

Antibiotics

I. General Terms

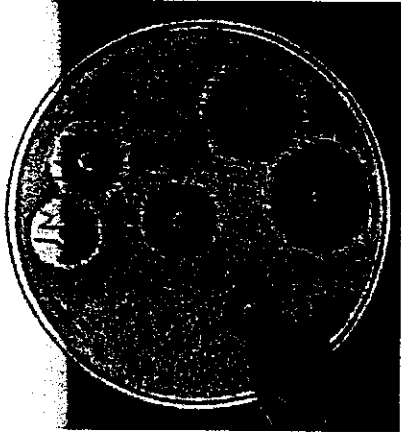
- A. : a type of substance produced by microbes of other microbes. Antibiotics do not harm (polymyxin, bacitracin) or (streptomycin, tetracycline, erythromycin, kanamycin, neomycin, myristatin).
 2. Should be extremely (unaffected by), effective in and have)
- B. 1 (drug) any that is used in medicine.
 2 : one made by
 3 : one made by and
- C. agent: an agent that the (penicillins)
- D. agent: bacteria growth by interfering with (tetracycline and erythromycin)
- E. antibiotic: acts on both and bacteria

II. Mechanisms of Action of Antibiotics

- A. involved in the of a : interferes with the function of the
 - Chloramphenicol, erythromycin, streptomycin, tetracyclines
- B. : interferes with and
- C. which causes the cell wall to be and eventually leads to
 - only affect
 - Bacitracin, vancomycin, cephalosporins, penicillin
- D. can cause a change in of the cell and

III. Evaluating an Antimicrobial Drug

- A. (Kirby-Bauer): Microorganisms are impregnated with various on agar plates
 Cleared indicate



Staphylococcus aureus (MRSA)

III. Resistance

- A. the antibiotic is : A bacteria that was formerly by it. and subsequent rate of resistance.
 1 Results from
 2 of antibiotics has
- B. Other Examples:
 1 infections: infections acquired during a
 2 Genus : gram, resistant to and
 3 causes ; resistant to and
 4 are resistant to

ENLARGE & COPY IN YOUR NOTEBOOK....

Family of Antibiotics	Produced by	Effective against pathogens & diseases?	Mode of action	Side Effects	
PENICILLIN	Naturally by				
AMINOGLYCOSIDES	Synthetic derivative				
TETRACYCLINE	Semi-synthetic				
CHLORAMPHENICOL	Semi-synthetic				
CEPHALOSPORIN					
VANCOMYCIN					
BACITRACIN					
CYCLOSERINE					
POLYMYXIN					
ERYTHROMYCIN					
RIFAMPIN					

Families of Antibiotics

BCB: ANTIBIOTICS- PENICILLIN

1. Where are antibiotics produced in nature? Why would it be advantageous for a microbe to produce antibiotics?
 - a. Name the species of bacteria that produce antibiotics.
 - b. Name the species of fungi that produce antibiotics.
2. List the 3 mechanisms antibiotics use to inhibit the growth of other microbes.
3. Describe two evolutionary tactics evident in bacteria that make them resistant to Penicillin.

BCB: ANTIBIOTICS

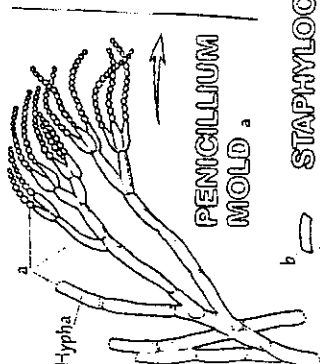
1. What is the difference between narrow spectrum and broad spectrum antibiotics?
2. Generally speaking, what are semi-synthetic antibiotics?

BCB: ANTIBIOTIC SUSCEPTIBILITY TEST

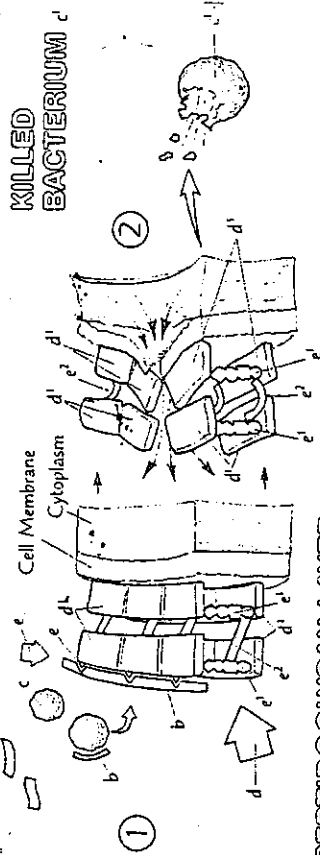
1. Before appropriate antibiotics can be prescribed, the physician must know what?
2. Outline the clinical process of preparing an unknown pathogen for antibiotic susceptibility. Start with obtaining the culture thru incubation.
3. What might the results look like if the pathogen IS susceptible to an antibiotic?
4. What might the results look like if the pathogen IS NOT susceptible to an antibiotic?

