Unit Plan – DNA, RNA, and Protein Synthesis

Honors Biology
Ninth Grade
Pendleton High School

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UNIT OVERVIEW

UNIT TOPIC: DNA, RNA, and Protein Synthesis
Standard B-4, Indicators B-4.1, B-4.2, B-4.3, B-4.4

GRADE LEVEL AND STUDENT CULTURE: 9th grade Honors Biology students, Freshman Academy

CLASS STRUCTURE: three 45-minute periods (Monday/Tuesday/Friday) and one 90-minute period (Wednesday/Thursday)

RATIONALE:
The cell is an amazingly fine-tuned machine, working nonstop to maintain homeostasis of organisms. The most crucial of all maintenance systems of the cell's processes is protein synthesis. Without proteins, life would not exist as we know it. This unit provides that understanding of the basic cellular processes that unify all living organisms and provides a basis of understanding of molecular heredity. It is essential that students understand how their own body functions and provides a means for the passing of genetic material to offspring. This unit also provides an opportunity to reinforce student understanding of the nature of scientific discovery, that advances in science requires contributions from many people over long period of time.

The details of protein synthesis are integral to many research and discovery endeavors of the twenty-first century. Students should be taught not only content knowledge but how to be a global citizen. This unit provides students with the tools to be a cognizant and knowledgeable citizen, capable of understanding advances in modern sciences. A basic understanding of the genetic code of organisms is also important for visualizing evolution across generations. As students learn about evolution, they will be able to apply their knowledge of DNA as the genetic code to the differences seen in populations over time.

OBJECTIVES:
The student should understand the molecular basis of heredity, specifically the role of DNA as the genetic material of organisms and the process of protein synthesis, specifically the processes of transcription and translation. Students should be able to 1) understand that DNA has a transient yet stable nature – science is about change 2) describe the process of protein synthesis and 3) identify the products of replication, transcription and translation.

This can be broken down further into:

The student should be able to:

1. Describe the discoveries that led to the acceptance of DNA as the genetic material

2. Describe the characteristics of DNA and the process of replication
3. Explain the flow of information from DNA to RNA to proteins
4. Illustrate/identify illustrations of the processes of replication, transcription, and translation
5. Sequence the steps of protein synthesis
6. Explain the significance of protein synthesis

Through these objectives the student should expand his learning on the following key concepts and enduring ideas of science:

1. Tentative and every-changing nature of science and discovery
2. Unifying nature of human processes, specifically cellular processes
3. Connections between scientific knowledge and real-world applications

The student should be prepared for standardized assessment on the following:

Standard B-4: *The student will demonstrate an understanding of the molecular basis of heredity.*

B-4.1 Compare DNA and RNA in terms of structure, nucleotides, and base pairs.
B-4.2 Summarize the relationship among DNA, genes, and chromosomes.
B-4.3 Explain how DNA functions as the code of life and the blueprint for proteins.
B-4.4 Summarize the basic processes involved in protein synthesis (including transcription and translation).

CONTENT:
The content of this unit is broken down into three sections: DNA, Chromosomes and DNA Replication, RNA and Protein Synthesis.

Lesson Topics:

- DNA: History of DNA as Genetic Material, Structure and Purpose of DNA, Nucleotides
  - Key Concepts: nucleic acids (deoxyribonucleic acid (DNA) and ribonucleic acid (RNA)), nucleotides, nitrogenous base, sugar, phosphate group, complementary bases
- Chromosomes and DNA Replication:
  - Key Concepts: gene, chromosome, DNA, genetic code, sex chromosome, autosomal chromosome, DNA replication
- RNA and Protein Synthesis:

- Key Concepts: protein synthesis, transcription, messenger RNA, translation, ribosomal RNA, codon, anticodon, transfer RNA, anticodon site, peptide bond, stop codon

REFERENCES AND RESOURCES

- Notes Power Point, student notes sheets, quizzes and test materials
  - Adapted from Mrs. Beth Standridge (Pendleton High School, Anderson School District 4)
- Textbook Resources
  - Text – McDougal Littell Biology by Stephen Nowicki
  - Biology Inquiries: Standards-Based Labs, Assessments, and Discussion Lessons by Martin Shields
- SC Standards and Initiatives Documents
- SC Standards Support Documents
- Strawberry DNA Extraction Lab
  - Adapted from Ms. Elizabeth Moon (Clemson University, Student Teacher Seneca High School)
- Video animations of protein synthesis processes
  - http://www.stolaf.edu/people/giannini/flashanimat/molgenetics/transcription.swf
  - http://www.cmbi.ru.nl/edu/VWO/4vwodag/gene3.swf
  - http://learn.genetics.utah.edu/content/begin/dna/transcribe/

LESSON PLANS

LESSON 1

Standard B-4:
The student will demonstrate an understanding of the molecular basis of heredity.

Standard B-1:
The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.

B-1.6 Evaluate results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.

Objectives:
Describe the discoveries that led to the acceptance of DNA as the genetic material.
Identify the components of the structure of DNA.
Explain the purpose and role of DNA in organisms.

Time:
One 42 minute period, one 88-minute period

Prerequisites/Prior Knowledge:
Students have no prior knowledge of this material

Materials/Preparation:

- Ch12 Pretest and answer key
- Guided notes for students
- Power point presentation of notes
- Chargaff's DNA worksheet and answer key (Biology Inquiries by Martin Shields)
- Open Notes Quiz sheets

Safety:
There are no additional safety procedures beyond that of normal classroom procedures.

Procedures/Content:
Students should take a 12 question pre-test of the unit before any instruction has begun.

Use the Power Point presentation to present information to students while students take notes on the provided student guided notes sheets.

- Be sure to point out the nature of science evident in the history of the discovery of DNA as the genetic material.
- Emphasize the importance of DNA to modern practices – especially medicine and agriculture.
- Point out to students the vocabulary section of the notes and encourage them to develop study habits by beginning to learn the vocabulary words.

Inquiry Activity:

Before reaching the section of the notes in which Chargaff's Base Pairing rules are presented, distribute the student handouts of Chargaff's DNA Data worksheet. Allow students to find a partner to work with to complete the activity.

Students should be able to discover patterns in the pairing of bases and be able to draw connections from the patterns to the models and pictures of the structure of DNA

Continue with the notes in the section detailing base pairing rules

Close with an Open Notes Quiz the following class period to assess comprehension.

Assessment:
Open questioning during lecture – individual and entire class
Chargaff's DNA worksheet
Open Notes Quiz

Adaptations:
For ESOL students – more visuals and pairing with an English speaking students
For lower ability levels – additional supplemental activities for the history and structure of DNA; entire class complete Chargaff's DNA activity together, guided inquiry

Follow-up Lessons/Activities:
This lesson should be followed up by a discussion of RNA, replication, and protein synthesis. Additional activities would include construction of the DNA model

Reflection:
This lesson was very successful as an inquiry lesson. Students did not respond well to having to think critically but they were challenged and after complaints, rose to the challenge. Students did well discovering the base pairing rules with little guidance. Students developed their critical thinking and observation skills. The lesson also emphasized nature of science through the discussions of the historical discoveries that led to DNA's acceptance as the genetic material.

LESSON 2

Standard B-4:
The student will demonstrate an understanding of the molecular basis of heredity.

B-4.1 Compare DNA and RNA in terms of structure, nucleotides, and base pairs
B-4.2 Summarize the relationship among DNA, genes, and chromosomes
B-4.3 Explain how DNA functions as the code of life and the blueprint for proteins

Objectives:
Compare and contrast DNA and RNA.
Summarize the way that DNA's genetic information is used by the cell.
Describe/illustrate the steps of replication.

Time:
Two 88-minute periods

Prerequisites/Prior Knowledge:
Students should have prior knowledge of what DNA is, the purpose of DNA and where DNA is located in the cell from previous units and lessons in this unit.

The student should be familiar with experimental procedure including the use of a question, materials list, procedures list, and analysis.

Materials/Preparation:

- Teacher materials –
  - PowerPoint for opener, notes, discussion and exit slip
  - Lab handout
- Student materials –
  - Lab handout
  - 1 lab materials bucket for each group
- Lab materials – (for each group)
  - Fruit (strawberry, banana, etc)
  - Ziploc baggies
  - 10 mL DNA extraction buffer solution (detergent solution)
  - Filter paper
  - Funnel
  - Test tube
  - Glass rod
  - 20 mL ethanol

Safety:

- Be sure to follow all directions EXACTLY. This is important to make sure that the DNA separates from the cells properly

- NO food or drink in the lab at any time
- Do not eat or drink any lab materials – solutions or solids!
- We will be using ethyl alcohol in the lab:
    - Strong clear liquid
    - Toxic if ingested or inhaled and can irritate body tissue
    - Avoid body contact
    - Highly flammable – avoid flames!
    - Everyone **must** wear safety goggles and aprons **at all times!**
- Let me know immediately if there are any safety issues or accidents in the lab

Procedures/Content:
Use Power Point and student guided notes to introduce content about DNA replication.

DNA Extraction Lab

- Prepare the lab in advance, making student group lab stations will all required materials

Alternative Assignment for DNA Extraction Lab – virtual lab

Assessment:
Informal questioning during lecture – individual and class, check in slides in lecture
Lab handout – individual
Open Notes Quiz

Adaptations:
Students with IEPs will be assisted by resource teachers in the room or by the classroom teacher. Students can be given more time outside of class to complete post-lab and analysis questions

For students with other considerations, ability grouping can be used. Students with special considerations can be intentionally paired with students without considerations.

Follow-up Lessons/Activities:
This lesson could/should be followed with
- Further lab exploration of what contains DNA
- Carrying out the labs designed by students
- Exploration of the purpose of DNA for protein synthesis

Reflection:
This lesson went extremely well. The students responded well to the lab, thoroughly enjoying the experience of smashing strawberries as an actual part of the class. Students did take away from the experience the understanding that our food has DNA. If time had allowed, more activities involving manipulatives for the DNA structure vs. RNA structure and the process of replication could have been beneficial.

LESSON 3

Standard B-4:
The student will demonstrate an understanding of the molecular basis of heredity.

B-4.4 Summarize the basic processes involved in protein synthesis (including transcription and translation)

Objectives:
Explain the flow of information from DNA to RNA to proteins.
Illustrate/identify illustrations of the processes of protein synthesis.
Sequence the steps of protein synthesis and explain the significance of the process.

Time:
Two 42-minute class periods

Materials/Preparation:

- Power Point with student guided notes sheets
- Say It With DNA worksheet activity

Safety:
There are no additional safety considerations for this lesson.

Procedures/Content:
Lecture on central dogma, protein synthesis and transcription

Say it with DNA worksheet – each student receives a slip of paper with a DNA code written out and they have to write out the transcribed RNA strand based on their DNA code.

Assessment:
Informal questioning during lecture, check in slides
Open Notes Quiz
Say It With DNA Worksheet

Adaptations:
Students can work in pairs or small groups on the worksheet if struggling with the activity.

Reflection:
The lecture went well, students understood the material presented based on the feedback received during lecture and through the quiz the following day. They particularly enjoyed having an

animation that we could watch several times and see the overall idea of what happens in the process as a whole as well as the individual steps. If done again, a more hands on activity might be better though when pressed for time, the worksheet is sufficient.

LESSON 4

Standard B-4:
The student will demonstrate an understanding of the molecular basis of heredity.

Objectives:
Explain the significance of protein synthesis.
Determine the amino acid sequence that would be produced from a sequence of DNA nucleotides.

Time:
One 88-minute class period, one 42-minute class period

Materials/Preparation:
Say it with DNA Activity – codon cards posted around the room, DNA message sheets for each student

Safety:
There are no additional safety considerations for this lesson.

Procedures/Content:
Finish lecture on translation and protein synthesis

Activity – Post anticodon cards around the room in random locations
Each student receives one sheet that has a DNA code on it. They must transcribe the code, translate it, then figure what the anticodons would be for each codon. Each card has an anticodon, amino acid, and secret word on it. Students will assemble their protein by figuring out the sequence of anticodons then discover the secret message based on the secret words for each amino acid.

Chapter 12 Quiz – quiz on the entire chapter

Assessment:
Codon activity student worksheet
Chapter 12 quiz

Reflection:
This lesson went very well; the students enjoyed being up out of their seats assembling their proteins and discovering the sentences that the sequences made up. The only thing about the

activity that should be done differently is the secret sentences. Some of the sentences were nonsensical and silly. Students said that they would have enjoyed having better sentences. This could easily be done by altering the secret words.

LESSON 5

Standard B-4:
The student will demonstrate an understanding of the molecular basis of heredity.

B-4.8 Compare the consequences of mutations in body cells with those in gametes.
All indicators of the unit

Objectives:
Compare the results of a mutation in a body cell to a mutation in a gamete.
Identify ways of genetic engineering including selective breeding and hybridization.

Time:
Two 42-minute class periods

Materials/Preparation:

- Beach ball
- List of open response questions for the review game
- Power Point of notes
- Student guided notes sheets

Safety:
There are no additional safety considerations for this lesson.

Procedures/Content:
Use the Power Point to finish the discussion of the unit's content about mutations.

Review Game – using a beach ball with topics written on each color stripe of the ball, have students toss the ball to each other and whichever color their thumb lands on when they catch the ball is the category of question they have to answer.

Assessment:
Study Guide completion, notebook check, participation in review game, test

Reflection:
This lesson tied up the loose ends of the unit and helped students put the pieces together into a more cohesive comprehension. The review game went well although student participation was not quite what was hoped. Many students were disengaged and did not get as much out the game as was intended. This could be improved by having a book work alternative assignment or by having several review balls with the questions written on them so that the classes could play the game in smaller groups with the instructor as a monitor.

UNIT ANALYSIS

The major objectives of this unit were that students should be able to 1) understand that DNA has a transient yet stable nature – science is about change 2) describe the process of protein synthesis and 3) identify the products of replication, transcription and translation. The unit included a variety of instructional strategies including models, animations, charts, diagrams, direct instruction, labs, inquiry activities, and a variety of assessments. The conveyance of the subject matter to the students was determined by a summative multiple choice and open response unit test.

