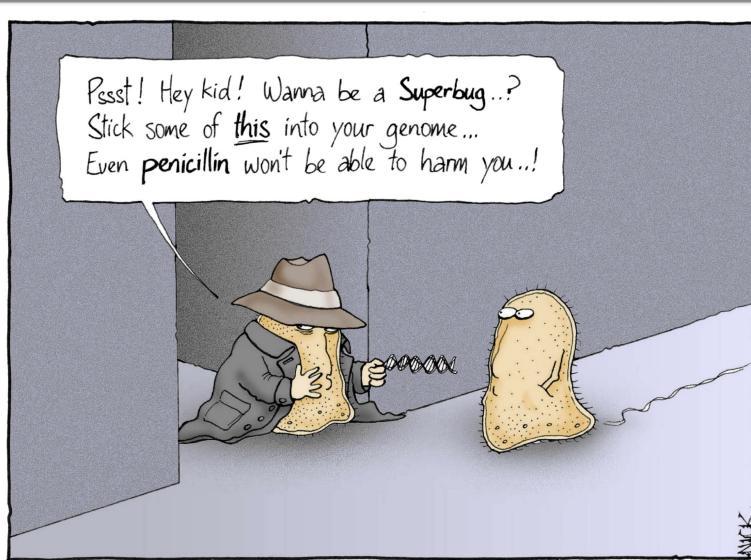


TEAM NUMBER:

MICROBE MISSION: C

SCHOOL: _____

NAME: _____ NAME: _____



It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.

MICROBE MISSION

MIT INVITATIONAL SCIENCE OLYMPIAD TOURNAMENT

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By: Dhruv Puri

DIRECTIONS:

This is a long test. You are not intended to finish completely. You can take apart the test, but make sure to staple it before you hand it back to me. Only the answer sheet will be graded. Please write clearly. Please keep your answers as short as possible. Only on questions 100, 121-127 can you use more than 4 words to answer the question, otherwise I will not grade it. All questions are worth 1 point unless otherwise stated. Good luck!

Part 1: Microscope Madness

1) Fill in the Blanks

Ocular Lens Magnification	Objective Lens Magnification	Total Magnification	Reticle (mm/division)
10	20	Q1	1 mm/div
10	Q2	500	Q4
Q3	100	1000	Q5

Convert the following to micrometers (remember to answer in scientific notation and include units)

6.) 3.3m

7.) 0.7 dm

8.) 2 nm

9.) 1.337 cm

Let's say the field view diameter is 2400 μm at 40x.

Answer the following questions

10.) What is the field view diameter at 100x?

11.) Let's say you can fit 5 bacteria end to end across the field diameter at 100x, what is the length of a single bacterium.

12.) Guess the kind of microbe you're looking at. Be Specific!

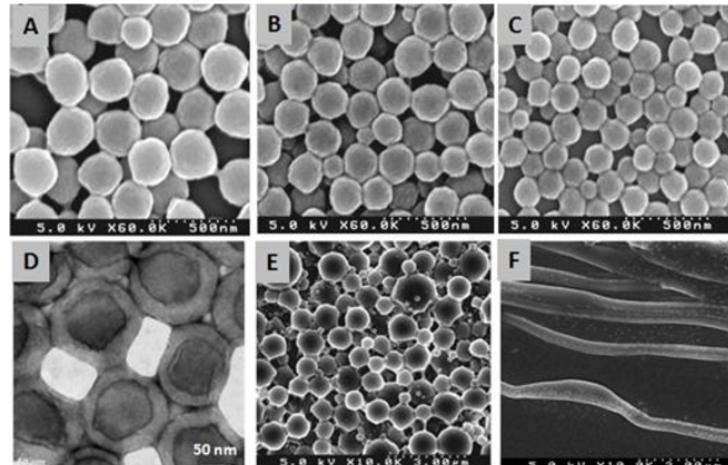
For the following questions indicate what type of microscope is the best for the task.

- A.) Light Compound Microscope
- B.) Dissection Microscope or Stereoscope
- C.) Confocal Microscope
- D.) Electron Microscope

- 13.) Requires immunofluorescence of the sample when used in microbiology
- 14.) Determining if a bacteria is a cocci or a bacilli shape
- 15.) Examining the surface of an antenna of a wasp
- 16.) Has the ability to go into the dark field state
- 17.) Examining a fecal sample for giardia
- 18.) Examining a tissue for virus infiltration
- 19.) Used for the diagnosis for various corneal diseases
- 20.) Sexing male and female flies (with a lot of accuracy)

For the following questions refer to types of microscopy. Indicate which answer choice fits the description.