ANTIBIOTICS: PENICILLIN

PENICILLIN ^b



STAPHYLOCOCCUS ^c



PEPTIDOGLYCAN LAYER ^d

CARBOHYDRATE SHEET ^{d'}

PENICILLIN-BINDING PROTEIN ^e

AMINO ACID SIDE CHAIN ^{e'}

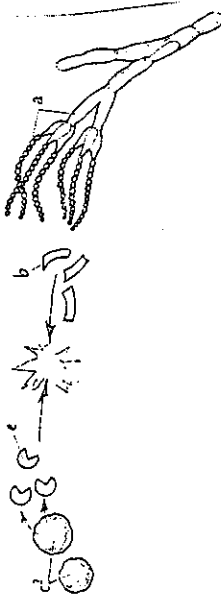
PEPTIDE CROSS BRIDGE ^{e''}

PENICILLIN RESISTANCE ^{*}

PENICILLIN ^b

PENICILLIN RESISTANT BACTERIA ^c

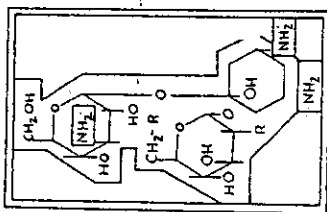
PENICILLINASE ^e



ANTIBIOTICS

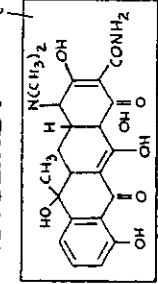
STREPTOMYCES ^a

AMINOGLYCOSIDE ^b



STREPTOMYCIN ^{b'}

TETRACYCLINE ^c



OXY-TETRACYC. ^{e'}

CHLOR-TETRACYC. ^{e''}

DOXYCYC. ^{e'''}

MINOCYC. ^{e''''}

AMINOGLYCOSIDE ^b

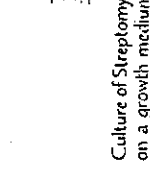
KANAMYCIN ^{b^s}

AMIKACIN ^{b^t}

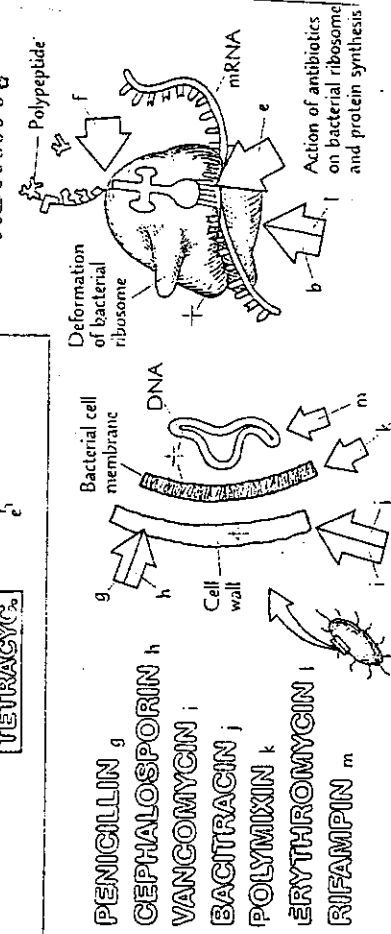
NEOMYCIN ^{b¹}

GENTAMYCIN ^{b²}

CHLORAMPHENICOL ^f

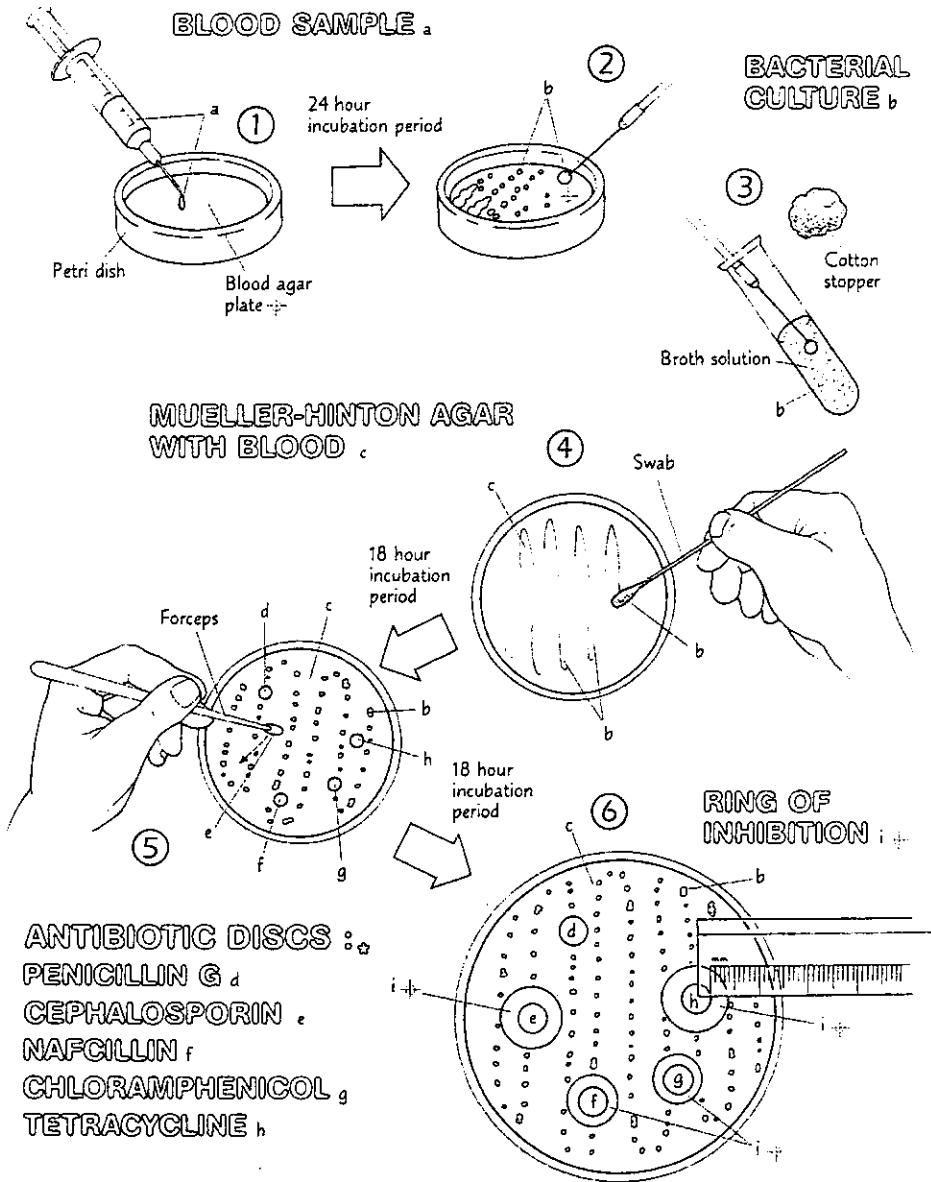


SITES OF ANTIBIOTIC ACTIVITY ^{*}



ANTIBIOTIC SUSCEPTIBILITY TEST

ANTIBIOTIC
SUSCEPTIBILITY TEST



Antibiotic Sensitivity

Pre-lab

1. DEFINE:

- chemotherapeutic agent
- selective toxicity
- serendipitous (look it up!)
- antibiotic
- synthetic
- semi-synthetic
- narrow spectrum
- broad-spectrum
- microstatic
- microcidal
- antibiotic resistance
- Zone of Inhibition

2. Explain how the discovery of Penicillin was serendipitous.

3. Why aren't antibiotics effective against viruses? (HINT: Think about how antibiotics work.)

4. When would it be advantageous for a physician to prescribe a broad spectrum antibiotic such as Penicillin instead of a narrow spectrum antibiotic?

5. Because of rapid bacterial resistance to current antibiotics, there is a constant search for new antibiotics. What would be the five characteristics of an ideal antibiotic?

6. How are antibiotics used in agriculture? Do you think consumers have the right to know if antibiotics have been used in the process of their food production?

7. What aseptic techniques will you be using in this lab?

8. Write a hypothesis in if/then format, stating which antibiotic(s) will inhibit the growth/prohibit the growth of each type of bacteria. Use info from the background, textbook and BCBs.

9. What is the purpose of using the blank disk? What do you expect to see in this area when you check the results?

10. Why is it important to place the antibiotic disks in the middle of the quadrant? (HINT: Think about what the results might look like if the disk was too close to the edge.)

RESULTS:

- Draw the Petri dishes and the growth you observe. Date each drawing. Label bacteria species and location of antibiotic disks.
- Copy this table into your RESULTS section in your scientific notebook. With a millimeter ruler, measure the size of the clear zone surrounding each disk. If no clear zone is present, i.e. the bacteria are growing right up to the disk, record the measurement as zero.

Table 1. Inhibition of Bacterial Growth by Antibiotics (Zone of Inhibition in mm)

Disk	24 hours	48 hours
Antibiotic	<i>B. subtilis</i>	<i>E. coli</i>
Streptomycin		<i>E. coli</i>
Tetracycline		
Penicillin		
Erythromycin		
BLANK	center	

DATA ANALYSIS: Answer incomplete sentences.

- Which antibiotic was *most* effective against
 - both species?
 - Gram negative bacteria?
 - Gram positive bacteria?
- Which antibiotic was *least* effective against
 - both species?
 - Gram negative bacteria?
 - Gram positive bacteria?
- Did any antibiotic affect the two species differently? Which antibiotic(s)? Explain.

CONCLUSION:

Explain how the results relate to your original hypothesis. Discuss experimental errors that may have affected your data.

Rise of Antibiotic Bacteria

Name _____

- 1) What has the overuse of antibiotics led to?
- 2) How many types of antibiotics are available?
- 3) What is vanomycin?
- 4) How does bacteria become antibiotic resistant?
- 5) Explain what happened in the 1940's with antibiotics.
- 6) Explain what happened in the 1950's with antibiotics.
- 7) What happened as doctors prescribed antibiotics as a quick fix?
- 8) What is the amount of antibiotics not administered properly?
- 9) Humans only constitute half of antibiotic use, where does the rest get used?
- 10) List some evidence or data showing the rise of antibiotic resistant bacteria.
- 11) Who needs to be educated about inappropriate antibiotic use?
- 12) What do they need to be taught?
- 13) What type of research are concerned organizations calling for?

ARTICLE: Vancomycin Resistant Bacteria

- 1) What is enterococcus?
- 2) How does Vancomycin work on killing the enterococcus bacterial cells?
- 3) Why don't doctors use penicillin any more to treat enterococcal infections?
- 4) How long ago was Vancomycin discovered?
- 5) 25% of inner city patients are infected with VRE, what problems can arise for these VRE infected patients?
- 6) Besides the health problems that arise for VRE patients, what else does the CDC think is a problem for VRE patients?
- 7) TRUE or FALSE: There are other antibiotics besides Vancomycin to treat enterococci.
- 8) What causes a bacteria to have resistance to Vancomycin?
- 9) Who are most at risk for VRE?
- 10) How is VRE spread?
- 11) How can one prevent VRE infection?
- 12) How long can the bacteria live on the hands of a healthcare worker?
- 13) TRUE or FALSE: Some hospitals will quarantine patients with VRE to prevent spread of the infection.

ARTICLE: Got Cipro?

1. What antibiotic is used to treat Anthrax?
2. Why are bacteria able to evolve so quickly?
3. What mechanisms do antibiotic resistant bacteria use to outwit the drug?
4. What are two mechanisms of resistance? Explain each.
5. Which mechanism led to antibiotic resistant Cipro?
6. What initiates plasmid transfer? Why is it considered an evolutionary advantage?
7. According to this article, how can we slow the development of antibiotic resistant bacteria?