The student performance on both the pre-test and the unit test were analyzed based on each objective. Every question was categorized by which objective it assessed and the number of students who answered the question correctly was collected. Data from 77 students was collected for the pre-test and data from 67 students was collected for the unit test. In the pre-test, 33% of the students tested correctly answered questions assessing the overarching objective of the unit. Twenty-five percent of the students answered questions about objective 1 correctly and 24% correctly answered questions regarding objective 2. The unit test was summative and included both multiple choice questions and an open response section. Of the multiple choice questions dealing with the main objective, 78% of students answered correctly. This was a 45% increase from the pre-test. Seventy-eight percent answered questions about objective 1 correctly, a 53% increase from the pre-test; seventy-nine percent answered questions about objective 2 correctly, a 55% increase. The average increase in correct multiple choice answers was 51%. This increase in correct multiple choice answers indicates an increase in student knowledge of the unit content and achievement of the objectives for the unit.

Objective	Pre-test	Post-test	Increase in Correct Answers
	% Correct	% Correct	
1	33.12	77.96	45%
2	24.68	77.83	53%
3	23.90	79.10	55%

The unit test also included an open response question, asking students to describe the process of protein synthesis in detail. A word bank of suggested words was provided as a basis for the level of detail expected. It was clear based on an overall assessment of the open response answers that many students struggled with expressing themselves. This was based upon their sentence structure and flow of thought. However, the content included in the student responses demonstrates an overall understanding of the ideas of protein synthesis, the necessary steps taken by the structures in the cell and the reasons for the processes. Some students did struggle with the details associated with the processes by confusing parts of replication with transcription or using the wrong name for the enzyme responsible but where the details were slightly off, the main concepts were there. Student Sample A, G, and H (see Appendix) show an understanding of the

overall concepts and ideas, though not all students were able to articulate the details of the processes. Student Samples C and D (see Appendix) show a high level of detail with only a few errors in addition to an overall understanding.

Student grades were assigned based on rubrics and answer keys then posted to PowerSchool for students and parents to observe.

This unit was a success at conveying content information to the students. Based on the data collected and the samples analyzed, students learned the subject matter and the objectives set for the unit were obtained. The unit's strengths were in tying the pieces together through an inquiry activity, a wet lab, and a variety of review methods. The students enjoyed the activities and the lab. The unit could have been improved through more hands on activities and models to help the students visualize the specifics of the processes. A weakness of the unit was the speed at which students were expected to learn the material. This was due to the pressure of the upcoming EOC and end of the year. The entire year could have been planned out to better allot time for this particular unit.

Overall the experience has been positive; good relationships were built with the students, cooperating teacher and other professionals at Pendleton High School. There were many opportunities for improvement and things learned to implement in future years of teaching.

APPENDIX

Honors Biology
Chapter 12 PRE - TEST

1. The process by which one strain of bacteria is apparently changed into another strain is called
   a. Transcription
   b. Translation
   c. Transformation
   d. Replication

2. A nucleotide does NOT contain
   a. A 5-carbon sugar
   b. Polymerase
   c. A nitrogen base
   d. A phosphate group

3. The process by which genetic code of DNA is copied into a strand of RNA is called
   a. Translation
   b. Transcription
   c. Transformation
   d. Replication

4. In messenger RNA, each codon specifies a particular
   a. Nucleotide
   b. Purine
   c. Amino acid
   d. Pyrimidine

5. Changes in DNA sequence that affect genetic information are known as
   a. Replications
   b. Mutations
   c. Transformations
   d. Prokaryotes

6. An expressed gene is one that
   a. Functions as a promoter
   b. Is transcribed into RNA
   c. Codes for only one amino acid
   d. Is made of mRNA

7. During replication, which sequence of nucleotides would bond with the DNA sequence TATGA?
   a. TATGA
   b. UAUGA
   c. ATACT
   d. AUAGA

Honors Biology
Chapter 12 PRE - TEST

8. In which of the following ways does RNA differ from DNA?
    a. RNA contains uracil and deoxyribose
    b. RNA contains ribose and thymine
    c. RNA contains uracil and ribose
    d. RNA contains adenine and ribose
    e. RNA contains uracil, thymine and ribose

9. Which of the following nucleotide(s) bond(s) with adenine?
    a. Thymine only
    b. Uracil only
    c. Cytosine and guanine
    d. Thymine and uracil
    e. Thymine, uracil, and cytosine

10. The process of decoding mRNA into polypeptide chain is known as
    a. Transformation
    b. Transpiration
    c. Translation
    d. Transcription
    e. Translocation

11. What did Hershey and Chase's work show?
    a. Genes are probably made of DNA
    b. Genes are probably made of protein
    c. Genes are made of both DNA and protein
    d. Viruses contain DNA but not protein
    e. Bacteria contain DNA but not protein

12. Anticodons are part of the structure of
    a. DNA
    b. Messenger RNA
    c. Transfer RNA
    d. Ribosomal RNA
    e. Proteins

Honors Biology

- Thinking back to our Organic Compounds unit, what are the 2 types of nucleic acids?
- What is the function of DNA?
- Where is DNA located in the cell?
- What is the monomer of DNA?

HONORS BIOLOGY – UNIT 10

DNA

DRIVING QUESTION

What is the chemical basis of life?
How do genes code for proteins?

What did scientists discover about the relationship between genes and DNA?

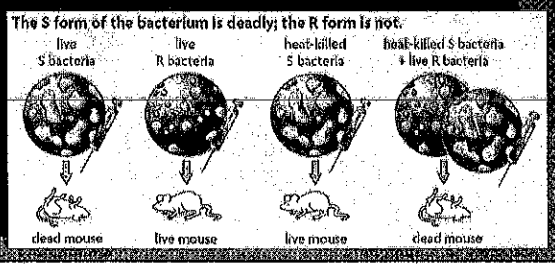
What is the overall structure of the DNA molecule?

CHAPTER 12 -1

DNA

Frederick Griffith

- In 1928, Griffith studied 2 forms of bacteria that caused pneumonia.
  - 1 bacteria (S) looked smooth
  - 1 bacteria (R) looked rough



Frederick Griffith

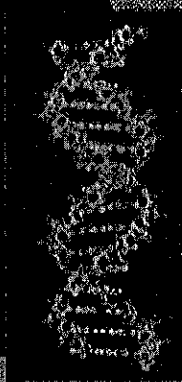
- Griffith said some material must have been transferred from the heat-killed S bacteria to the live R.
- "Transforming principle" changed harmless R bacteria into disease-causing S bacteria.
- Transformation – when one strain of bacteria apparently is changed permanently into another strain of bacteria

Oswald Avery

- He worked for 10 years to find out what the **transforming principle** was.
- He combined living R bacteria w/ S bacteria.
  - *This allowed him to observe the transformation of R bacteria into S in a petri dish.*

Oswald Avery

- Avery performed several tests:
  1. Destroyed proteins
     - Transformation occurred
  2. Destroyed lipids, carbs, and mRNA
     - Transformation occurred
  3. Destroyed DNA
     - Transformation didn't occur



Avery's Data

CHEMICAL ANALYSIS OF TRANSFORMING PRINCIPLE

	% Nitrogen (N)	% Phosphorus (P)	Ratio of N to P
Sample A	14.21	8.57	1.66
Sample B	15.93	9.09	1.75
Sample C	15.36	9.04	1.69
Sample D	13.40	8.45	1.58
Known value for DNA	15.32	9.05	1.69

Avery's Conclusion

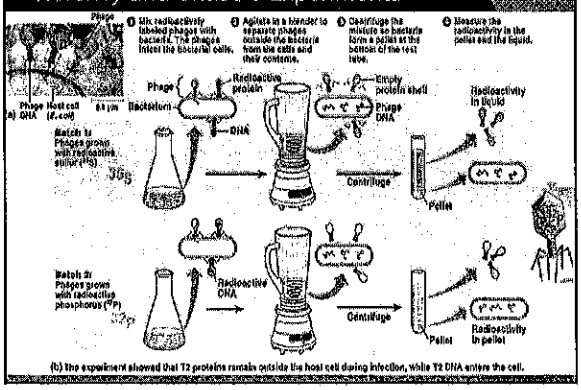
- In 1944, Avery stated that DNA must be the transforming principle!
- *Some scientists didn't believe him until Hershey and Chase's confirmation.*

Hershey & Chase

- In 1952, Alferd Hershey & Martha Chase found that DNA was genetic material while studying viruses that infect bacteria.

Bacteriophage – virus that takes over a bacterium's genetic makeup & tells it to make more viruses.

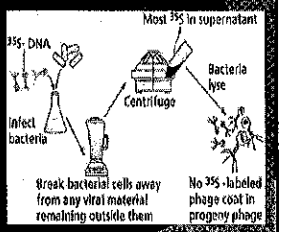
Hershey and Chase's Experiments



(b) The experiment showed that T2 proteins remain outside the host cell during infection, while T2 DNA enters the cell.

Hershey and Chase's Conclusion

- Hershey & Chase concluded that the phage's DNA had entered the bacteria, but the protein had not.
- Their findings supported the hypothesis that genetic material is DNA!



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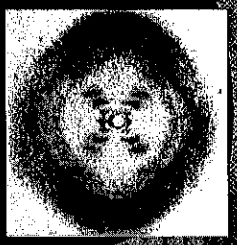
- Why do we say "supported the hypothesis" instead of saying it "proved it"??
- NOTHING in science is PROVEN!

Franklin & Wilkins

- Rosalind Franklin & Maurice Wilkins studied DNA using **x-ray crystallography**.
  - DNA is bombarded w/ x-rays.
  - This causes a pattern to be captured on film.

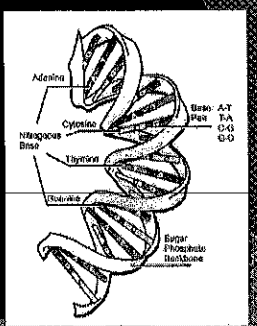


Watson & Crick

- James Watson & Francis Crick used the x-ray images produced by Franklin & Wilkins to create a 3-D model of the DNA molecule.
  - *In 1953, Watson & Crick published their double helix model of DNA.*

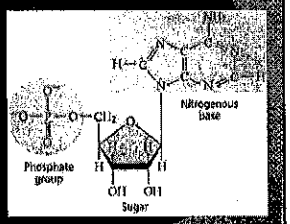
What is DNA?

- **DNA** (deoxyribonucleic acid) –codes for proteins and all cellular activity.



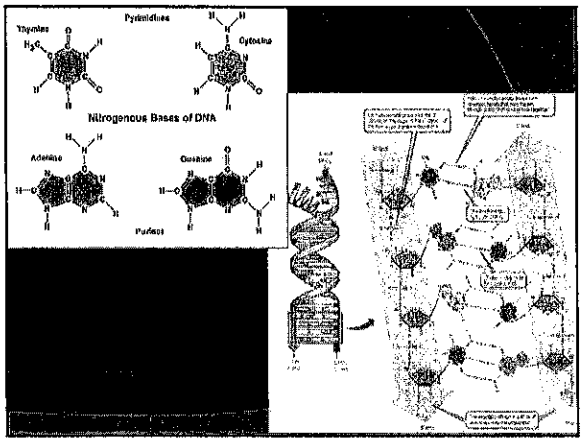
What is DNA made of?

- **Nucleotides** – monomers that make up DNA
- Nucleotides consist of 3 parts:
  - Phosphate Group
  - Deoxyribose Sugar
  - Nitrogen- Base



Chargaff's DNA Data

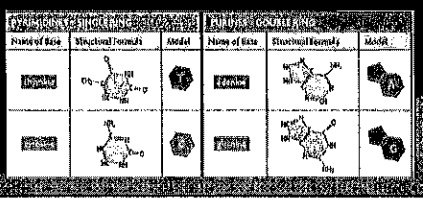
- What is DNA?
- What does it do?
- How does it do it?



4 Types of Nucleotides

Chargaff's Rule (Base Pair Rule)

- Cytosine (C) = Guanine (G)
- Adenine (A) = Thymine (T)

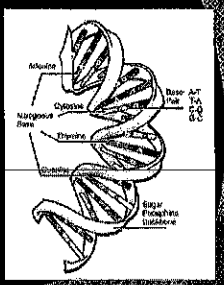


Sample Problems

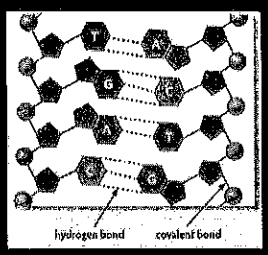
- Assume that a 100-base pair section of DNA contains 45 cytosines. How many adenines are there?
- Assume that an 80-base pair section of DNA contains 30 adenines. How many thymines are there?

Double Helix

- **Double Helix** – 2 strands of DNA wind around each other.
  - The strands are complementary
  - They fit together & are opposite of each other.



Bonding in DNA



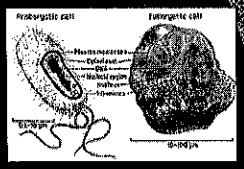
- **Hydrogen bonds** hold each of the base pairs together.
- **Covalent bonds** hold the sugar to the phosphate.

What happens during DNA replication?

CHAPTER 12-2
CHROMOSOMES AND DNA REPLICATION

DNA and Chromosomes

- Prokaryotic cells – DNA is located in the cytoplasm.
  - Most have a single circular DNA molecule that contains nearly all of the cell's genetic information.
  - Plasmid – circular DNA
- Eukaryotic cells – DNA is located in the nucleus.
  - Each organism has a different number of chromosomes.



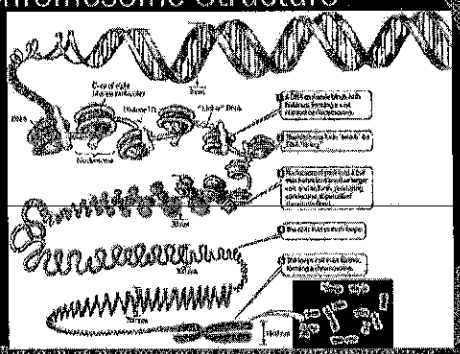
E.coli (which lives in the large intestines) contains 4,639,221 base pairs.

1 human cell contains 1000x as many base pairs. Each cell's nucleus contains at least 1 meter of DNA.

Chromosome Structure

- DNA is packed tightly to form chromatin
- Chromatin consists of DNA coiled around histones (proteins)
- The histone and DNA form nucleosomes
- Nucleosomes pack together to form a thick fiber of loops and coils
- The fiber supercoils to form chromosomes

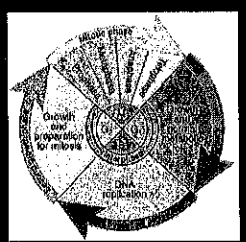
Chromosome Structure



DNA Replication

- Why does DNA need to be replicated?
- When does DNA replication take place?