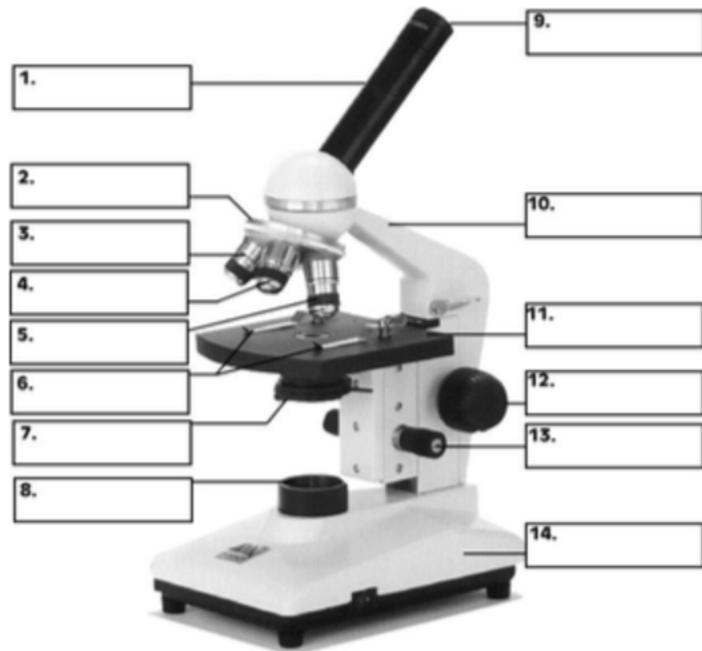
- A.) TEM
- B.) SEM
- C.) SEM and TEM
- D.) Neither



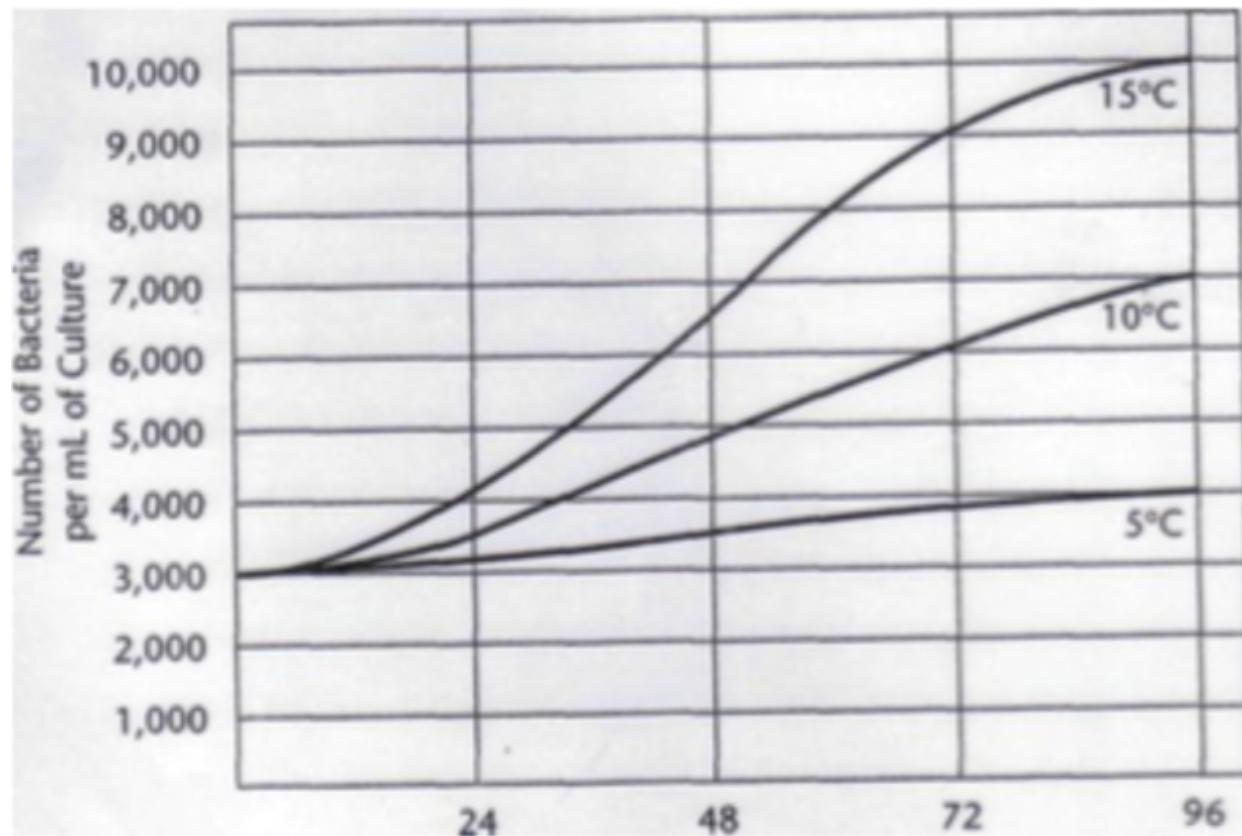
- 21.) Image A was taken by a?
- 22.) Image E was taken by a?
- 23.) Has a higher Resolution?
- 24.) Has a magnification beyond
100 million times the original size of the image?
- 25.) Can be used to characterize a mitochondria?