BACTERIAL REPRODUCTION

I. Bacteria reproduce by

II. Bacteria reproduce by one of three special means.

A. exchanging genetic material

1. Exchange of and provides for
2. Increases the chances that some bacteria will survive the environment changes.
3.
 - a. Confers to another bacterium.
 - b. Bacteria attach together using specialized.
 - A bridge of cytoplasm, a forms between two bacteria cells.
 - A duplicate plasmid is transferred from the to the
4.
 - a. F+ plasmid and chromosome (high frequency of recombination). Cell is called a
 - b. Duplicate is made of Hfr chromosome/plasmid and passed through to F-
 - c. F- integrates Hfr genetic material into its own and is now called a

B. which bacteria cells pick up and from dead bacterial cells of the same or a closely related species

1. Results in the
2. demonstrated transformation:

a. inoculated three groups of mice with 3 different strains of *Streptococcus pneumoniae*

- S Strain: pathogenic, mice =
- Heat Killed S Strain: mice =
- R Strain: mice =

b. inoculated a group of mice with a Strain and R Strain: mice
• blood sample showed only present.

3. Process

- a. starts with an of DNA from a ruptured bacterium.
- b. nearby R strain will pieces of DNA and a segment of its own DNA with this new segment.

C. involves the use of a to transfer DNA from one bacterium to another.

1. Viruses called carry DNA between cells.

- a. Bacteriophage to a hole in the cell wall
- b. Phage DNA is into bacterium.
- c. cut up bacterial and phage DNA into segments.
- d. Segments are enclosed in and eventually are from bacterium when it ruptures.
- e. New viruses free to

2. Used in to alter bacteria to make large amounts of for research and medicine. need by diabetics.

Genetic Transfer

1. Define VERTICAL GENE TRANSMISSION:

2. Name the three main mechanisms microbes use for genetic recombination.

- a.
- b.
- c.

3. Define HORIZONTAL GENE TRANSMISSION:

4. What are some examples of traits that are acquired through horizontal transmission?

5. What is one example of a disease that acquires virulence through horizontal transmission?

6. What is the role of a bacteriophage in transduction? How does the piece of bacterial DNA get transferred?

7. What is transferred during conjugation? What is the ultimate genetic relationship between the donor and the recipient cell?

8. How is there free floating DNA in the environment? Are all cells competent for transformation?

9. What is transposition? What are transposons? What might a transposon code for?

10. How is transposition different than the other mechanisms of genetic recombination?

11. What viral disease has affected the Casaba plant? What effect does it have on the plant? How does it spread?

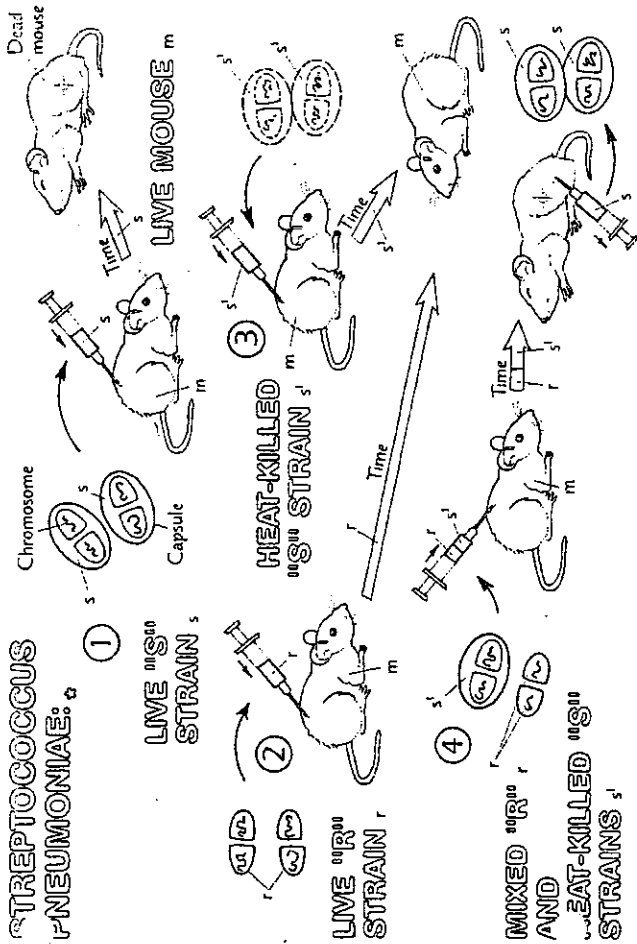
12. How has the Casaba plant been genetically modified? Describe the process including the role of Agrobacterium. What trait does the modified Casaba now have?

13. Why can't the genetically altered Casaba plants be grown in Africa?

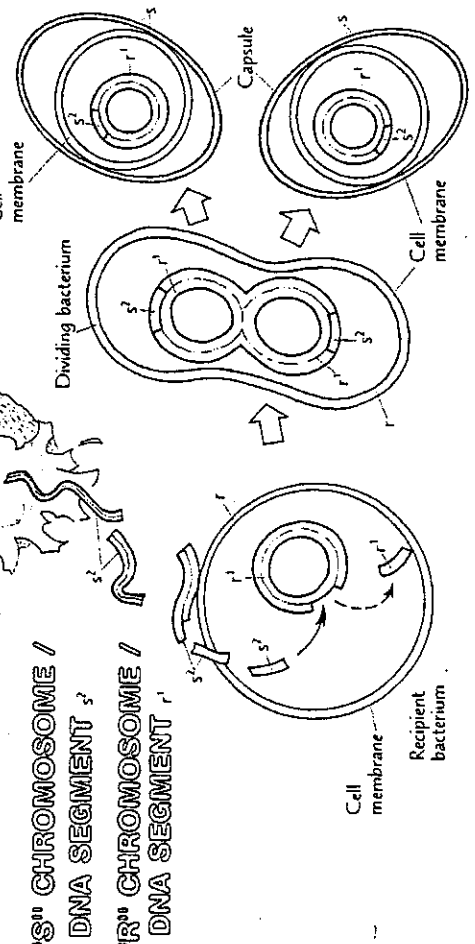
14. Describe the research Dr. So is working on in her lab. How does she test for competence?

BACTERIAL TRANSFORMATION

STREPTOCOCCUS PNEUMONIAE:



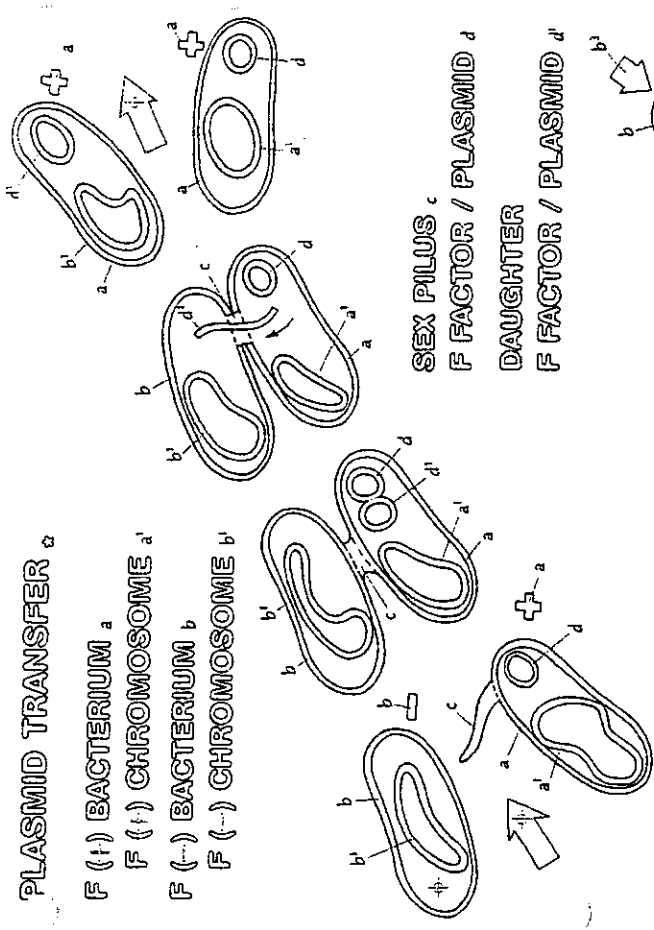
PROCESS OF TRANSFORMATION



BACTERIAL CONJUGATION

PLASMID TRANSFER

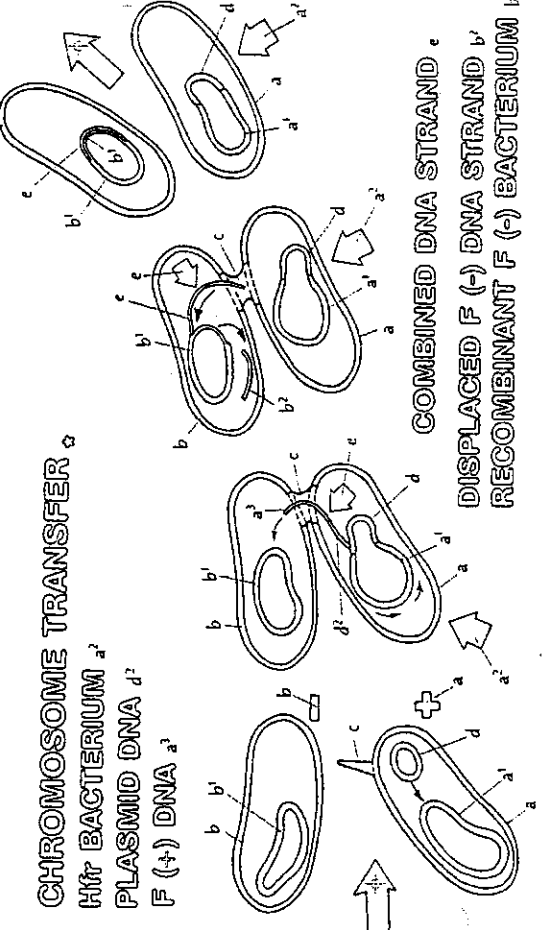
- F (+) BACTERIUM
- F (-) CHROMOSOME
- F (-) BACTERIUM
- F (-) CHROMOSOME



SEX PILUS
F FACTOR / PLASMID
DAUGHTER
F FACTOR / PLASMID

CHROMOSOME TRANSFER

- Hfr BACTERIUM
- PLASMID DNA
- F (+) DNA



COMBINED DNA STRAND
DISPLACED F (-) DNA STRAND
RECOMBINANT F (-) BACTERIUM

BACTERIAL TRANSDUCTION

GENERALIZED TRANSDUCTION

BACTERIAL WALL b
CHROMOSOME b'
DNA SEGMENT b^2

BACTERIOPHAGE PROTEIN COAT a

PHAGE DNA a'

②

①

ENZZYME c

Cytoplasm

Receptor Site

③

SPECIALIZED TRANSDUCTION

DONOR BACTERIUM e / DNA e'

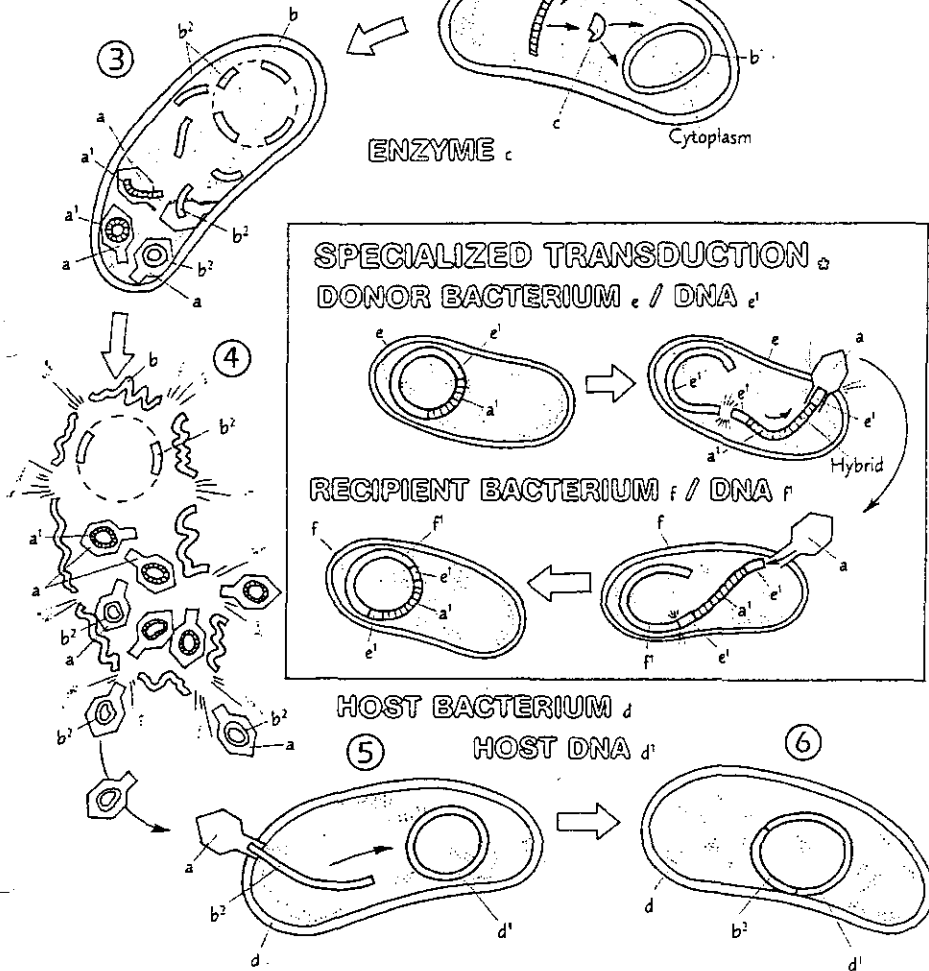
RECIPIENT BACTERIUM f / DNA f'

HOST BACTERIUM d

HOST DNA d'

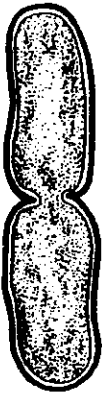
⑤

⑥



Bacterial Growth

A single bacterium reproduces by dividing into two bacteria. This process, shown in the illustration at the right, is known as *fission*. All of the essential cell machinery is duplicated beforehand so that each new cell is an exact copy of the parent. As this process occurs over and over again, the bacteria are said to be "growing." What this really means is that they are increasing in number.



Dr. Hideyo Noguchi's research concentrated on disease-causing bacteria. People infected with disease-causing bacteria get sicker as the bacteria multiply. To cure these diseases, bacterial growth must be stopped. Antibiotic drugs that are used to treat diseases stop bacterial growth by interfering with some step in the process of fission. Penicillin, an antibiotic used in the treatment of syphilis and other bacterial infections, interferes with the process of building new cell walls.

In this activity, you will set up a bacterial "growth chart" to examine how fast the number of bacteria increases when they are allowed to grow unchecked.

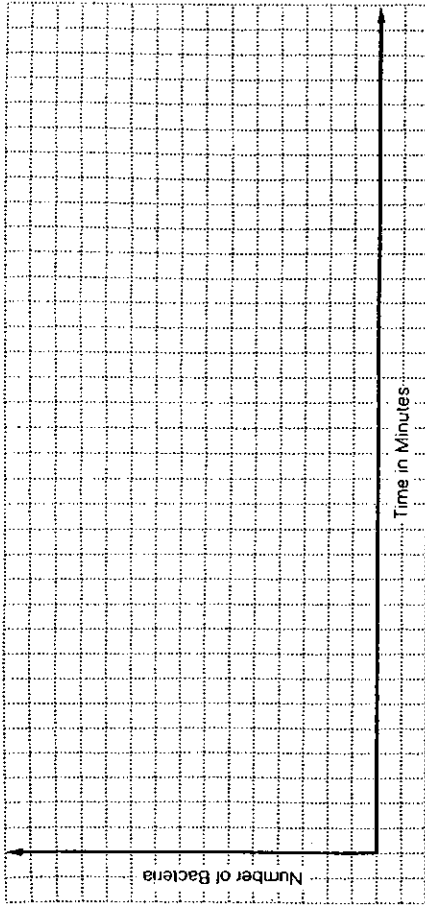
Growth Data

- Suppose a type of bacteria divides every twenty minutes. Fill in the chart below.