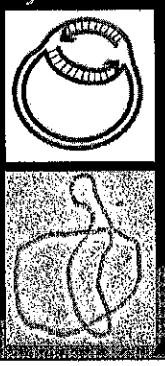
DNA Replication



- *Replication – process of copying DNA during the **synthesis** phase (interphase) of the cell cycle.*
- *Replication assures that every cell has a complete set of identical genetic information.*

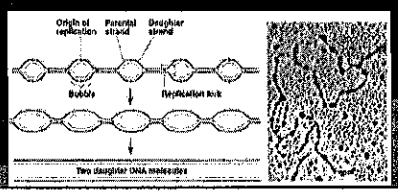
Replication in Prokaryotes

- In prokaryotic cells, DNA replication begins at a **single point** in the chromosome and proceeds, often in **2 directions**, until the entire chromosome is replicated.



Replication in Eukaryotes

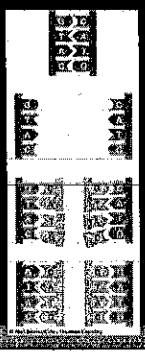
- In eukaryotic cells, DNA replication occurs at hundreds of places.
  - Replication proceeds in both directions until each chromosome is completely copied.
  - The sites where separation and replication occur are called replication forks.



DNA Structure Helps Explain How it Duplicates

- Hydrogen bonds b/w 2 strands are easily broken.
- Each single strand then serves as template for new strand.

DNA Replication

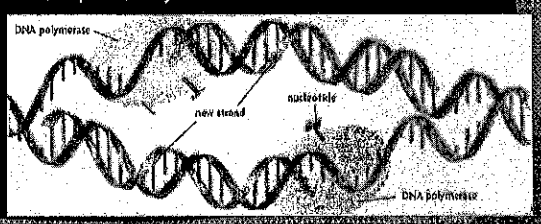


- Each parent strand remains intact.
- Every DNA molecule is "semi-conservative" - half "old" and half "new".

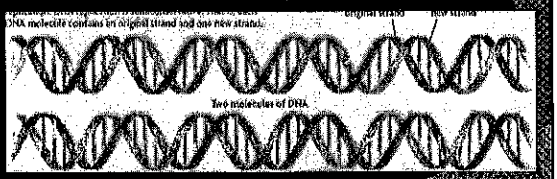
Replication – How It Works

1. **DNA helicase enzymes** unzip the DNA at several places along the strand by breaking the hydrogen bonds b/w the base pairs.
2. Once the strands are separated, **helix-destabilizing proteins** bind to the single strand preventing the strands from coming back together.

3. Floating nucleotides pair up w/ the bases on the template strands as they are unzipped.
4. **DNA polymerases** catalyzes and links the nucleotides together to form new strands that are complementary.

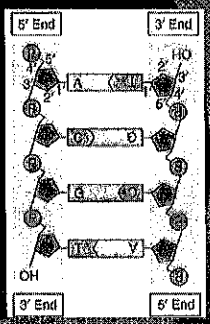


5. Two identical molecules of DNA are made!
   - Each DNA molecule has 1 old strand and 1 new strand.



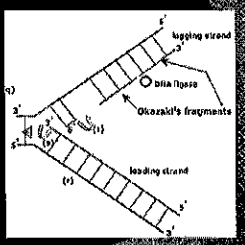
DNA is Antiparallel

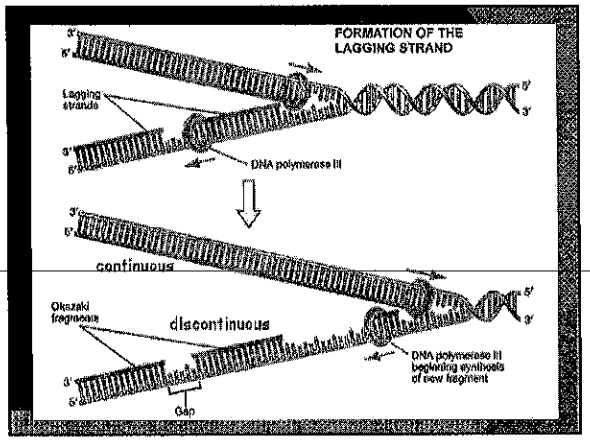
- The 2 chains are **antiparallel**, or run in opposite directions.
- Replication always occurs in a 5' → 3' direction.
  - 5' = phosphate group
  - 3' = sugar group.



Leading and Lagging Strands

- This 5'→3' direction requires one DNA strand to be synthesized continuously and the other discontinuously.
  - Leading Strand – continuous replication
  - Lagging Strand – discontinuous replication
    - Produces Okazaki fragments which will be joined together by DNA ligase.





Replication happens Fast!

- DNA replication happens often, so it has to be fast.
- In humans, 50 nucleotides are added every second.
- DNA polymerase will detect errors and replace incorrect nucleotides.

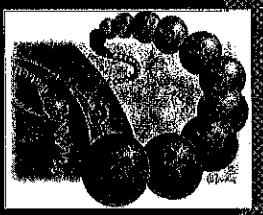
What are the three main types of RNA?
What is transcription?
What is translation?
How does translation convert an mRNA message into a protein?

CHAPTER 12-3
RNA AND PROTEIN SYNTHESIS

√ IN

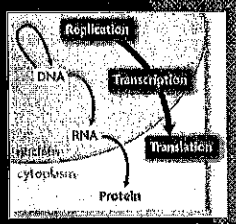
- What are the three parts of a nucleotide?
- Which nitrogen bases pair together?
- When during the cell cycle does replication take place?
- Where replication take place?
- What are the four steps of replication?

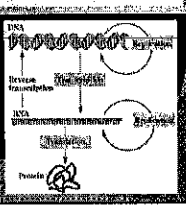
- When a protein is needed, the cell makes a protein through *protein synthesis*.
- DNA molecules cannot leave the nucleus of the cell.
- Protein synthesis must occur in the ribosomes which are located in the cytoplasm.
- Therefore, the code must be carried from the nucleus to the cytoplasm.



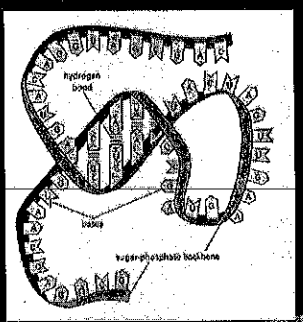
Central Dogma

- Central Dogma – describes the flow of information from DNA to RNA to proteins.
  - Replication – copies DNA
  - Transcription – converts DNA into RNA
  - Translation – Interprets RNA into a string of amino acids (protein)





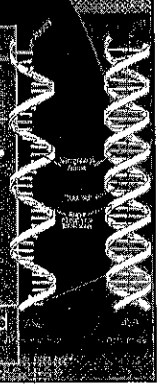
RNA



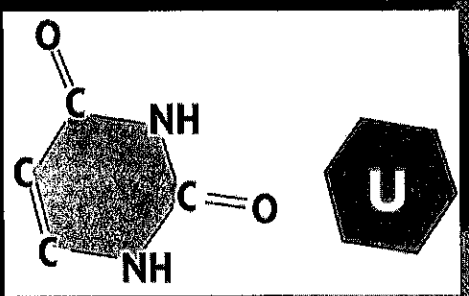
- RNA (ribonucleic acid) – chain of nucleotides.
  - Acts as an middle-man b/w DNA in the nucleus and proteins in the cytoplasm.

RNA vs. DNA

	DNA	RNA
Type of sugar	Deoxyribose	Ribose
Type of nitrogen bases	Cytosine (C) Adenine (A) Guanine (G) Thymine (T)	Cytosine (C) Adenine (A) Guanine (G) Uracil (U)
Structure or shape	Double helix	Single Strand



Uracil (U) replaces (T) in RNA

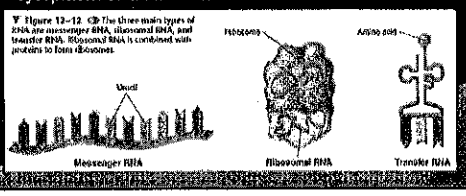


√ IN

- What are three differences between DNA and RNA?
  - Deoxyribose vs Ribose sugar
  - Thymine vs Uracil
  - Double helix vs Single strand

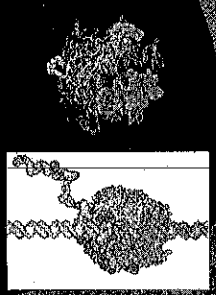
RNA Molecules

- 3 types of RNA molecules:
  - Messenger RNA (mRNA) – middle message that is translated to form a protein.
  - Ribosomal RNA (rRNA) – forms part of ribosomes.
  - Transfer RNA (tRNA) – brings amino acids from cytoplasm to a ribosome.



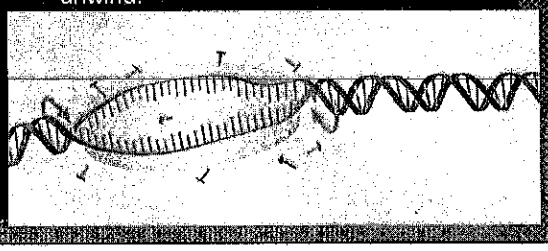
Transcription

- Transcription – process of copying a sequence of DNA to produce a complementary strand of RNA.
- RNA Polymerase – enzyme that bonds nucleotides together to make RNA



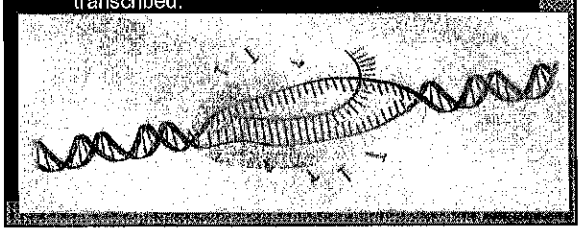
Steps of Transcription

1. RNA polymerase and other proteins recognize the start site of a gene, a promoter, and the DNA segment begins to unwind.



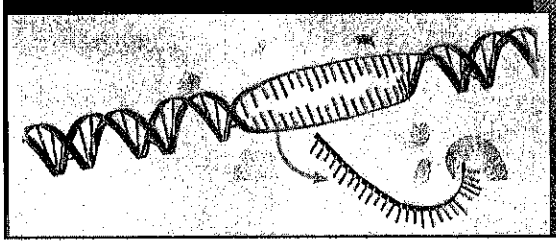
Steps of Transcription

2. RNA nucleotides form complementary base pairs with the DNA template.
   - The growing RNA strand hangs freely as it is transcribed.



Steps of Transcription

3. The completed RNA strand separates from the DNA template and the RNA polymerase falls apart.



Promoters

How does the RNA polymerase "know" where to start and stop making an RNA copy of DNA?

- RNA polymerase will bind only to regions of DNA sequence known as promoters.
- Promoters – specific base sequences that indicate to RNA polymerase where to bind.

RNA Editing

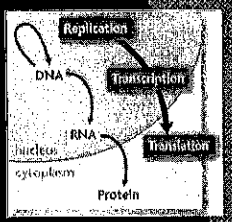
- Introns – sequences of nucleotides that do NOT code for proteins
- Exons – sequences of nucleotides that DO code for proteins
- After transcription, introns are cut out of RNA and exons are spliced together

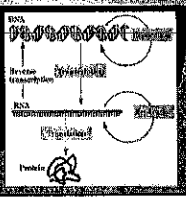
√ IN

- What are the three types of RNA?
- What are the steps of transcription?

Central Dogma

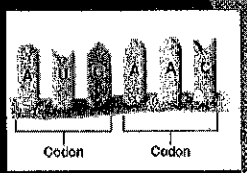
- Central Dogma – describes the flow of information from DNA to RNA to proteins.
  - Replication – copies DNA
  - Transcription – converts DNA into RNA
  - Translation – interprets RNA into a string of amino acids (protein)





Genetic Code

- CODON – 3-nucleotide sequence that codes for an amino acid.



UCGCACGGU

This sequence would be read three bases at a time as:

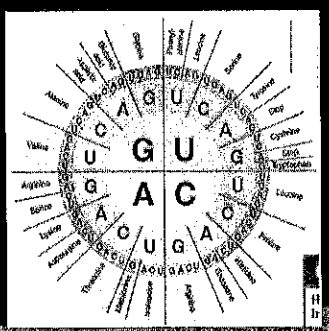
UCG-CAC-GGU

The codons represent the different amino acids:

UCG-CAC-GGU

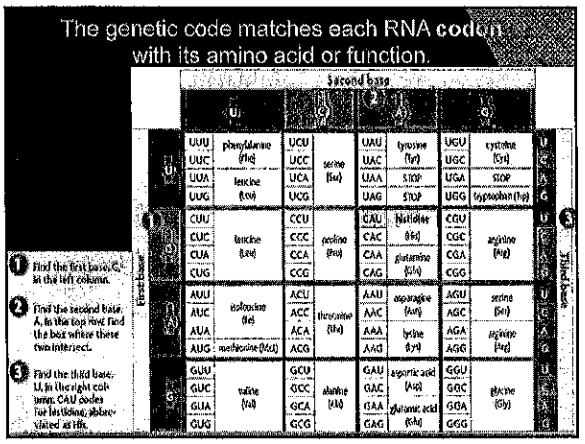
Serine-Histidine-Glycine

Amino Acids



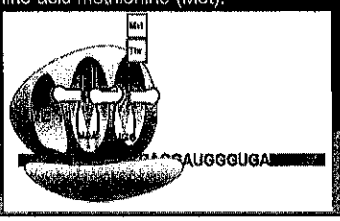
- AMINO ACIDS – molecule that makes up proteins.
  - There are 20 amino acids!

The genetic code matches each RNA **codon** with its amino acid or function.



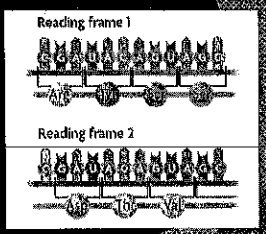
Start & Stop Codons

- A codon can also code for:
  - STOP CODONS – signals the **end** of the amino acid chain.
  - START CODONS – signals the **start** of translation & the amino acid methionine (Met).