Questions 26-30 refer to the picture below:

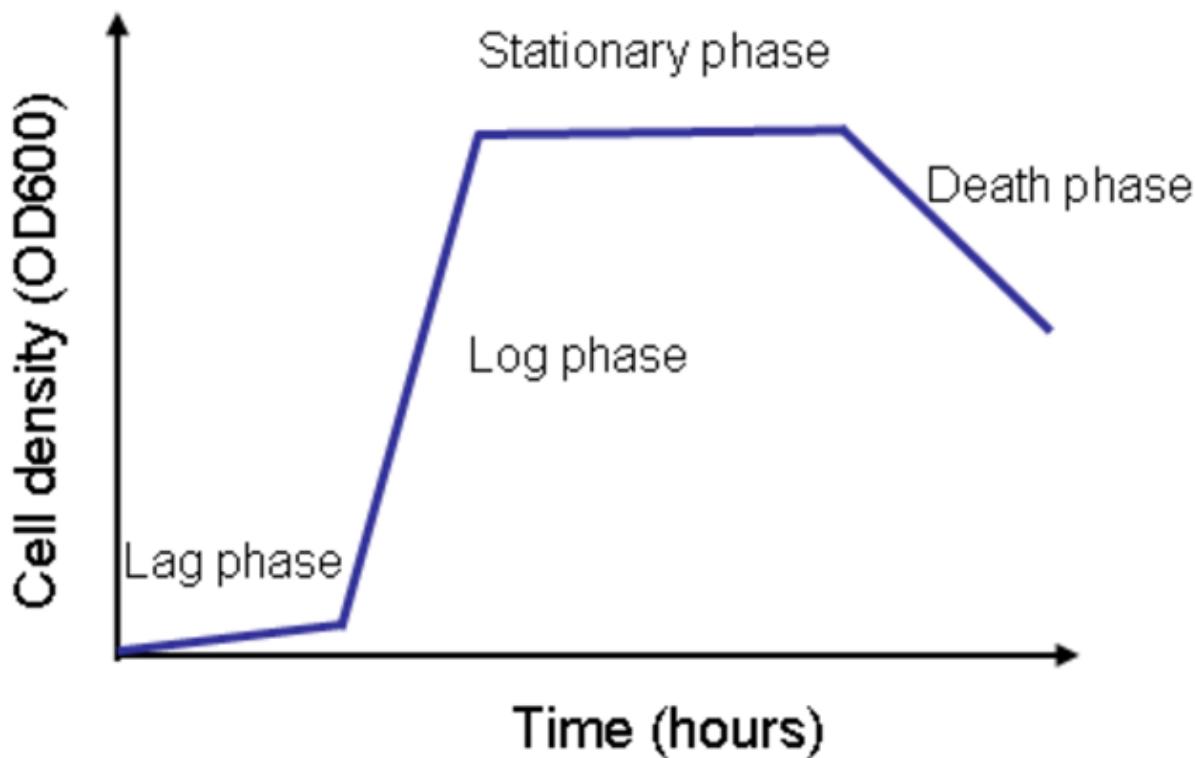
- 26.) What is part 12?
- 27.) What is part 3,4 and 5?
- 28.) Closing part 7 increases what?
- 29.) If you were to view artifacts in the field what part needs to be adjusted? (Give Number)
- 30.) Adding oil to a slide on part 11, would increase the numerical aperture. This happens because the index of refraction is closer to the value of which part?