Time in Minutes	Number of Divisions	Number of Bacteria
0	0	1
20	1	2
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Graphing Bacterial Growth

- Construct a graph of the growth data using the axes provided below.



- Based on your data, how many bacteria do you predict there will be after 6 hours. Show your calculations below.

- Based on your graph, what do you think will happen to the number of bacteria as time goes on?

- Can the number of bacteria continue to increase indefinitely? Why or why not?

- Develop a general formula for calculating the number of bacteria after n divisions.

NOTES: The Bacterial Genome

I. The _____ is the sum total of _____ the genetic material in a cell _____ and _____
A. Prokaryote: _____

1. up to 1000x longer than the cell itself, _____ of total volume
B. Eukaryote: _____

1. up to 180,000x longer than the cell itself

II. A _____ is a discrete cellular structure composed of tightly coiled _____

A. Prokaryote: _____ strand of DNA

B. Eukaryote: _____ DNA tightly wound around _____, vary in _____ or singles (_____)

III. A _____ is a segment of _____ that contains the necessary code to make a _____

A. AKA _____ Fundamental unit of _____ responsible for a given trait

B. AKA _____ Site on the _____ that provides information for a certain _____

IV. _____ is a macromolecule composed of individual repeating units called _____

A. Nucleotide consist of three parts.

1. _____
a) Covalently bonded to two sugar molecules

2. _____ : 5 carbon sugar in ring arrangement

a) Carbons are numbered 1 - 5 which gives each DNA strand direction

3. _____
a) Purines:

b) Pyrimidines:

B. Nitrogenous bases are held together by bonds according to the _____ rule.

1. adenine pairs with _____

2. cytosine pairs with _____

C. DNA is a _____

1. Structure _____ = sides = _____

a) _____

b) _____

rungs

2. Arrangement _____

a) Sides oriented in an _____ arrangement.

(1) one helix runs from the _____

to _____ direction.

(2) the other runs from the _____

to the _____ direction.

b) significant in DNA _____ and _____

Bacterial DNA Replication

- I. Process of making two copies of a double helix by using each side as a strand for the new strand. This is called replication and insures the new strands are copies of original.

II. Steps in the Process is synthesized and attaches at the

- B. disrupts the N bonds and exposes the nitrogen bases. moves along strand synthesizing 2 new strands at the

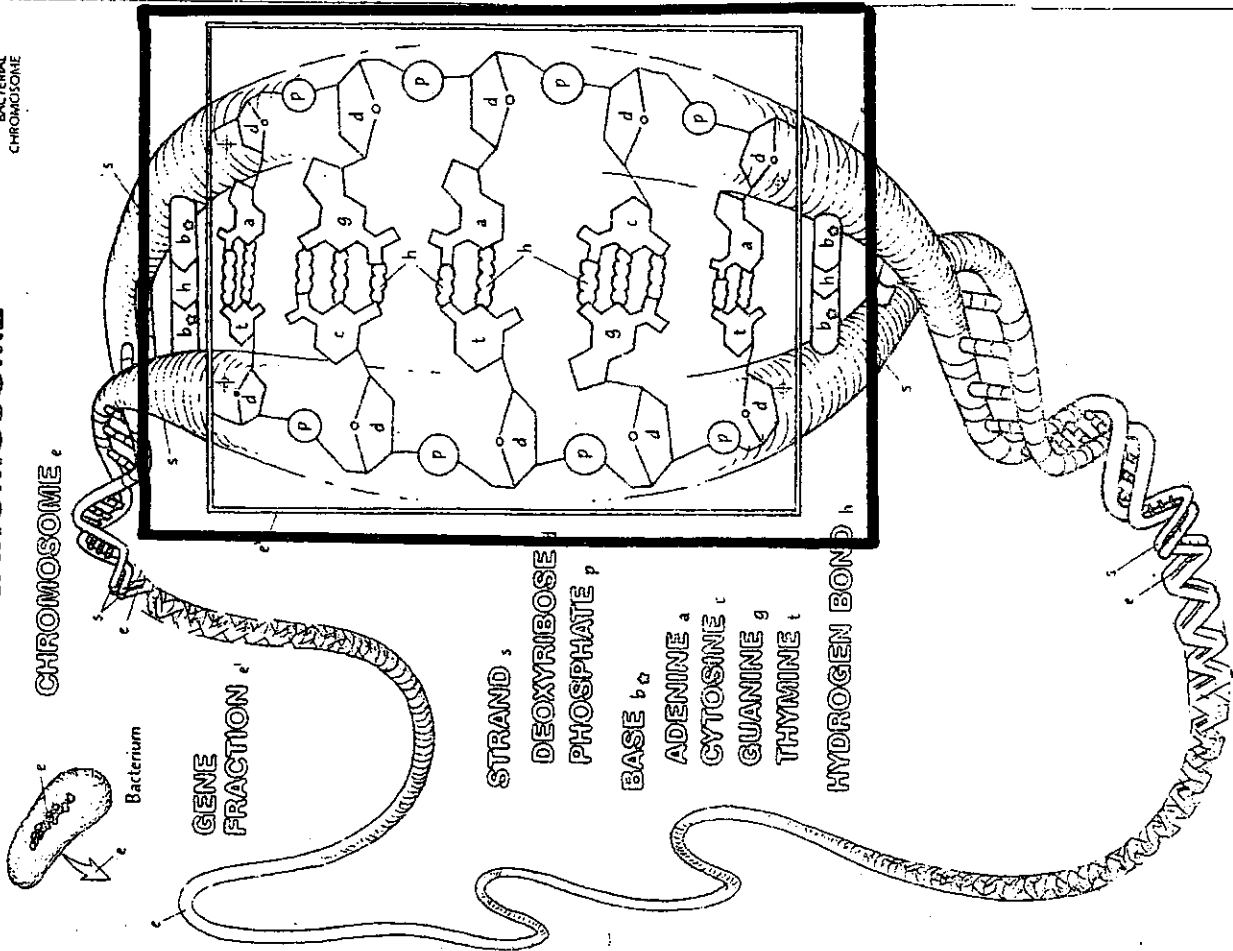
- A. acts in the 5' to 3' direction only
B. Forms a continuous strand in that direction

- C. The other strand which orients 3' to 5', must be made in short sections (5' to 3') called Okazaki fragments which are later joined together by the enzyme called DNA ligase.