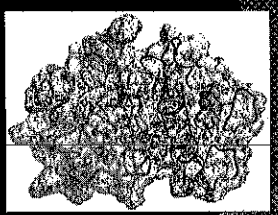
Universal Genetic Code

- For the mRNA code to be translated correctly, codons must be read in the right order.
  - A change in the order the codons are read changes the resulting protein.
- This genetic code is shared by all organisms – it is called the "Universal Genetic Code".



Translation

- TRANSLATION – process that converts, or translates, an mRNA message into proteins.

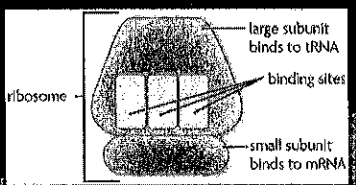


√ IN

1. You know mRNA is the middle-man b/w DNA and proteins.
2. You know DNA is transcribed into mRNA during TRANSCRIPTION.
3. You know mRNA is read in sets of 3 nucleotides, or codons.
4. You know each codon codes for an amino acid.
5. You know amino acids make up proteins.

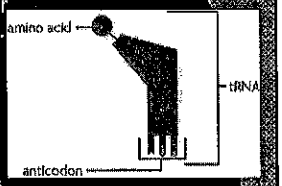
Ribosomes

- RIBOSOMES
  - Made up of 2 subunits:
    - The large subunit has three binding sites for tRNA.
    - The small subunit binds to mRNA.
  - Ribosomes are made up of rRNA and proteins.



tRNA

- tRNA – acts as an adaptor b/w mRNA & amino acids.
  - One end of the rRNA molecule has a specific amino acid;
  - The other end recognizes a specific codon.
    - ANTICODON – set of 3 nucleotides complementary to an mRNA codon.

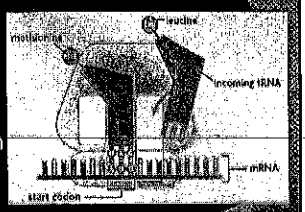


Steps of Translation

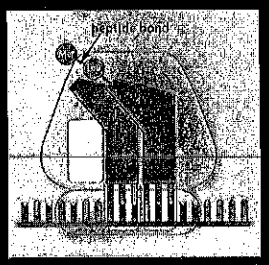
Translation Steps

1. The exposed codon attracts a tRNA molecule carrying an amino acid.

   The tRNA anticodon pairs with the mRNA codon, bringing it very close to the other tRNA molecule.



Translation Steps

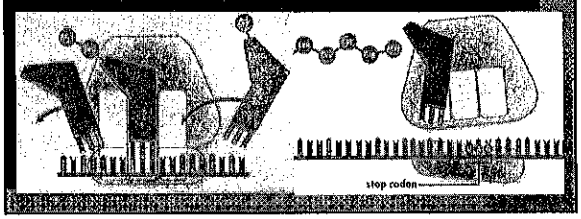


2. The ribosome helps form a PEPTIDE BOND between the 2 amino acids.

   The ribosome breaks the bond between the tRNA in the 2nd site and its amino acid.

Translation Steps

3. The ribosome pulls the mRNA strand the length of one codon. The tRNA molecule in the second site is shifted into the 3rd site. The tRNA leaves the ribosome to get another amino acid.



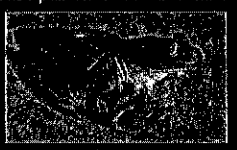
- http://www.cmbi.ru.nl/edu/VWO/4vwoda g/gene3.swf
- http://learn.genetics.utah.edu/content/be gin/dna/transcribe/

What are mutations?

CHAPTER 12-4 MUTATIONS

Mutations

- Mutation – alteration (change) of an organism's DNA
  - Could range from one base pair error or issues with large chunks of DNA



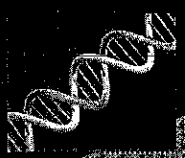
- Results from
  - Malfunction during meiosis or protein synthesis
  - Exposure to a physical or chemical agent – called a mutagen

Mutations

- Mutant cell – a cell that has a mutation that isn't repaired by enzymes
- Somatic mutant cell – daughter cells made by mitosis are affected but it *doesn't* get passed to offspring

Mutations

- Gamete mutant cell – altered DNA *IS* passed on to offspring
  - Results in genetic disorders
- 2 types
  - Gene mutation
  - Chromosome mutation

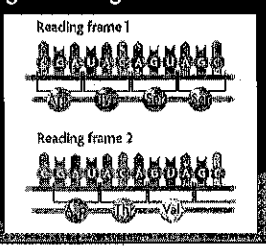


Gene Mutations

- Point Mutations –changes in 1 or a few nucleotides.
  - Substitutions – 1 base is changed.
  - Insertion / Deletion – a base is inserted / removed.
    - *Results in frameshift mutations*

Gene Mutations

- Frameshift Mutations – shifts the "reading" frame of the genetic message by inserting / deleting a base.

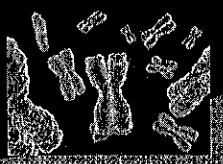


CHECK IN

- What were some of the genetic disorders we talked about that were caused by errors in genes?

Chromosomal Mutations

- Chromosomal mutations – involve changes in the number or structure of chromosomes.
  - 4 types of Chromosomal Mutations:
    - Deletions
    - Duplications
    - Inversions
    - Translocations

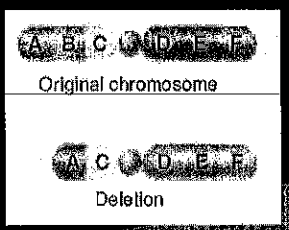


CHECK IN

- What were some of the genetic disorders we talked about that were chromosomal disorders?
- Caused by what?

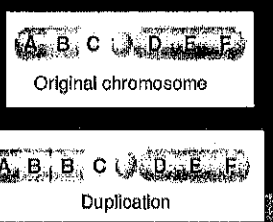
Deletion

- Deletions – involve the loss of all or part of a chromosome.



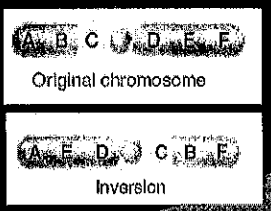
Duplication

- Duplication – produces extra copies of part of a chromosome.



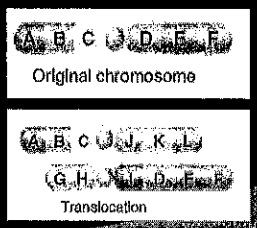
Inversion

- Inversion – reverses the direction of parts of chromosomes.



Translocation

- Translocation – part of one chromosome breaks off and attaches to another.



Beneficial Mutations

- Beneficial mutations - changes that may be useful to organisms.
- These mutations result in phenotypes that are favored by natural selection and increase in a population.

How do genes and chromosomes enable manipulation of genotypes and phenotypes?

GENETIC ENGINEERING

Genetic Engineering

- Genetic engineering – the process of replacing specific genes in an organism in order to ensure that the organism expresses a certain trait
- Can only happen if the exact location of the gene is known
  - Gene maps tell us the relative location
  - Genome – all the genetic material in an organism

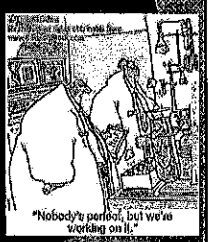
The Human Genome Project mapped the DNA sequence of human genes.

Types of Genetic Engineering

- Cloning – identical copy of a gene or organism is produced
  - Benefits like transplants, saving species, etc
  - Could result in genetic disorders or health problems
- Gene therapy – inserting an normal gene into an absent or abnormal gene
  - Gene begins to produce the correct protein or enzyme, eliminating the disorder
  - Host often rejects the new gene

Types of Genetic Engineering

- Stem cells – undifferentiated cells that have the potential to become specialized in structure or function
  - Found in embryos
  - Found in bone marrow but harder to isolate
- Stem cell therapy could replace tissue that is damaged or diseased



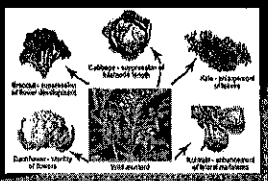
Selective Breeding

- Selective Breeding – the method of artificially selecting and breeding only organisms with a desired trait to produce the next generation
- All domesticated animals and crop plants are the result of selective breeding.

Process of Selective Breeding

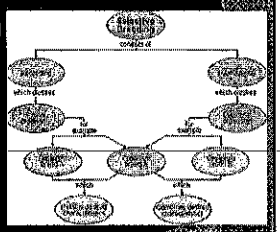
1. Successfully produce offspring with the desired trait
2. Inbreeding occurs
3. Over several generations, trait becomes more common

- Drawback of this – recessive gene defects should up more frequently



Selective Breeding

- Hybridization – another form of selective breeding
- Choose and breed organisms that show strong expression for two different traits
- Results in offspring that shows both strong traits



Chapter 12 Notes - DNA

12 -1 – DNA

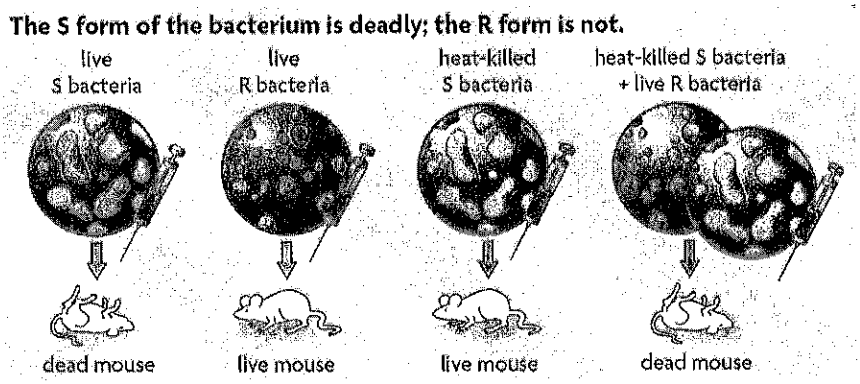
Essential Questions:

- What did scientists discover about the relationship between genes and DNA?
- What is the overall structure of the DNA molecule?

History and Discovery of DNA as Genetic Material

Frederick Griffith

- In 1928, Griffith studied 2 forms of bacteria that caused pneumonia.
  - 1 bacteria (S) looked smooth
  - 1 bacteria (R) looked rough
- Griffith said some material must have been transferred from the _____ **S bacteria** to the _____ **R.**
- "_____" changed harmless R bacteria into disease-causing S bacteria.
- _____ – when one strain of bacteria apparently is changed permanently into another strain of bacteria



Oswald Avery

- He worked for 10 years to find out what the _____ was.
- He combined _____ R bacteria w/ S bacteria.
  - *This allowed him to observe the transformation of R bacteria into S in a petri dish.*

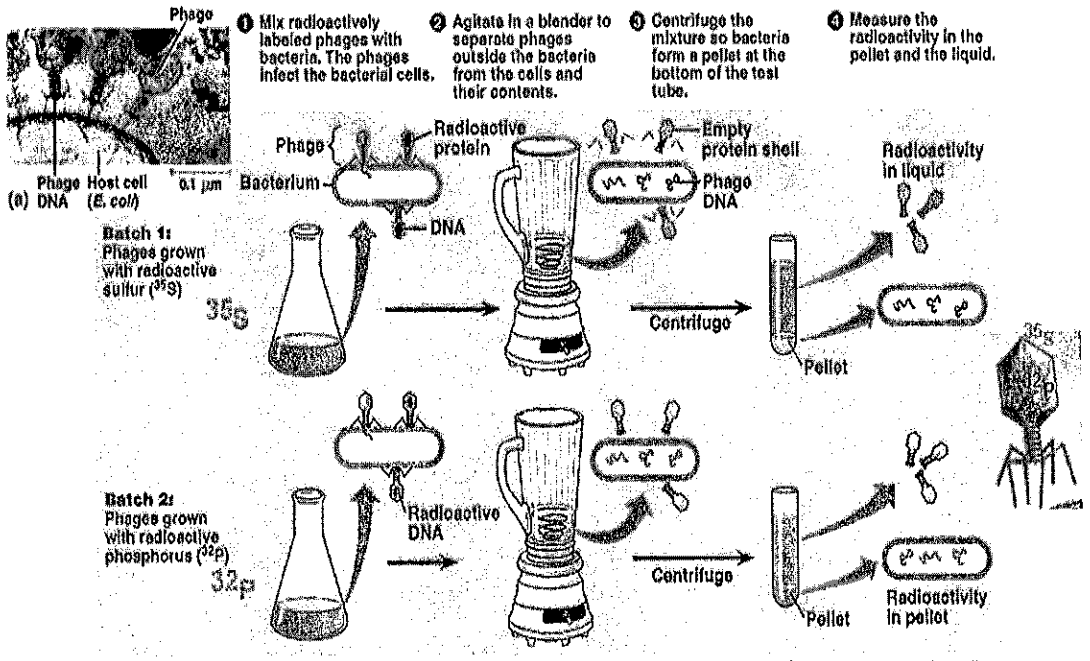
Chapter 12 Notes - DNA

- Avery performed several tests:
  1. Destroyed _____
     - Transformation _____
  2. Destroyed lipids, carbs, and mRNA
     - Transformation _____
  3. Destroyed DNA
     - Transformation _____
- In 1944, Avery stated that _____ must be the transforming principle!
- *Some scientists didn't believe him until Hershey and Chase's confirmation.*

Hershey and Chase

- In 1952, Alferd Hershey & Martha Chase found that DNA was _____ while studying viruses that infect bacteria.
- _____ – virus that takes over a bacterium's genetic makeup & tells it to make more viruses.

VOCABULARY WORDS TO KNOW:
- *TRANSFORMATION*
- *BACTERIOPHAGE*



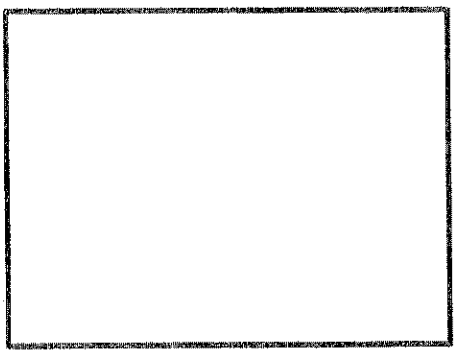
(b) The experiment showed that T2 proteins remain outside the host cell during infection, while T2 DNA enters the cell.

