why it matters_____

6. How does lung infection lead to consolidation on chest x-rays?

Answer:_____

Why it matters_____

7. What is the most common antibiotic treatment for pneumococcal pneumonia?

Answer:_____

Why it matters_____

8. How does pneumococcus spread from person to person?

Answer:_____

Why it matters_____

9. How can pneumococcal pneumonia be prevented?

Answer:_____

Why it matters_____

10. Who gets vaccinated with pneumococcal vaccine?

Answer:_____

Why it matters_____

What infections does S. pneumoniae cause?

Explore the different infections that S. pneumoniae does and does not cause?

https://onlinecourses.leeds.ac.uk/germbugs/revisiontool/revise-step2.html

List an infection S. pneumoniae commonly causes?

_____

List an infection S. pneumoniae does not commonly cause

_____

Apart from the lungs, which bit of the body might have their defences damaged by viral infections, and so be susceptible to pneumococcal infection?

_____

Which antibiotics should you use to treat a S. pneumoniae infection?

Explore the antibiotics we use to treat patients with here:
https://onlinecourses.leeds.ac.uk/germbugs/revisiontool/revise-step3.html

Use the questions below to direct your exploration about which antibiotics are good at treating S. aureus infection.

List 5 antibiotics that are highly effective at treating S. pneumoniae infections.

_____

List 5 antibiotics that have a low efficacy at treating S. pneumoniae infections. Which is the narrowest spectrum antibiotic for treating S. pneumoniae infections?

_____

Are there any similarities between the antibiotics that are effective against S. pneumoniae, and those effective vs. S. pyogenes?

_____

What is a beta-lactam antibiotic? Can you find 5 beta-lactam antibiotics? Do they all have pneumococcal activity or not?

_____

Clinical scenarios

Scenario 1: A 35-year-old asthmatic attend your GP surgery with a fever. They have a cough and a runny nose for 3 days. You collect and send a sputum sample for bacterial culture to the microbiology (bacteriology) laboratory and a nasal swab for viral PCR. The results comes back 2 days later, and they have S. pneumoniae isolated on the sputum culture and influenza virus isolated on the respiratory PCR sample. You call the patient, and they are starting to feel better. What should you do?

1. Arrange for a prescription to be collected for amoxicillin 500mg TDS PO
2. Arrange for a prescription to be collected for clarithromycin 500mg BD PO
3. Provide safety netting advice only, they are getting better.
4. Call the patient back to the GP practice for an urgent review.

Scenario 2: A patient with bronchiectasis is admitted to hospital with pneumonia. A blood culture collected on admission has S. pneumoniae isolated from it. They are currently on Intravenous piperacillin-tazobactam and still have fever, what could you do know?

1. Continue the same antibiotics, and step down to oral amoxicillin after 5 days of intravenous (IV) antibiotics.
2. Switch to IV benzylpenicillin
3. Switch to PO nitrofurantoin
4. Stop antibiotics, they have had an antibiotic which covers pneumococcus.

Scenario 3-A patient with a severe exacerbation of COPD has a sputum sample collected which grows H. influenzae and S. pneumoniae. They have a penillion allergy and are being treated with oral doxycycline. What should you do:

1. Continue with the current antibiotics.
2. Switch to oral amoxicillin 1 gram TDS PO.
3. Admit to hospital for intravenous penicillin 1.2 grams 4 hourly IV
4. Continue with doxycycline but add in clarithromycin 500mg BD PO
5. Switch to pivmecillinam 400mg followed by 200mg TDS PO