III. Proofreading enzymes monitor the process to correct errors that can result in mutations.

THE BACTERIAL CHROMOSOME

21
BACTERIAL
CHROMOSOME



CHROMOSOME

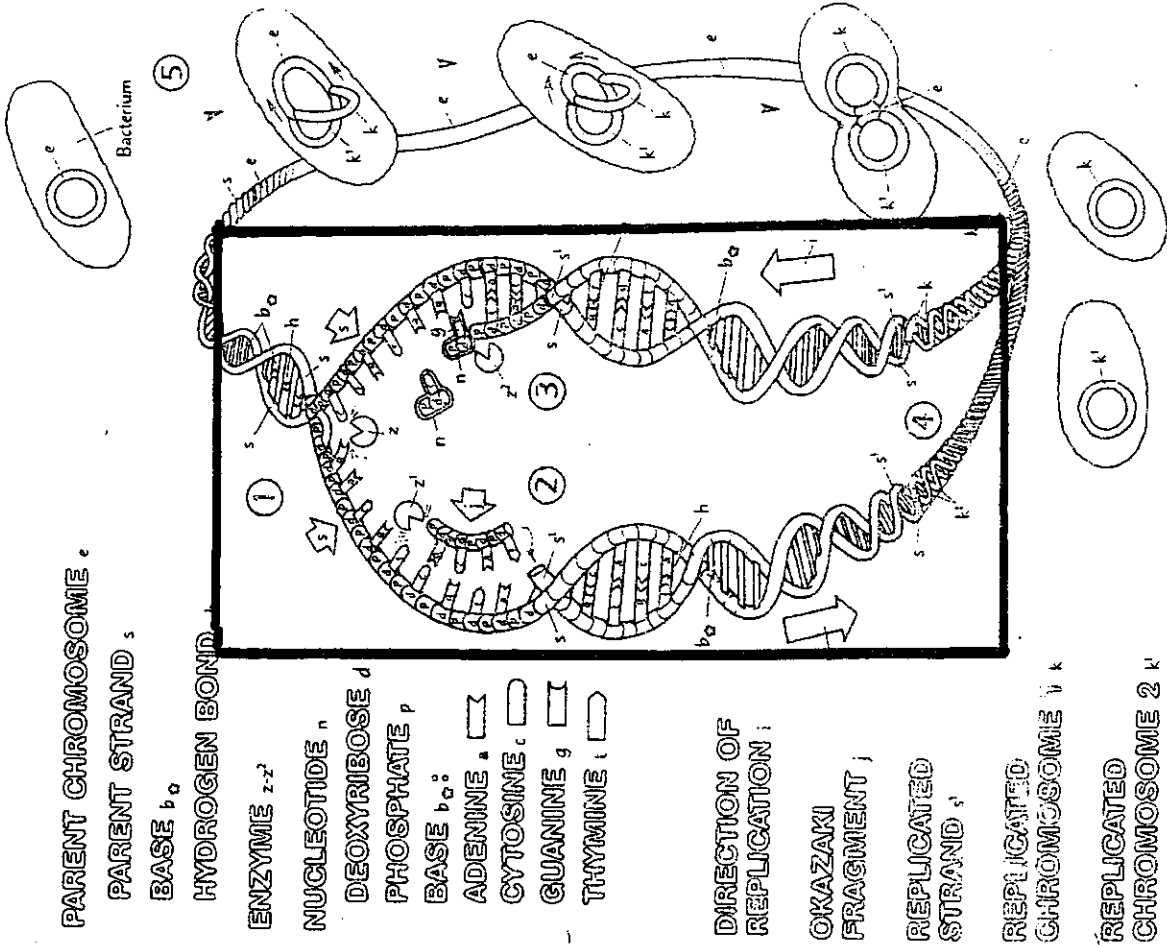
Bacterium

GENE FRACTION

STRAND
DEOXYRIBOSE
PHOSPHATE
BASE
ADENINE
CYTOSINE
GUANINE
THYMININE
HYDROGEN BOND

BACTERIAL CHROMOSOME REPLICATION

22
BACTERIAL
CHROMOSOME
REPLICATION



PARENT CHROMOSOME

PARENT STRAND

BASE

HYDROGEN BOND

ENZYME
NUCLEOTIDE
DEOXYRIBOSE
PHOSPHATE
BASE
ADENINE
CYTOSINE
GUANINE
THYMININE

DIRECTION OF REPLICATION

OKAZAKI FRAGMENT

REPLICATED STRAND

REPLICATED CHROMOSOME

REPLICATED CHROMOSOME 2

Bacterium

TRANSCRIPTION TRANSLATION and PROTEIN SYNTHESIS

- I. Information in _____ is converted to _____ by the process of _____ and _____
- A. _____ make up cell parts
 - B. _____ control an organisms metabolic activity = _____
- II. _____ is the formation of _____ using _____ as a template.
- A. Starts when _____ segment of _____ attaches to the _____ called the _____
 - B. _____ advances _____ in the _____ direction _____ synthesizing a _____ molecule _____ to the _____ strand of _____ (Remember R.N.A replaces _____ with _____)
 - C. Transcription continues until the _____ reaches the _____ code that signals the _____ and _____ of the _____ strand.

III

_____ occurs when the _____ is used to direct the synthesis of _____ on the _____ on the _____ pair with _____ to assemble a string of _____

- A. _____
- B. Continues until a _____ is reached.

IV. The message in mR.N.A is carried in the _____

- A. The Genetic Code is _____ for all living things.
- B. Codes for the _____ of _____ in a _____

I INTERPRETING THE GENETIC CODE

DNA	mRNA codon	Amino Acid
T		
A		
C		
C		
G		
A		
G		
G		
C		
A		
A		
G		
A		
T		
T		

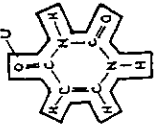
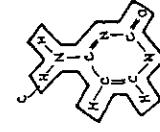
II

DNA	mRNA codon	Amino Acid
	U	
	A	
	G	
	C	
	A	
	A	
	C	
	U	
	U	
	G	
	A	
	C	
	U	
	G	
	A	

THE GENETIC CODE.

mRNA BASES.

ADENINE^A
 CYTOSINE^C
 GUANINE^G
 URACIL^U



AMINO ACIDS.

ALANINE^A
 ARGinine^R
 ASPARAGINE^E
 ASPARTIC ACID^D
 CYSTEINE^C
 GLUTAMINE^Q
 GLUTAMIC ACID^E

GLYCINE^G
 HISTIDINE^H
 ISOLEUCINE^M
 LEUCINE^L
 LYSINE^K
 METHIONINE^M
 PHENYLALANINE^F

PROLINE^P
 SERINE^S
 THREONINE^V
 TRYPTOPHAN^W
 TYROSINE^Y
 VALINE^V

STOP CODON.

SECOND mRNA BASE.

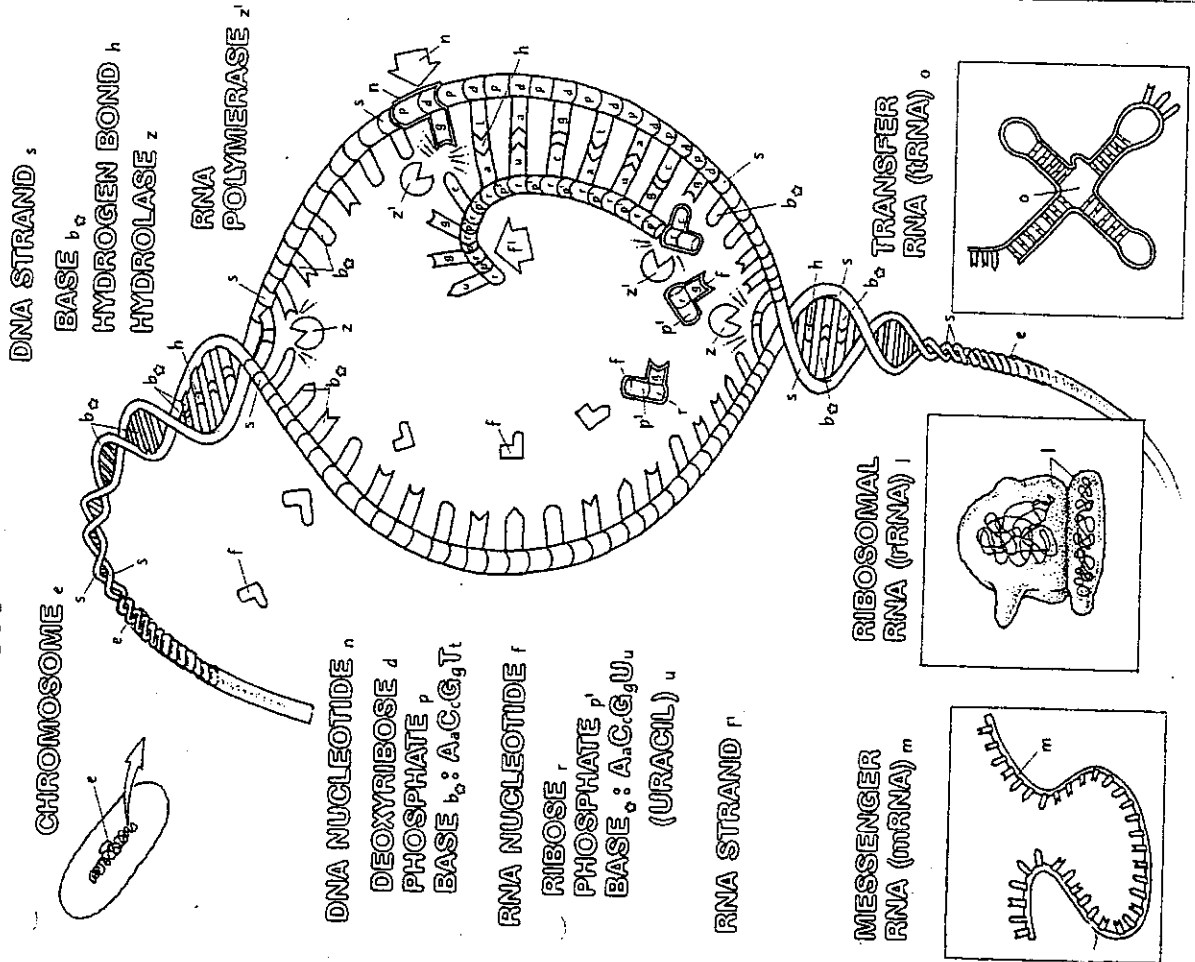
U ^U	C ^C	A ^A	G ^G
UUU	UCU	UAU	UCU
UUC	UCC	UAC	UGC
UUA	UCA	UAA	UGA
UUG	UCG	UAG	UGG
CUU	CCU	CAU	CGU
CUC	CCC	CAC	CGC
CUA	CCA	CAA	CGA
CUG	CCG	CAG	CGG
AUU	ACU	AAU	ACU
AUC	ACC	AAC	ACG
AUA	ACA	AAA	AGA
AUG	ACG	ARG	AGG
GUU	GCU	GAU	GGU
GUC	GCC	GAC	GGC
GUA	GCA	GAA	GGA
GUG	CGG	GAG	GGG