Chapter 12 Notes - DNA

- Hershey & Chase concluded that the phage's _____ the bacteria, but the protein had not.
- Their findings _____ the hypothesis that genetic material is DNA!

Franklin and Wilkins

- Rosalind Franklin & Maurice Wilkins studied DNA using _____
  - DNA is bombarded w/ x-rays.
  - This causes a _____ to be captured on film.

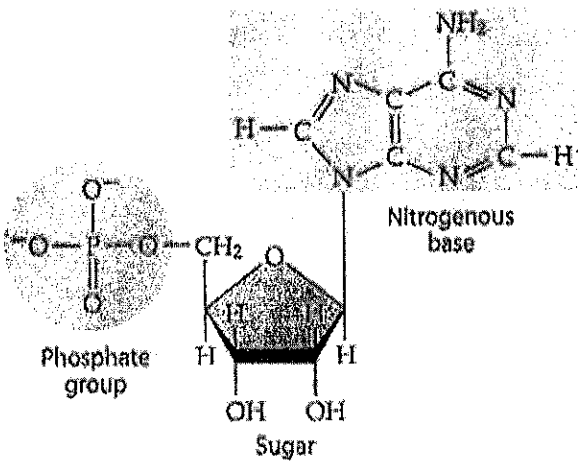


Watson and Crick

- James Watson & Francis Crick used the x-ray images produced by Franklin & Wilkins to create a _____ of the DNA molecule.
  - *In 1953, Watson & Crick published their double helix model of DNA.*

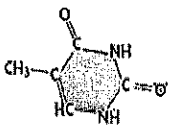
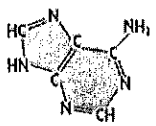
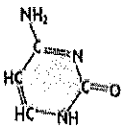
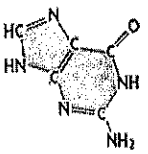
DNA and Nucleotides

- DNA (_____) –codes for proteins and all cellular activity.
- _____ – monomers that make up DNA
- Nucleotides consist of 3 parts:
  - _____
  - _____
  - _____

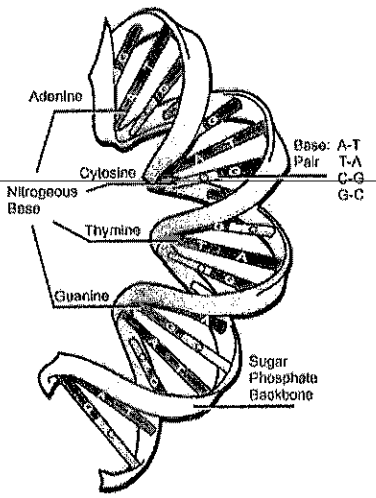


Chapter 12 Notes - DNA

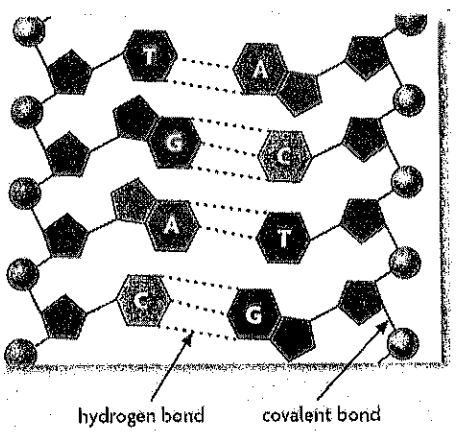
- **Chargaff's Rule (Base Pair Rule)**
  - _____ (C) = _____ (G)
  - _____ (A) = _____ (T)

PYRIMIDINES - SINGLE RING			PURINES - DOUBLE RING		
Name of Base	Structural Formula	Model	Name of Base	Structural Formula	Model
thymine			adenine		
cytosine			guanine		

- _____ – 2 strands of DNA wind around each other.
  - The strands are _____
  - They fit together & are opposite of each other.



- _____ bonds hold each of the base pairs together.
- _____ bonds hold the sugar to the phosphate.



VOCABULARY WORDS TO KNOW:

- *X-RAY CRYSTALLOGRAPHY*
- *DNA*
- *NUCLEOTIDES*
- *CHARGAFF'S RULE*
- *DOUBLE HELIX*
- *HYDROGEN BONDS*
- *COVALENT BONDS*

Chapter 12 Notes - DNA

12-2 – Chromosomes and DNA Replication

Essential Questions:

- What happens during DNA replication?

DNA and Chromosomes

_____ **cells** – DNA is located in the _____.

- Most have a single circular DNA molecule that contains nearly all of the cell's genetic information.
- _____ – circular DNA

_____**cells** – DNA is located in the _____.

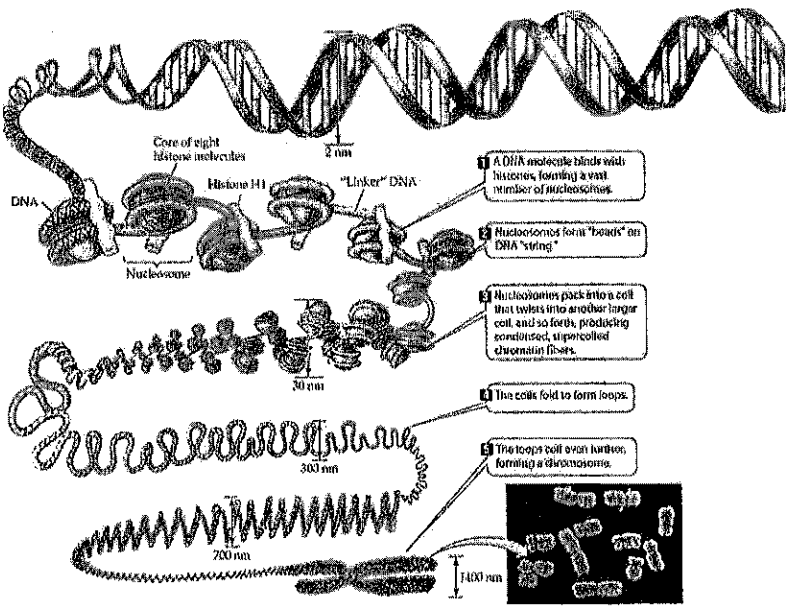
- Each organism has a different number of chromosomes.
  - *E.coli (which lives in the large intestines) contains 4,639,221 base pairs.*
  - *1 human cell contains 1000x as many base pairs. Each cell's nucleus contains at least 1 meter of DNA!!!*

Structure of DNA

- DNA is packed tightly to form _____
- Chromatin consists of DNA coiled around _____ (proteins)
- The histone and DNA form _____
- Nucleosomes pack together to form a thick fiber of _____

  _____
- The fiber supercoils to form

  _____

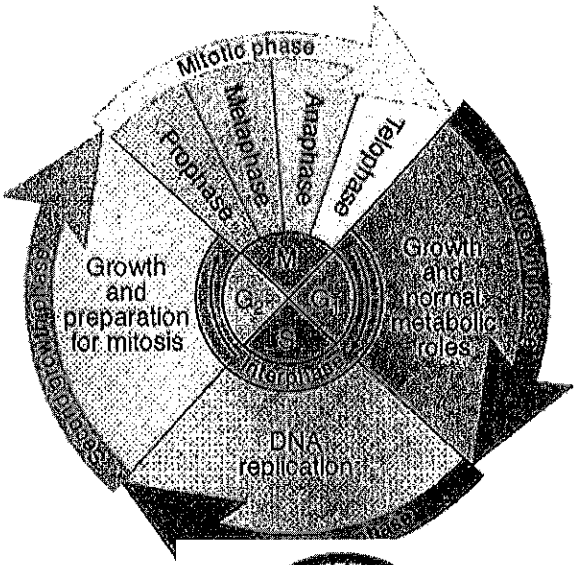


Chapter 12 Notes - DNA

DNA Replication

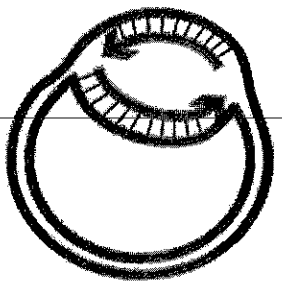
Why does DNA need to be replicated?

When does DNA replication take place?

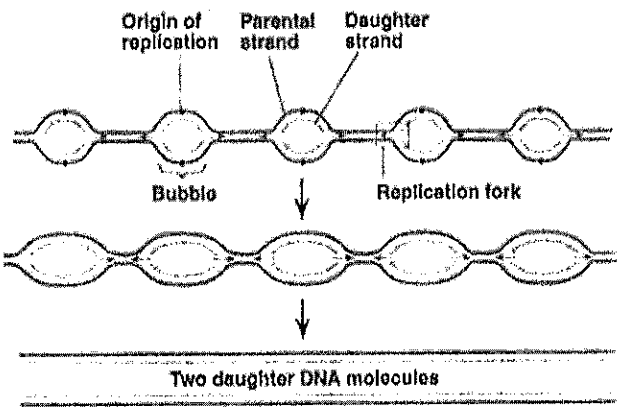


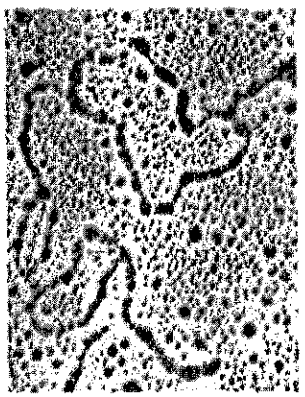
_____ – process of copying DNA during the synthesis phase (interphase) of the cell cycle.

Replication assures that every cell has a _____ set of _____ genetic information.



- In prokaryotic cells, DNA replication begins at a _____ point in the chromosome and proceeds, often in 2 directions, until the entire chromosome is replicated.
- In eukaryotic cells, DNA replication occurs at hundreds of places.
  - Replication proceeds in _____ directions until each chromosome is completely copied.
  - The sites where separation and replication occur are called _____ _____.

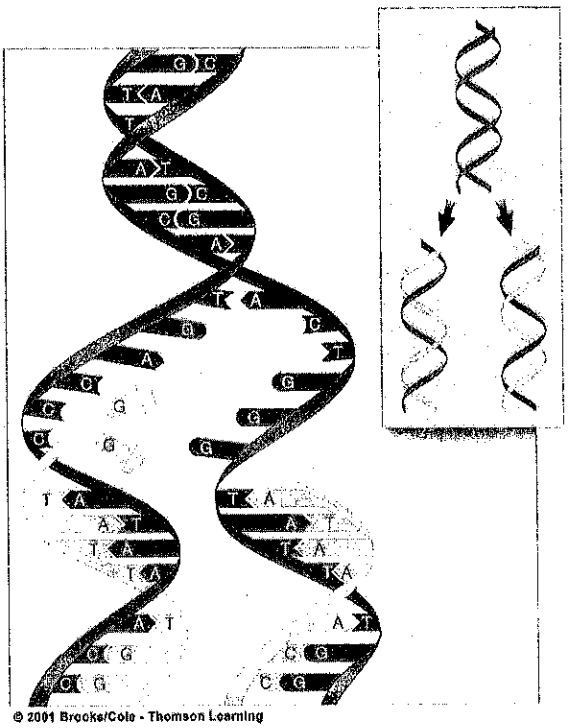




Chapter 12 Notes - DNA

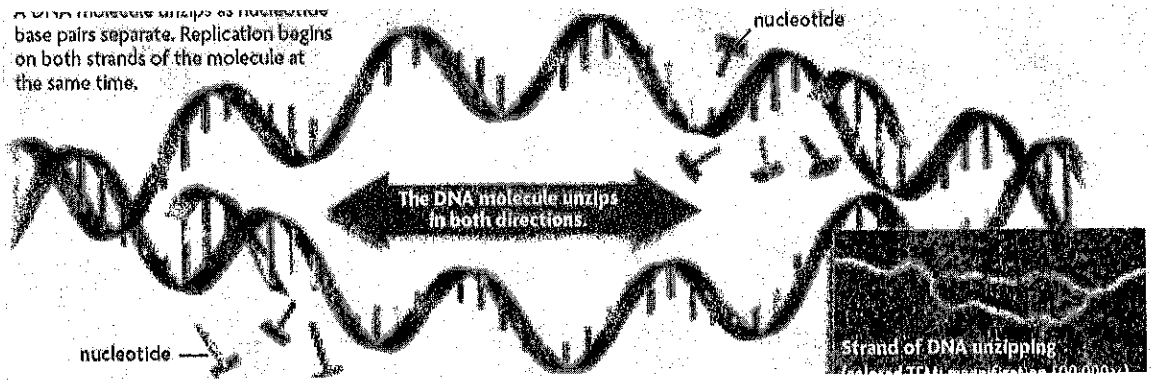
Structure Helps DNA Duplication

- Hydrogen bonds b/w 2 strands are _____ broken.
- Each single strand then serves as _____ for new strand.
- Each parent strand remains _____
- Every DNA molecule is "_____" - half "old" and half "new".