Part 2: Bacterial Growth



- 31.) How many hours did it take the culture at 15 degrees to reach a population of 9000 bacteria per ml of Culture?
- 32.) How much did the culture at 5 degrees increase by after 4 days?
- 33.) What was the average growth rate of the culture at 10 degrees over the four day period?
- 34.) If we were to run a culture at 7.5 degrees for 3 days, what do you think the population would be after that 3 day period?



Above is a standard diagram of microbial growth. Name the stage that best fits the description. Stages can be used once, more than once, or not at all.

- 35.) If the bacteria was previously in an environment where conditions were more suited toward replication, what stage would be affected most?
- 36.) During this phase rate of cell replication is relatively equal to rate of cell death.
- 37.) Where would an antibiotic that inhibits bacterial peptidoglycan synthesis be most effective?
- 38.) Let's say antibiotics could be produced as a secondary metabolite in this special strain of bacteria. Which phase would these antibiotics be produced?
- 39.) This stage has rapid cell growth.
- 40.) During which phase may false gram staining occur?

Part 3: GRAM STAINS

- 41.) What color should a gram negative bacterium be?
- 42.) What step of the gram stain procedure differentiates gram positive and gram negative bacteria?
- 43.) What part of the bacterium is affected in the step described by question 42?
- 44.) The Gram stain differentiates bacteria based on the composition of this structure?
- 45.) LPS is found in gram positive or gram negative bacteria?
- 46.) There are two famous bacteria that do not stain with the gram stain. Both are pathogenic. Name both. (2 points)
- 47.) If you wanted to do a gram stain of culture from a plate, what must you add to the slide before adding culture?
- 48.) Do you use heat or air to dry the slide?
- 49.) Does age of the culture affect the ability of Gram positive or negative bacteria to stain?
- 50.) True or false: Gram-negative organisms are believed to have a higher lipid content in their cell wall than do gram positive organisms

Part 4: Commercial Bacteria

- 51.) What class of bacteria produce acetic acid from ethanol?
- 52.) Give a possible use of the industrial production of amino acids.
- 53.) Cheese is produced by this process.
- 54.) Buttermilk and swiss cheese have a distinctive taste from a certain byproduct.
Name that byproduct.
- 55.) The molds of what bacterium produces the blue green clumps in blue chess.
- 56.) Propionibacterium produces a substance which makes the holes in Swiss cheese. Name that substance.
- 57.) Rennin is an enzyme used in the production of?

PROCESS	TYPE OF MICROBE
58.) Production of Butter	A.) Eubacteria
59.) Production of Pickles	B.) Archeae
60.) Production of Bread	C.) Fungi
61.) Production of Soy Sauce	D.) Protists
62.) Production of Thermostable enzymes	E.) None of the Above
63.) Production of Coffee	
64.) Sewage Treatment	
65.) production of Toothpaste	

Part 5: Viruses

Match the following

Virus	Type of Nucleic Acid
66.) Hepatitis B	A.) ssRNA
67.) Mumps	B.) dsRNA
68.) Ebola	C.) ssDNA
69.) Dengue	D.) dsDNA
70.) Mononucleosis	

What are the 5 stages of Viral Replication in order from beginning to end.

- 71.)
- 72.)
- 73.)
- 74.)
- 75.)

There are two million new infections of HIV each year with 1 million individuals dying of HIV related causes. Answer these questions about HIV.

- 76.) What types of cells does HIV infect? Be Very Specific!
- 77.) Can we make Antibodies to HIV?
- 78.) What animal is HIV theorized to have come from? (HINT: SIV)
- 79.) Suggest a method to diagnose HIV. You can suggest more than one. No more than three (3 points)
- 80.) Is sex or a blood transfusion more likely to transmit HIV?