FIRST mRNA BASE

THIRD mRNA BASE

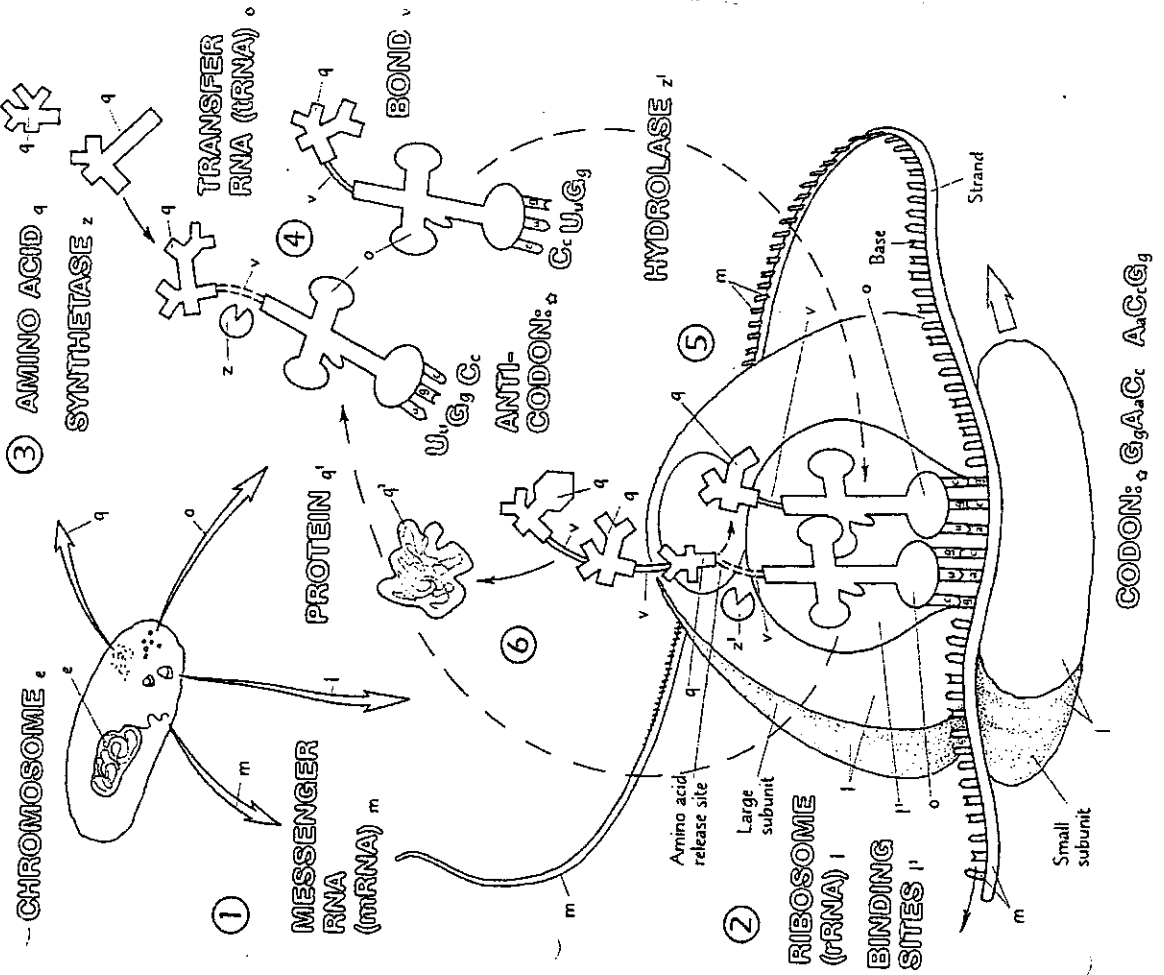
PROTEIN SYNTHESIS: TRANSCRIPTION

23
PROTEIN SYNTHESIS:
TRANSCRIPTION



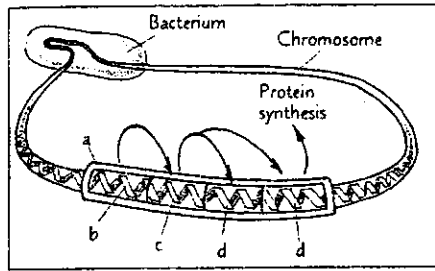
PROTEIN SYNTHESIS: TRANSLATION

24
PROTEIN SYNTHESIS:
TRANSLATION



REGULATION OF PROTEIN SYNTHESIS

REGULATION OF PROTEIN SYNTHESIS

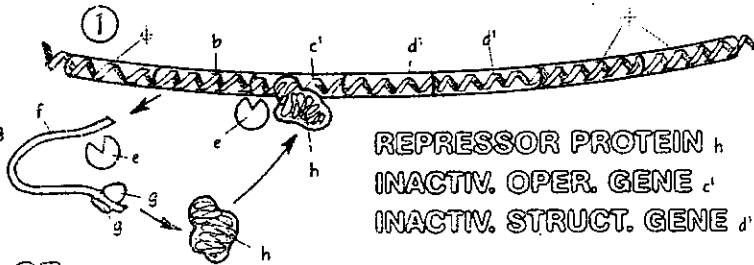


OPERON

- REGULATOR GENE *b*
- OPERATOR GENE *c*
- STRUCTURAL GENE *d*

OG OFF +

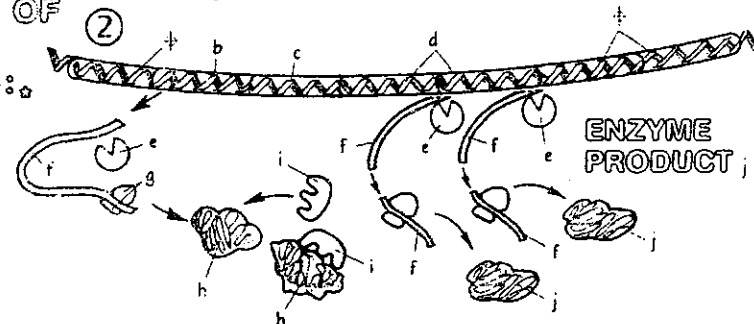
- ENZYME *e*
- mRNA *f*
- RIBOSOME *g*



- REPRESSOR PROTEIN *h*
- INACTIV. OPER. GENE *c'*
- INACTIV. STRUCT. GENE *d'*

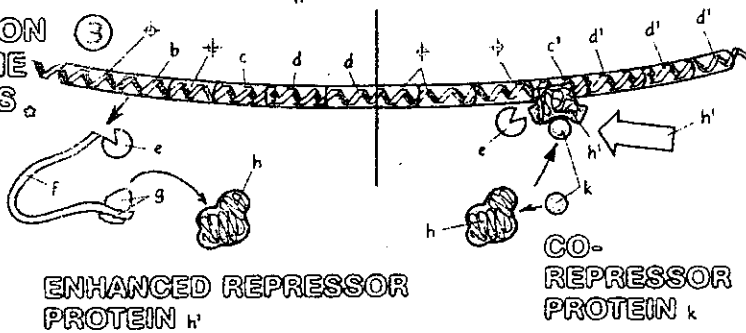
- INDUCTION OF ENZYME SYNTHESIS:
- OG ON

INDUCER *i*



ENZYME PRODUCT *j*

- REPRESSION OF ENZYME SYNTHESIS



BCB: Regulation of Protein Synthesis

1. Genes code for the production of which macromolecule?
2. Why is it important for a cell to be able to control gene expression?
3. List and describe the three kinds of functional genes in an operon.
 -
 -
 -
4. Where is operator gene and the regulator gene located relative to the structural genes in an operon?
5. C/C the structure and function of an INDUCTION OPERON and a REPRESSION OPERON.