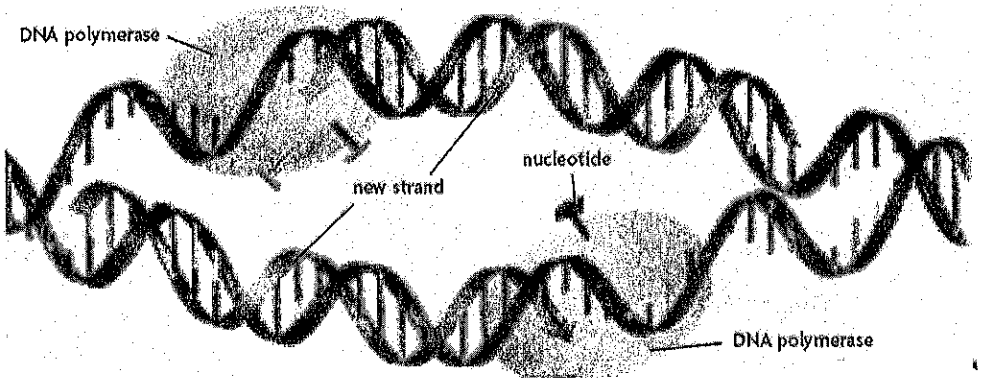
Replication – How It Works

1. DNA _____ enzymes unzip the DNA at several places along the strand by breaking the _____ b/w the base pairs.
2. Once the strands are separated, helix-destabilizing _____ bind to the single strand _____ the strands from coming back together



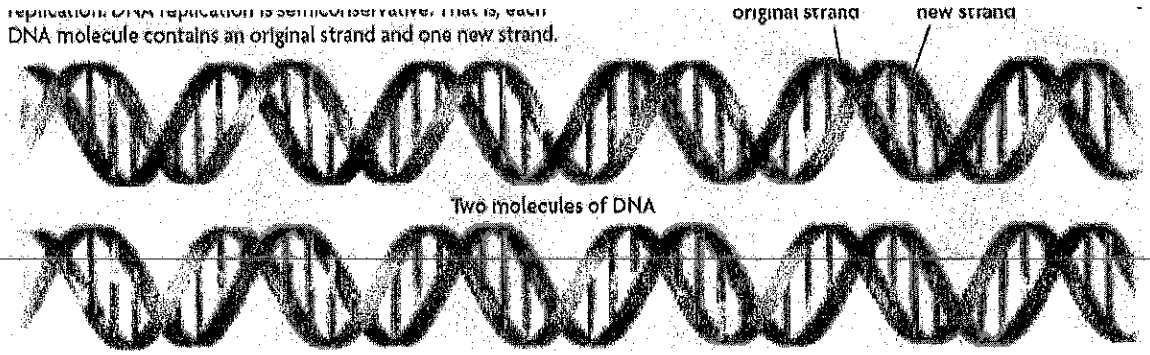
3. Floating nucleotides pair up w/ the bases on the _____ strands as they are unzipped.

4. DNA _____ catalyzes and links the nucleotides together to form new strands that are complementary.



5. Two _____ molecules of DNA are made!

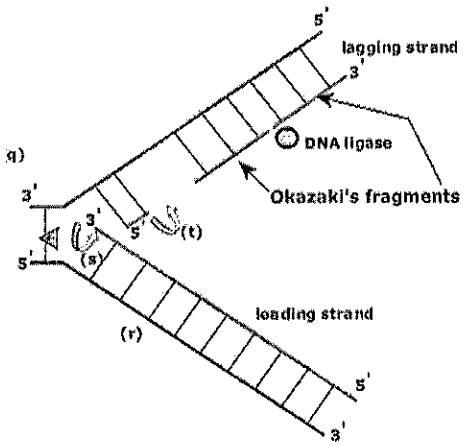
- Each DNA molecule has 1 _____ strand and 1 _____ strand.

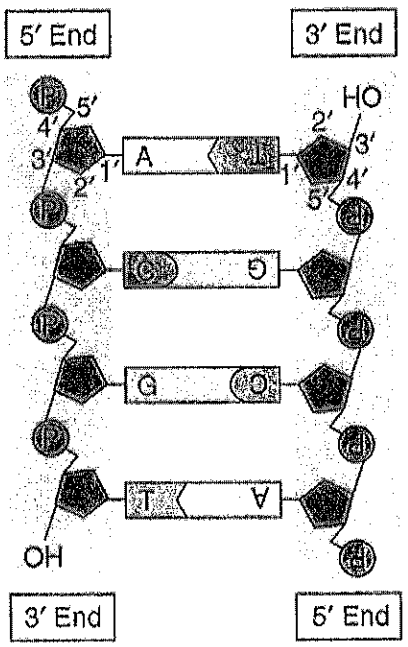


- The 2 chains are _____, or run in opposite directions.
- Replication always occurs in a _____ direction.

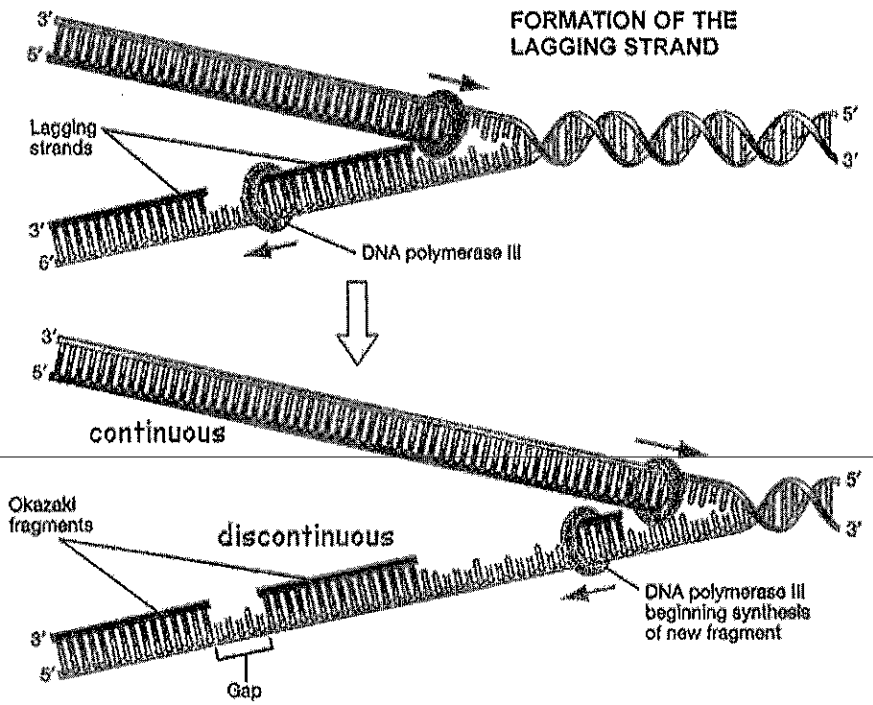
5' = phosphate group

3' = sugar group.





- This 5'→3' direction requires one DNA strand to be synthesized _____and the other _____
  - _____ Strand – continuous replication
  - _____ Strand – discontinuous replication
    - Produces _____ _____ which will be joined together by DNA ligase.



- DNA replication happens often, so it has to be fast.
- In humans, _____ nucleotides are added every second.
- DNA _____will detect errors and replace incorrect nucleotides.

Chapter 12 Notes - DNA

VOCABULARY WORDS TO KNOW:

- *PROKARYOTIC CELL*
- *EUKARYOTIC CELL*
- *CHROMATIN*
- *HISTONE*
- *NUCLEOSOME*
- *CHROMOSOME*
- *REPLICATION*
- *REPLICATION FORK*
- *SEMI-CONSERVATIVE*
- *DNA HELICASE*
- *HELIX-DESTABILIZING PROTEINS*
- *DNA POLYMERASE*
- *ANTIPARALLEL*
- *DIRECTION OF REPLICATION*
- *5'*
- *3'*
- *LEADING STRAND*
- *LAGGING STRAND*

12-3 RNA and Protein Synthesis

- What are the three main types of RNA?
- What is transcription?
- What is translation?
- How does translation convert an mRNA message into a protein?

When a protein is needed, the cell makes a protein through _____.

DNA molecules _____ leave the nucleus of the cell.

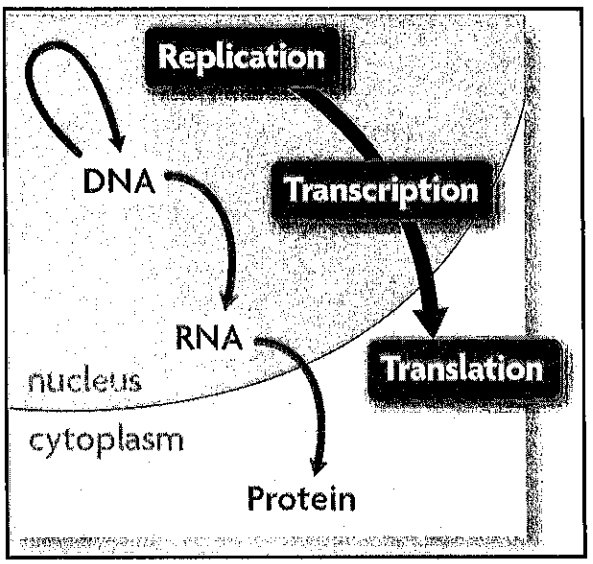
Protein synthesis must occur in the ribosomes which are located in the cytoplasm.

Therefore, the code must be _____ from the nucleus to the cytoplasm.

But how?

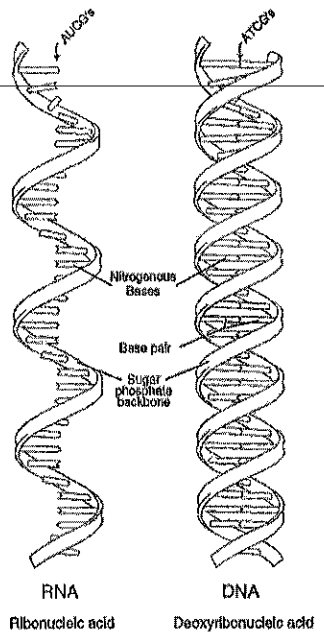
Chapter 12 Notes - DNA

- _____ – describes the flow of information from DNA to RNA to proteins.
  - Replication – _____ DNA
  - Transcription – _____ DNA into RNA
  - Translation – _____ RNA into a string of amino acids (protein)



- **RNA (_____)** – chain of nucleotides.
  - Acts as a middle-man b/w DNA in the nucleus and proteins in the cytoplasm.
  - _____ (U) replaces _____ (T) in RNA

	DNA	**RNA**
Type of sugar	Deoxyribose	Ribose
Type of nitrogen bases	Cytosine (C) Adenine (A) Guanine (G) Thymine (T)	Cytosine (C) Adenine (A) Guanine (G) Uracil (U)
Structure or shape	Double helix	Single Strand



- 3 types of RNA molecules:
  - _____ **RNA (mRNA)** – middle message that is translated to form a protein.
  - _____ **RNA (rRNA)** – forms part of ribosomes.
  - _____ **RNA (tRNA)** – brings amino acids from cytoplasm to a ribosome.

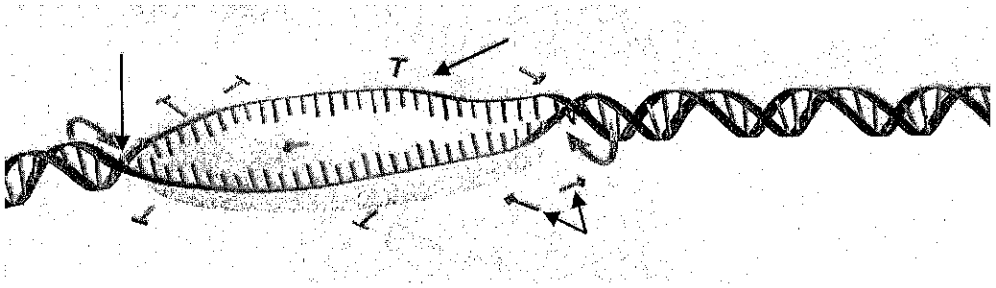
Chapter 12 Notes - DNA

Transcription

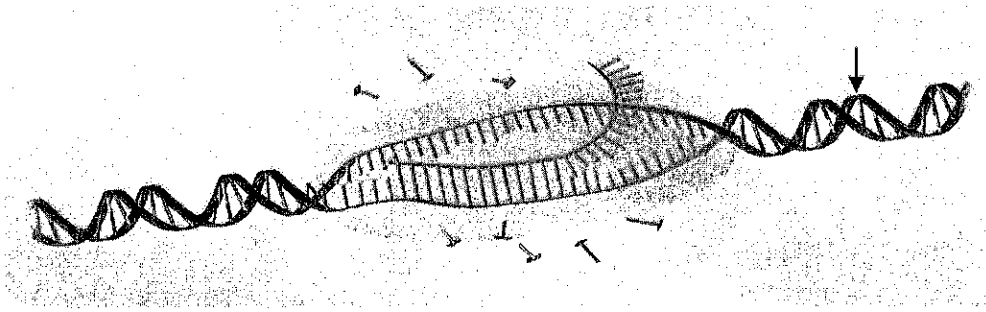
- _____ – process of copying a sequence of DNA to produce a complementary strand of RNA.
- _____ – enzyme that bonds nucleotides together to make RNA

Steps of Transcription

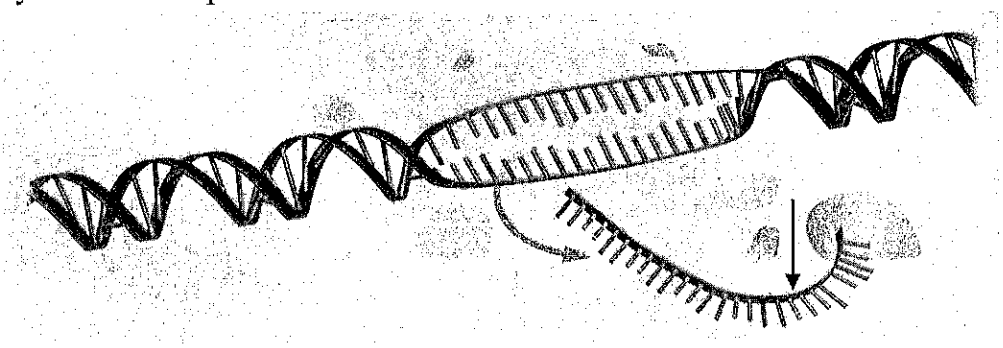
1. _____ and other proteins recognize the start site of a gene, _____, and the DNA segment begins to unwind.



2. RNA nucleotides form _____ with the DNA template.
    - The growing RNA strand hangs freely as it is transcribed.



3. The completed _____ strand separates from the DNA template and the RNA polymerase falls apart.



Chapter 12 Notes - DNA

Promoters

How does the RNA polymerase "know" where to start and stop making an RNA copy of DNA?

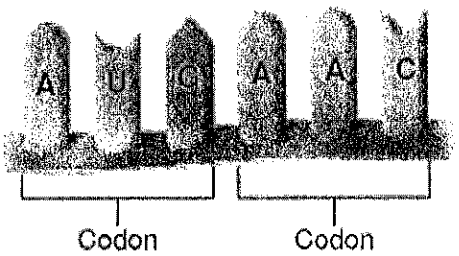
transcription complex

- RNA polymerase will bind _____ to regions of DNA sequence known as promoters.
- _____ – specific base sequences that indicate to RNA polymerase where to bind.