Part 6: Bacteria

Fill in the following chart on bacteria: (No more than 2 words in each box, otherwise it is wrong)

	Cholera	Tetanus	Strep Throat	Botulism	Anthrax
Main Mechanism of Immune Evasion	81.)	Surface coating	82.)	None	83.)
Location of Infection (Intracellular or Extracellular)	Extracellular	84.)	85.)	86.)	87.)
Secretes Toxin? (Y/N)	88.)	89.)	90.)	Y	Y
Gram Positive or Negative?	91.)	Positive	Positive	92.)	93.)
Humoral or Cell mediated immunity more important?	Humoral	94.)	95.)	Humoral	Humoral

It is the year 2020, life is good. You are a practicing doctor, the Obama administration is fixing the country, and naturally you have a patient to treat. She complains of fever, slight weight loss, diarrhea, and a cough. You decide to do a X ray and get the below image.

- 96.) What disease do you think she has?
- 97.) Let's say you decide to do a namesake skin test for the disease and it comes up positive, does that mean she has the disease from question 96? (Y/N?)
- 98.) Suggest an explanation for your answer in 97. NO more than 5 words! (2 points)



A 38-year-old HIV-infected man with a CD4 count of 429 cells/mm³ presents with a 5-day history of a skin lesion on his left hand. He describes having a pimple-like lesion on the dorsal surface of his left hand that has now progressed with erythema surrounding the initial lesion. In addition, the lesion has gradually expanded and has become tender. It is shown below. This lesion only appeared after he was in the hospital for retroviral therapies. You suspect it is nosocomial in nature.

99.) What bacteria do you think he is infected with?

100.) What is the most important part in treating this infection? (2 pts)

Fill in the Chart to the Right.

	Chlamydia	Syphilis
Location of Infection (Intracellular or Extracellular)	101.)	Intracellular
Can be transmitted by fomites? (Y/N)	102.)	N
Can be transmitted via birth canal? (Y/N)	Y	103.)
Relative growth rate? (Fast/Slow)	104.)	105.)

Part 7: Fungi

Answer the following questions True or False.

- 106.) All fungi have cell walls made of cellulose.
- 107.) Hyphae are involved in fungi reproduction.
- 108.) Penicillin is a fungi.
- 109.) Wearing white color socks can reduce your risk for Athlete's foot.
- 110.) Wind acts as a vector when transmitting Dutch Elm Disease from Tree to Tree.
- 111.) Ringworm can infect the whole body and become systemic.
- 112.) Tinea capitis is the causative agent of Ringworm.
- 113.) Babies less than a month old are one of the most likely populations to develop Thrush.
- 114.) Alternaria solani is the causative agent of Early Potato Blight.
- 115.) Ergotism can lead to gangrene.

Answer these questions about Histoplasmosis:

- 116.) What body system does Histoplasmosis affect?
- 117.) How do people MOST LIKELY get Histoplasmosis? (What do they come into contact with)
- 118.) How does it enter their body?
- 119.) How is Histoplasmosis usually diagnosed and confirmed?
- 120.) How is it treated?

Part 8: Protozoans

Plasmodium falciparum can evade the immune system via antigenic variation.

121.) What is antigenic variation (in general)? (2 points)

122.) How does P. falciparum each undergo antigenic variation

123.) What cells do these antigenic variation occur on?

124.) If we were to make a vaccine against Plasmodium falciparum while it was in RBCs, what form of the protozoan would we be targeting?

Giardia is a nasty protozoan disease as well:

125.) What kind of antibodies do we produce against Giardia? (Hint: It infects the mucosa)

Part 9: Prion Diseases

126.) Why does "Mad Cow disease" (better known as bovine spongiform encephalopathy (BSE) in cows and variant CJD in humans) take many years to develop in humans AFTER they eat scrapie prion protein (PrPsc)infected beef products? (3 points)

127.) What is this process called?

Part 10: Parasitic Worms

128.) Schistosoma mansoni is a trematode that feeds on blood. Which of the following is not a characteristic of this parasite?

- A) larvae penetrate host skin
- B) causes bloating from ascites fluid in abdomen
- C) you can get it by walking on contaminated soil
- D) adult worm lives in the bloodstream of the host

129.) Which of the following parasites can form cysts in the muscle cells of an infected host?

- A) Pinworm
- B) Hookworm
- C) Tapeworms (*Taenia solium*)
- D) Trichinella
- E) A and B
- F) B and D
- G) C and D

130.) What is the most common infection in the US?

- A) Pinworm
- B) Hookworm
- C) Tapeworms (*Taenia solium*)
- D) Trichinella