TRANSLATING THE CODE

1. The code of life is contained in the molecule _____ which codes for the making of _____
2. In order for the code contained in DNA to be understood by the cell, _____ and _____ must occur.
3. _____ synthesizes _____ from _____. This molecule takes the info to the _____ where _____ bring in _____ which bond together to make a _____
4. Changes in DNA are called _____ and produce _____
5. Why is genetic variety essential to species survival?
6. What role do enzymes play in preventing mutation?
7. What is an example of a beneficial mutation that has occurred in a microbe?
8. Why are mutations seen more frequently in microbes than in eukaryotes?
9. According to the video, what percentage of antibiotic prescriptions by doctors are inappropriate?

10. What is the source of the genetically modified microbes in the Ukraine lab? What happened here?
11. How did the surviving soil microbes demonstrate Natural Selection?
12. Why are the scientists collecting these soil microbes? What are they hoping to find?
13. Why are the soils samples different even though they are collected from virtually the same location in the same park?
14. Why can't most soil microbes be grown in lab?
15. How is DNA technology helping to overcome this obstacle?
16. Bacteria transfer antibiotic resistance via which process?
17. What evidence does Teragen have that there is a new antibiotic in the harvested soil samples?
18. Why does a cell control when a gene is expressed?

ACTIVITY: WHAT IS YOUR DNA ALIAS?

Pre-Activity

Relate the following: nucleotide bases, genes, amino acids, DNA proteins, genome, chromosome, translation, transcription. **DO NOT LIST AND DEFINE!** Instead, explain the relationship to each other in terms of structure and function. (Variations of the terms are okay).

2 Use the base pairing rules and the Genetic Code to fill in the missing info. It is possible in some boxes that answers will vary. Label transcription, translation, protein, codon, DNA, mRNA, amino acid. (HINT: Start with 'a' and proceed alphabetically).

d) → e) →

a)	b)	c)	Methionine
A		f)	
G			
A			
		G	
		U	
		G	
			Proline
T			
C			
C			
		U	
		A	
		A	

g) →

DATA:

Letters in your name: _____

Codon replacement for each letter: _____

Color translation for each base: _____

DATA ANALYSIS:

Compare the sequence of colors in your strand with the sequence in the strands of your classmates. Scientists are doing the same kind of thing when they compare the different combinations of proteins that are found in living things.

1. It is possible if you have the same name as one of your classmates that your strand would be an exact match. What is the only situation when this is possible in "real-life" inheritance?

2. With only four nitrogen bases coding for only 20 amino acids, why don't exact DNA matches happen more often?

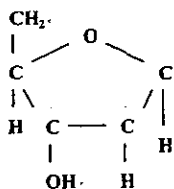
3. If your entire name represents a protein, what would each letter represent? What would the entire sequence of DNA that codes for your name be analogous to? If you made a strand of your complete first, middle and last names, what would this be analogous to?

ACTIVITY: Origami DNA Model

DNA Structure Color Key:

DEOXYRIBOSE =

(a five carbon sugar; number the carbons on your model #1 - #5 to identify the 5' and 3' ends)



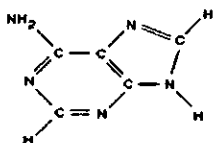
PHOSPHATE GROUP =



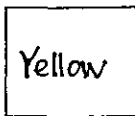
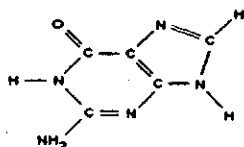
NITROGENOUS BASE

The purines

Adenine =

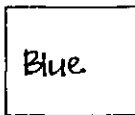
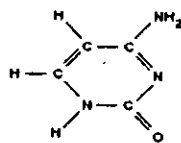


Guanine =

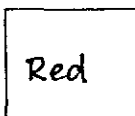
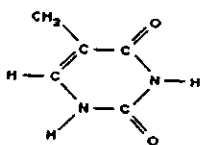


The pyrimidines

Cytosine =

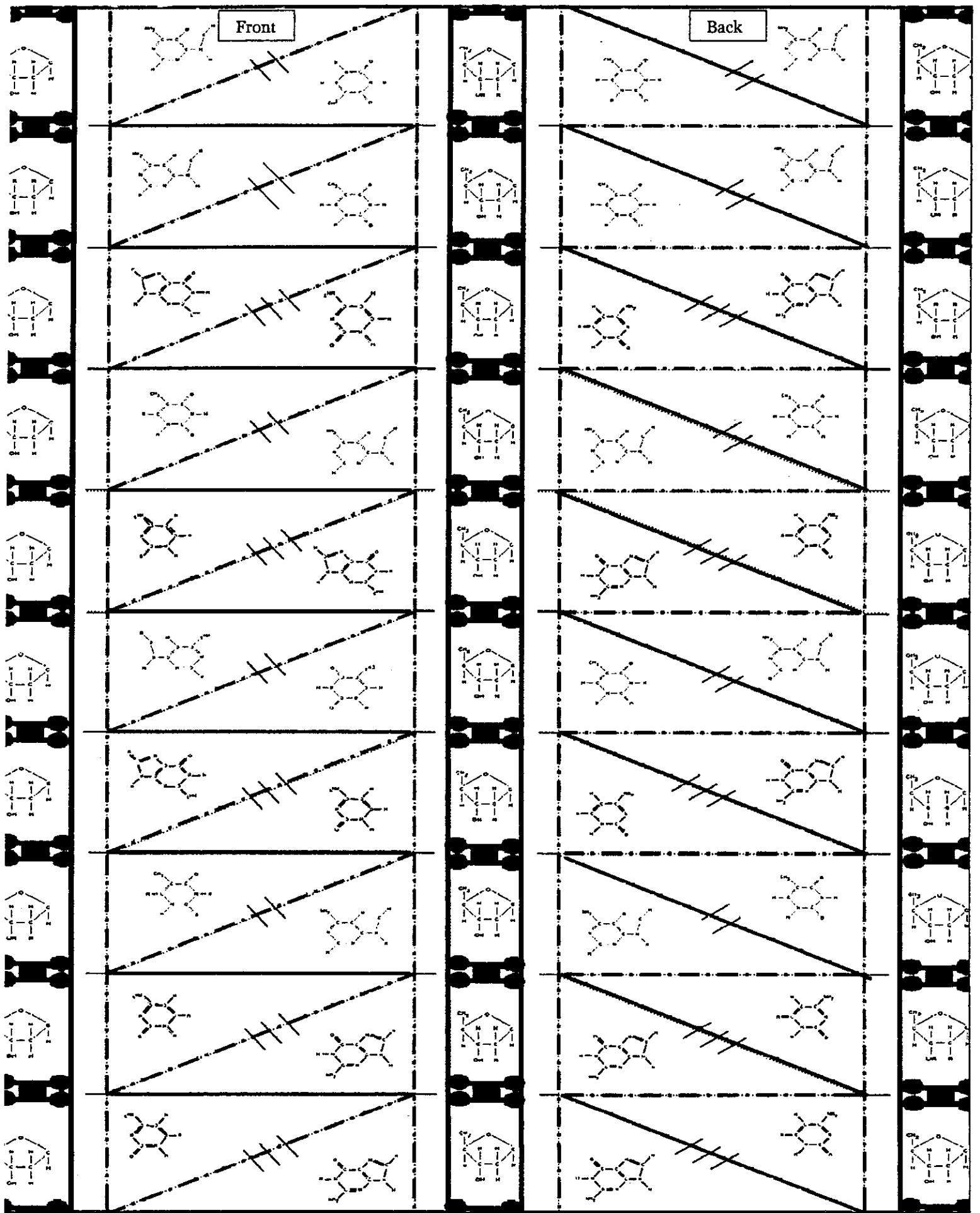


Thymine =



Color, cut, and fold according to the directions. Show your completed origami DNA model to your teacher for a stamp.

STAMP



Adapted from Yen, T., 1995, Make your own DNA. *Trends in Biochemical Sciences*, 20: 94.