RNA Editing

- _____ – sequences of nucleotides that do NOT code for proteins
- _____ – sequences of nucleotides that DO code for proteins
- After transcription, introns are _____ of RNA and exons are _____

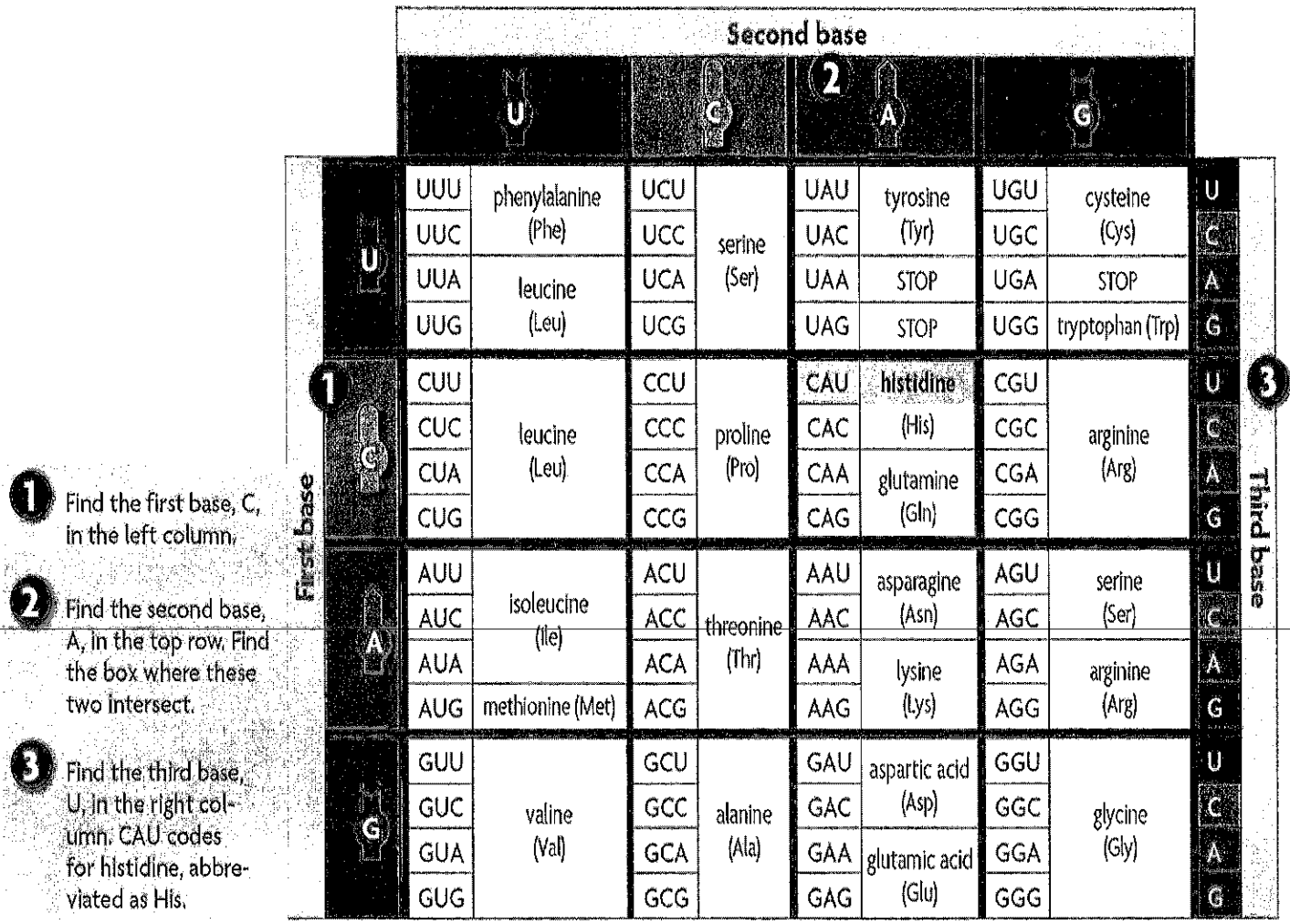
The Genetic Code



- _____ – 3-nucleotide sequence that codes for an amino acid.
- _____ – molecule that makes up proteins.
  - There are 20 amino acids!
- A codon can also code for:
  - _____ – signals the <u>end</u> of the amino acid chain.
  - _____ – signals the <u>start</u> of translation & the amino acid _____(Met).
- For the mRNA code to be translated correctly, codons must be read in the right order.
  - A change in the order the codons are read changes the resulting protein.

Chapter 12 Notes - DNA

- This genetic code is shared by all organisms – it is called the "Universal Genetic Code".



First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	UUU phenylalanine (Phe)	UCU serine (Ser)	UAU tyrosine (Tyr)	UGU cysteine (Cys)	U
	UUC	UCC	UAC	UGC	C
	UUA leucine (Leu)	UCA	UAA STOP	UGA STOP	A
	UUG	UCG	UAG STOP	UGG tryptophan (Trp)	G
C	CUU leucine (Leu)	CCU proline (Pro)	CAU histidine (His)	CGU arginine (Arg)	U
	CUC	CCC	CAC	CGC	C
	CUA	CCA	CAA glutamine (Gln)	CGA	A
	CUG	CCG	CAG	CGG	G
A	AUU isoleucine (Ile)	ACU threonine (Thr)	AAU asparagine (Asn)	AGU serine (Ser)	U
	AUC	ACC	AAC	AGC	C
	AUA	ACA	AAA lysine (Lys)	AGA arginine (Arg)	A
	AUG methionine (Met)	ACG	AAG	AGG	G
G	GUU valine (Val)	GCU alanine (Ala)	GAU aspartic acid (Asp)	GGU glycine (Gly)	U
	GUC	GCC	GAC	GGC	C
	GUA	GCA	GAA glutamic acid (Glu)	GGA	A
	GUG	GCG	GAG	GGG	G

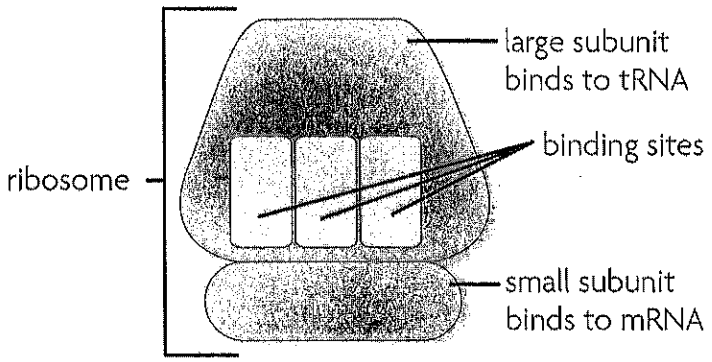
1. Find the first base, C, in the left column.
2. Find the second base, A, in the top row. Find the box where these two intersect.
3. Find the third base, U, in the right column. CAU codes for histidine, abbreviated as His.

DNA

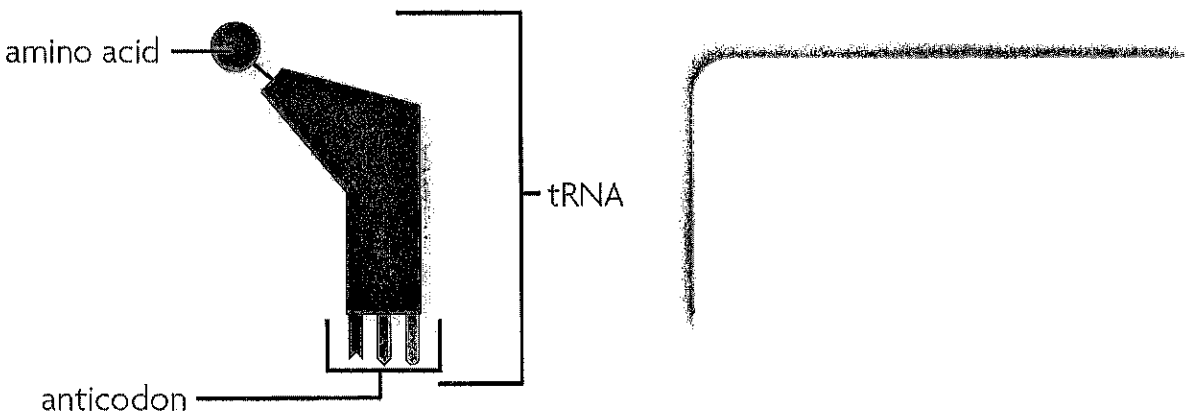
Chapter 12 Notes - DNA

Translation

- _____ – process that converts, or translates, an mRNA message into proteins.
- _____
  - Made up of 2 _____:
    - The large subunit has three binding sites for tRNA.
    - The small subunit binds to mRNA.
  - Ribosomes are made up of _____ and _____.



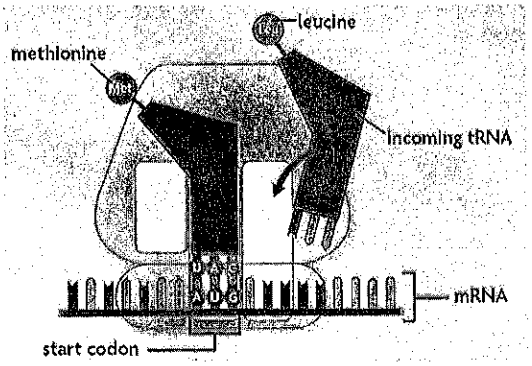
- _____ – acts as an adaptor b/w mRNA & amino acids.
  - One end of the rRNA molecule has a specific _____
  - The other end recognizes a specific _____.
    - _____ – set of 3 nucleotides complementary to an mRNA codon.



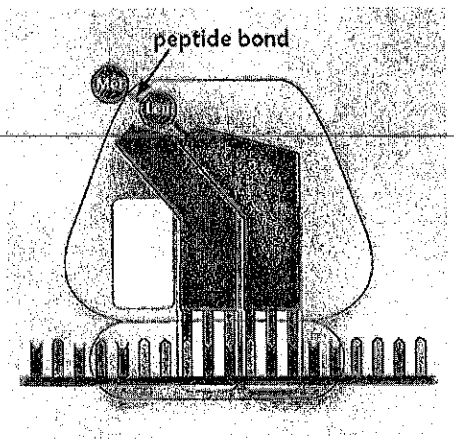
Chapter 12 Notes - DNA

Steps of Translation

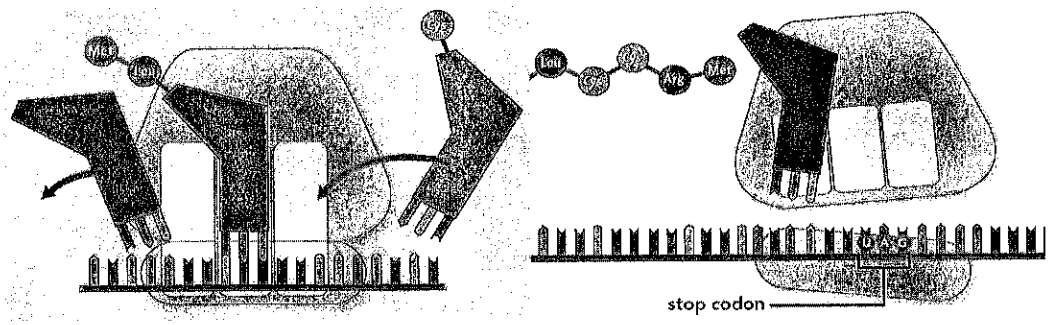
1. The exposed codon attracts a tRNA molecule carrying an amino acid.
   The tRNA anticodon pairs with the mRNA codon, bringing it very close to the other tRNA molecule.



2. The ribosome helps form a _____ between the 2 amino acids.
   The ribosome breaks the bond between the tRNA in the 2nd site and its amino acid.



3. The ribosome pulls the mRNA strand the length of _____ codon. The tRNA molecule in the second site is _____ into the 3rd site. The _____ _____ the ribosome to get another amino acid.



Name: _____ Period: _____

Honors Biology - Ch 12-1 Open Notes Quiz

1. What is a bacteriophage?

2. Describe Watson and Crick's model of the DNA molecule:

3. What are the three parts of a nucleotide?

4. Describe Frederick Griffith's experiments that determined the presence of a "transforming principle."

Name: Key Period: _____

Honors Biology - Ch 12-1 Open Notes Quiz

1. What is a bacteriophage?
   a virus that infects bacteria and turns it into a host
2. Describe Watson and Crick's model of the DNA molecule:
   double helix
3. What are the three parts of a nucleotide?
   nitrogen base, phosphate group, sugar
4. Describe Frederick Griffith's experiments that determined the presence of a "transforming principle."
   previously harmless strain turned lethal when introduced with dead lethal strain

Name: _____ Period: _____

Honors Biology - Ch 12-1 Open Notes Quiz

1. What is a bacteriophage?

2. Describe Watson and Crick's model of the DNA molecule:

3. What are the three parts of a nucleotide?

4. Describe Frederick Griffith's experiments that determined the presence of a "transforming principle."

Name: _____ Period: _____

Honors Biology - Chapter 12-2 Open Notes Quiz

1. What is the difference between the DNA in prokaryotic cells and eukaryotic cells?

2. The sites where separation and replication occur are called _____.

3. What is the function of the DNA helicase enzyme?

4. What is the function of the helix-destabilizing proteins?

5. What does it mean for DNA to be "antiparallel"?

6. Which direction does DNA replication always occur?

7. Which strand, leading or lagging, produces Okazaki fragments?

8. What is the function of DNA ligase?

____ 11. Which of the following events occurs directly after a DNA molecule is unzipped?
   a. Mismatched nucleotide bases are identified and replaced.
   b. Free-floating nucleotides pair up with exposed bases.
   c. Identical double-stranded DNA molecules are formed.
   d. Enzymes break hydrogen bonds between base pairs.

____ 12. The process of making new DNA molecules is semiconservative. This means that every new DNA molecule is composed of
   a. two completely identical strands of DNA.
   b. one original and one new strand of DNA.
   c. one strand of DNA and one strand of RNA.
   d. two strands that mix original and new DNA.

____ 13. In eukaryotes, DNA
   a. is located in the nucleus.
   b. floats freely in the cytoplasm.
   c. is located in the ribosomes.
   d. is circular.

____ 14. DNA is copied during a process called
   a. replication.
   b. translation.
   c. transcription.
   d. transformation.

