Lesson 1.1

1. Define medical intervention. What are 3 medical interventions that Sue Smith would have encountered during her infection with *Neisseria meningitidis*.

2. How is PCR used with bioinformatics to identify a pathogen? Explain each step that is shown in the diagram below:

3. How is ELISA used to detect antigen in a patient?

4. What is an antibody? Draw it below and label points of interest.
5. What is the dilution factor and protein concentration in each tube?

<table>
<thead>
<tr>
<th>Move:</th>
<th>60 µL</th>
<th>60 µL</th>
<th>60 µL</th>
<th>60 µL</th>
<th>60 µL</th>
<th>60 µL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Into:</td>
<td>(180 µL)</td>
<td>120 µL</td>
<td>120 µL</td>
<td>120 µL</td>
<td>120 µL</td>
<td>120 µL</td>
</tr>
</tbody>
</table>

Tube Dilution Factor: N/A

Total Dilution Factor: N/A

Protein concentration: 12,000 ng/mL

6. How does ELISA provide both qualitative and quantitative results? How can these results be used when treating a patient?

7. Describe the relationship between antigen, antibody, and pathogen.

8. Which of these is not treatable with antibiotics? Explain why.
   a. botulism
   b. the flu
   c. *Salmonella* food poisoning
   d. meningitis (caused by *Neisseria meningitidis*)

9. Once an outbreak is identified, what can scientists do to diagnose, treat, and prevent future spread of disease?

10. What type of pathogen is *Neisseria meningitidis*? What can be used to treat it?

---

Lesson 1.2
11. On the bacterium, label the following structures:
   a. capsule
   b. cell wall
   c. flagellum
   d. cell membrane
   e. nucleoid
   f. pilus
   g. plasmids
   h. ribosomes

12. Identify the differences between Gram + and Gram –

13. Small circular DNA called _____________________ carry accessory genes separate from those of the bacterial chromosome.

14. **Matching:** Match the class of antibiotic with its mode of operation.
   
   a. Sulfonamides (Sulfa drugs) _____ interfere with the formation of cell wall.
   b. Fluoroquinolones _____ interfere with the supercoiling of DNA in the bacterial chromosome.
   c. β-Lactams or penicillin _____ prevent protein synthesis.
   d. Tetracyclines _____ interrupt folic acid biosynthesis

15. A patient goes into the student health center at her university because she's feeling extremely run down and is beginning to spike a fever. She complains of a stiff neck and a headache, and after the examination, the doctor sends the patient to the lab where they take samples of her blood, urine, and lymph to use for diagnostic laboratory tests. A portion of her sample undergoes microscopic analysis. The laboratory technician views the slide and sees red, rod-shaped cells. The cells also test resistant to antibiotics that inhibit protein synthesis and folic acid synthesis.

   a. Is the bacteria gram positive or gram negative?

   b. What class of antibiotics should be used to treat this infection and why?

16. Explain the importance of taking antibiotics as prescribed.

17. Describe and explain how actions that humans are taking contribute to bacteria becoming resistant to commonly used antibiotics.

18. **Use the graph to the right to answer questions 18 – 20:**

   18. What likely happened on Day 3 to cause the results seen on Day 4?

   19. What likely happened on Day 4 to cause the results seen on Day 5?
20. What do you predict will happen to this patient?

21. Name the type of genetic transfer occurring in each picture. Give a short description of the mechanism.

A. __________________________________________
   Description ______________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________

B. __________________________________________
   Description ______________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________

C. __________________________________________
   Description ______________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________

22. What type of DNA is transferred in bacterial conjugation?

23. A patient with a skin infection caused by *Staphylococcus aureus* visits the doctor after taking an antibiotic for several days with no improvement. Which antibiotic should the doctor prescribe to treat the infection?

24. Why can’t antibiotics be used to treat a virus?
25. What is sound? How does sound travel? Through what medium c

26. How do frequency and amplitude of sound affect how it is interpreted by humans?

27. Which sound would be interpreted as high pitched? (Circle one)

28. Which sound would be interpreted as loud? (Circle one)

29. Label and describe the function of the parts of the ear:

30. Color the parts of the outer ear green, the middle ear yellow, and the inner ear red.

31. Describe the pathway of sound vibrations from the time a sound is generated to the time the brain registers the sound.

32. What is the difference between conductive and sensorineural hearing loss? What are some causes of each?

33. Describe which structures of the ear are involved in Meniere's disease and explain how those structures relate to the symptoms of the disease.
34. What tests can be used to diagnose hearing loss?

35. A patient has been diagnosed with mild hearing loss at frequencies above 1,000 Hz. Highlight on the diagram which sounds the patient CAN hear.

36. Describe the patient's audiogram results and give a possible explanation for the hearing loss:

37. Describe 3 medical interventions available for patients with hearing loss.

38. Explain the cochlear implant debate. Give two arguments for each side.

Lesson 1.4

39. Who is Edward Jenner and what is his contribution to public health?

40. What is a vaccine and how does it activate the immune system? Why is a booster shot sometimes needed?

41. How can vaccines be used to eradicate disease?

42. How are vaccines made?
43. Similar Pathogen
   a. vaccine that is produced from an altered pathogen for a different disease

   _____ Live Attenuated
   b. vaccine that is almost completely devoid of pathogenic ability but still able to induce an immune response

   _____ Killed
   c. vaccine that is harmless and inactivated when treated with formalin, which allows it to mimic a substance normally secreted by the bacteria

   _____ Toxoid
   d. vaccine that uses only the antigen best suited for the immune response instead of the entire microbe

   _____ Subunit
   e. vaccine that is new and it uses the pathogen’s genetic material to code for the antigens important in immunity

   _____ Naked-DNA
   f. vaccine that is inactivated and causes a weaker immune response, which means multiple doses or boosters are necessary

44. Explain how herd immunity works.

45. How are plasmids engineered and used to move genetic information?

46. Which restriction enzyme should be used to cut the plasmid?

<table>
<thead>
<tr>
<th>Restriction Enzymes</th>
<th>DNA Sequence (both strands are represented)</th>
</tr>
</thead>
</table>
| Bam HI              | G GATCC  
|                     | CCTAG G |
| Eco RI              | G AATTC  
|                     | CTAA G |
| Hpa I               | GTT AAC  
|                     | CAA TTG |

Plasmid DNA:

\[
cggggatcctctagtgtaacctgcaggc 
ccccctaggagatcctcagcaatggacgtccg
\]

47. How is attack rate calculated and how can it be used to determine the possible source of an outbreak?

48. What is the difference between a cohort study and a case-control study? Which does the following description qualify as:

Researchers want to determine how using ear buds affects hearing. A group of high school students from South Mecklenburg High School that use ear buds and a group of students who do not use ear buds are followed over 10 years and hearing tests are completed annually.
Label the following diagrams:

(#’s 5 - 6) Process & Explanation:

(#’s 8 - 10) Process & Explanation:

Type of vaccine & Explanation:

Direction of strand: ________________

Direction of strand: ________________