____ 15. During DNA replication, a DNA strand that has the bases CTAGGT produces a strand with the bases
   a. TCGAAC.
   b. GATCCA.
   c. AGCTTG.
   d. GAUCCA.

Name: _____ Date: _____ Period: _____

Honors Biology – Open Notes Quiz – Ch 12-3 RNA & Transcription

1. Which of the following events occurs directly after RNA polymerase recognizes the transcription start site of a gene?
   a) The polymerase strings amino acids into a polypeptide.
   b) Free-floating DNA nucleotides pair up with exposed DNA bases.
   c) A complementary RNA strand detaches itself from the DNA.
   d) The DNA strand begins to unwind, separating the two strands.

2. What is the name of the enzyme that bonds nucleotides together to make RNA?
   a) DNA polymerase
   b) RNA polymerase
   c) Helix polymerase
   d) RNA helicase

3. _____ are specific base sequences in DNA that indicate to the enzyme where to bind in make RNA.
   a) mRNA molecules
   b) Anticodons
   c) Enzymes
   d) Promoters

4. List 3 differences between DNA and RNA:

5. Name the 3 types of RNA molecules and their role in the transcription/translation:

Name: Key Date: _____ Period: _____

Honors Biology – No Notes Quiz – Ch 12-3 RNA & Transcription

1. Which of the following events occurs directly after RNA polymerase recognizes the transcription start site of a gene?
   e) The polymerase strings amino acids into a polypeptide.
   f) Free-floating DNA nucleotides pair up with exposed DNA bases.
   g) A complementary RNA strand detaches itself from the DNA.
   h) The DNA strand begins to unwind, separating the two strands.

2. What is the name of the enzyme that bonds nucleotides together to make RNA?
   e) DNA polymerase
   f) RNA polymerase
   g) Helix polymerase
   h) RNA heliase

3. _____ are specific base sequences in DNA that indicate to the enzyme where to bind in make RNA.
   e) mRNA molecules
   f) Anticodons
   g) Enzymes
   h) Promoters

4. List 3 differences between DNA and RNA:
   bases, sugar, strands

5. Name the 3 types of RNA molecules:
   mRNA
   tRNA
   rRNA

Name: _____ Date: _____ Period: _____

Honors Biology – Ch 12-3 Translation Open Notes Quiz

____ 1. What is the term for a three-nucleotide sequence that codes for an amino acid?
a. base
b. codon
c. amine
d. serine

____ 2. Which phrase best describes translation?
a. converts mRNA into a polypeptide
b. catalyzes bonds between amino acids
c. produces RNA from DNA molecules
d. recycles tRNA molecules for reuse

____ 3. Which of the following is the site of translation?
a. vacuole
b. lysosome
c. nucleus
d. ribosome

____ 4. The anticodons for the codons in the mRNA with the sequence CUCAAGUGCUUC are
a. GAG—UUC—ACG—AAG.
b. GAG—TTC—ACG—AAG.
c. CUC—GAA—CGU—CUU.
d. CUU—CGU—GAA—CUC.

____ 5. Transfer RNA
a. carries an amino acid to its correct codon.
b. synthesizes amino acids as they are needed.
c. produces codons to match the correct anticodons.
d. converts DNA into mRNA.

Name _____ Date _____

WORKSHEET 4.4
Chargaff's DNA Data

Introduction

DNA was first discovered in 1869, but not much was known about the molecule until the 1920s. Early researchers discovered that DNA was comprised of repeated units called nucleotides. Each nucleotide contains a part called a nitrogen base. There are four different nitrogen bases found in DNA:

Adenine (A)
Cytosine (C)
Guanine (G)
Thymine (T)

In the 1920s it was believed that these nitrogen bases occurred in all living things in the same repeated pattern, such as ATGC ATGC ATGC. If this were true, then DNA could not be the hereditary molecule. With the same repeated pattern in all species, DNA could not provide the variety needed for a molecule containing the genetic code.

After World War II the biochemist Erwin Chargaff made some major discoveries about the nitrogen bases in DNA. His research revealed the percentage of each base (A, C, T, and G) found in an organism's DNA. The table below includes some of Chargaff's data and some more recent additions.

Table 4.2. Nitrogen Base Make-Up of Different Organisms' DNA (in Percentages)

Organism	A	T	G	C
Mycobacterium tuberculosis	15.1	14.6	34.9	35.4
Yeast	31.3	32.9	18.7	17.1
Wheat	27.3	27.1	22.7	22.8
Sea Urchin	32.8	32.1	17.7	17.3
Marine Crab	47.3	47.3	2.7	2.7
Turtle	29.7	27.9	22.0	21.3
Rat	28.6	28.4	21.4	21.5
Human	30.9	29.4	19.9	19.8

Name _____ Date _____

Analysis

1. What observations can you make about the data in the table? What patterns do you notice?

2. What mathematical calculations could you make with the above data that would reveal more information about important patterns? Make calculations and record your results in a table.

3. What does the data show about the make-up of DNA for different species? Explain.

4. After seeing data like this in the 1940s, what do you think researchers concluded about DNA's potential to carry the genetic code? Explain.

5. Before concluding that the pattern seen in the data is universal, which other species would you want to test? Why?

Name _____ Date _____

Chargaff's DNA Data, *Cont'd.*

Background Information

Adenine and guanine are similarly shaped nitrogen bases called purines. Thymine and cytosine are similar in shape and they are classified as pyrimidines.

1. For at least four species in the data table, calculate the ratio of purines:pyrimidines and organize your results in a table.

2. What can you conclude about the purine:pyrimidine make-up of DNA?

Piecing It Together

Chargaff's data was a central piece of evidence used by James Watson and Francis Crick in 1953 to successfully describe the structure of DNA.

Look at a drawing of the DNA molecule that has labeled nitrogen bases. Such drawings are easily found in biology textbooks and on the Internet, or your teacher may show you one.

1. What do you notice about the arrangement of the nitrogen bases? Record as many observations as you can.

2. How do you think Chargaff's data helped Watson and Crick to predict that DNA looks like this?

Name _____
Date _____ Period _____
Lab Partners _____
_____
_____

Strawberry DNA Extraction Lab

Today you will extract DNA from strawberries. You will isolate and view it under a microscope. The expectation before the end of class is that you will be able to describe in detail what DNA looks like (the structure of DNA).

PRE-LAB:

- Create a hypothesis
- Read through all materials, procedures, and questions
- Read the Safety Procedures!!

HYPOTHESIS

Form a hypothesis as to what you think DNA will look like when we isolate it from strawberry cells. In as much detail as possible, write a hypothesis statement.

MATERIALS

In each tub you should have:
-strawberries
-swatch of cheese cloth
-disposable pipettes
-test tube
-test tube holder
-timer

Each lab table should have:
-beaker of detergent solution
-beaker of meat tenderizer
-beaker of ethyl alcohol

SAFETY PROCEDURES

- Be sure to follow all directions EXACTLY. This is important to make sure that the DNA separates from the cells properly
- NO food or drink in the lab at any time
- Do not eat or drink any lab materials – solutions or solids!
- We will be using ethyl alcohol in the lab:
    - Strong clear liquid

- Toxic if ingested or inhaled and can irritate body tissue
- Avoid body contact
- Highly flammable – avoid flames!
- Everyone **must** wear safety goggles and aprons **at all times!**

➢ Let me know immediately if there are any safety issues or accidents in the lab

LAB PROCEDURES:

STEP 1: Mash the strawberries in your Ziploc back for 3 minutes or until completely mashed

STEP 2: Add 1 pipette of detergent solution and mash in with the strawberries. Let the solution sit for 3 minutes while reading the rest of the lab. After three minutes, strain the strawberry solution through the cheesecloth into the test tube. You should have at least 1 inch of liquid in the bottom of the test tube.

Why am I adding detergent?

To get DNA out of the cells, you need to break open both the cell membranes and the nuclear membranes. Cell membranes and nuclear membranes consist primarily of _____.
Dishwashing detergent, like all soaps, breaks up clumps of lipids. This is why you use detergents to remove fats (which are lipids) from dirty dishes. Adding the detergent to our strawberry cells will break open the cell membranes and nuclear membranes and release the DNA into the solution.

STEP 3: Add one small scoop of meat tenderizer to your tube. Invert quickly a few times. Let it sit and answer the first question set.

Why am I adding meat tenderizer?

The nucleus of each of the cells contains multiple long strands of DNA with all the instructions to make your entire body. If you stretched out the DNA found in one of your cells, it would be 2-3 meters long. To fit this DNA inside a tiny cell nucleus, the DNA is wrapped tightly around proteins. The enzyme in meat tenderizer is a protease, which is an enzyme that cuts proteins into small pieces. As this enzyme cuts up the proteins, the DNA will unwind and separate from the proteins.

QUESTION 321 +

DNA consists of two strands of **nucleotides** wound together in a spiral called a **double helix.** Read the explanation in the figure before answering questions 1 and 2.

1. The three components of each nucleotide are:

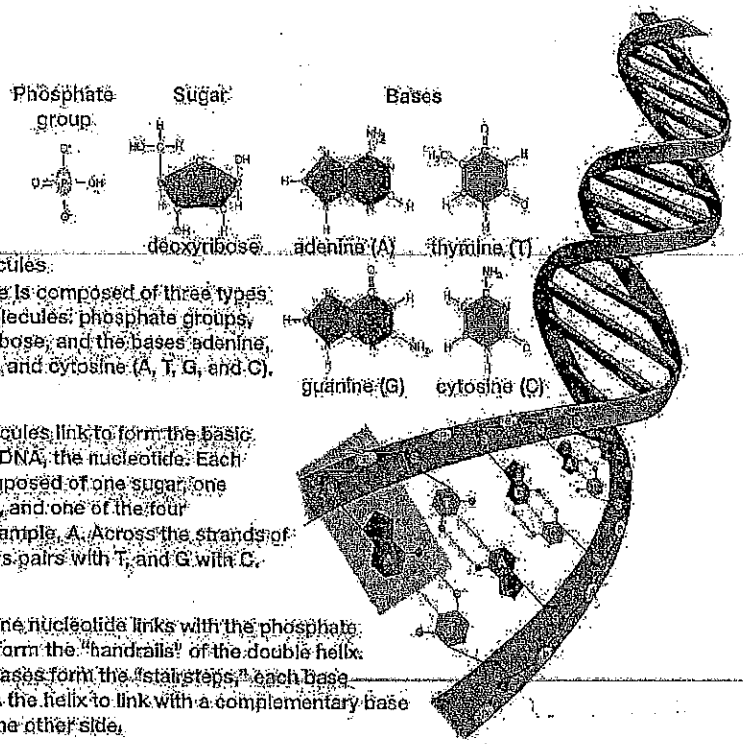
_____

_____

_____

Draw a rectangle around a single nucleotide in the double helix.

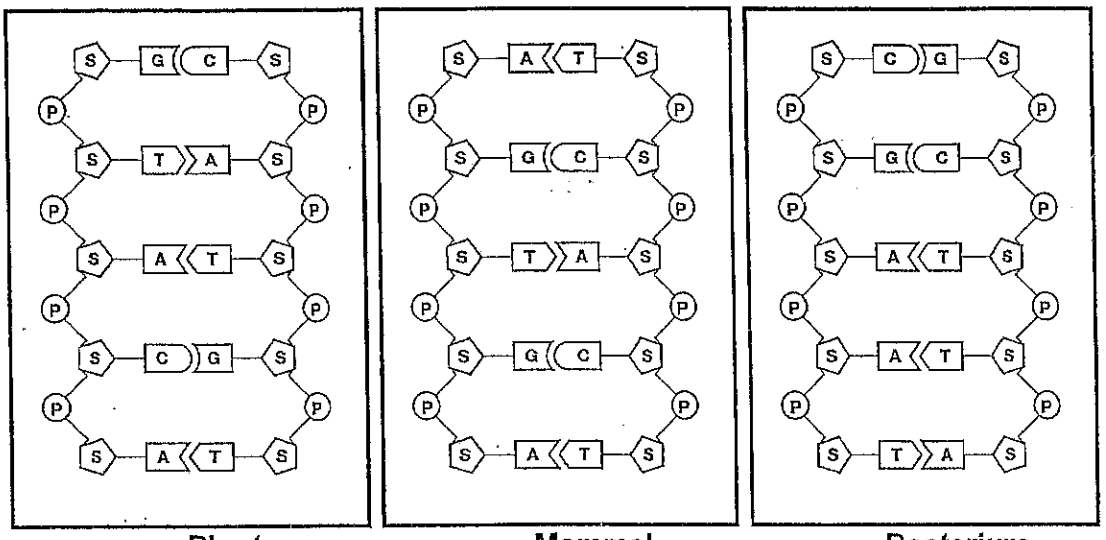
2. The complete name for DNA is **deoxyribonucleic acid.** Which component of each nucleotide accounts for the "deoxyribo" part of this name?



(Figure from Biology -- A Guide to the Natural World by Krogh)

The drawings below show a very small section of the DNA double helix from three very different organisms: a plant, a mammal, and a bacterium. Each strand of DNA shown contains five nucleotides. Each nucleotide has:

S = sugar molecule called deoxyribose
P = phosphate group
plus one of the four bases: **A** = adenine, **C** = cytosine, **G** = guanine, or **T** = thymine



Plant **Mammal** **Bacterium**

(From BioRad's "Forensic DNA fingerprinting kit" http://www.bio-rad.com/cmc_upload/Literature/12525/4006096G.pdf)

3. Complete the following sentences to describe the structure of DNA.

In the backbone of each strand in the DNA double helix molecule, the sugar of one nucleotide is bonded to the _____ in the next nucleotide.

The _____ of the nucleotides in each strand of DNA extend toward each other in the center of the DNA double helix molecule.

A in one strand always pairs with _____ in the other strand, and G in one strand always pairs with _____ in the other strand. These are the **base-pairing rules.**

STEP 4: With your own pipette, gently put in at least 1 inch of ethyl alcohol by holding the test tube slanted and dropping the alcohol on the side and letting it run down the tube. You should get two distinct layers here due to different densities of the solutions. GENTLY set the test tube down into the holder and do not move or bump it while you answer the second question set.

Why am I adding ethyl alcohol?

The cold alcohol reduces the solubility of DNA. When cold alcohol is poured on top of the solution, the DNA precipitates out into the alcohol layer, while the lipids and proteins stay in the solution.

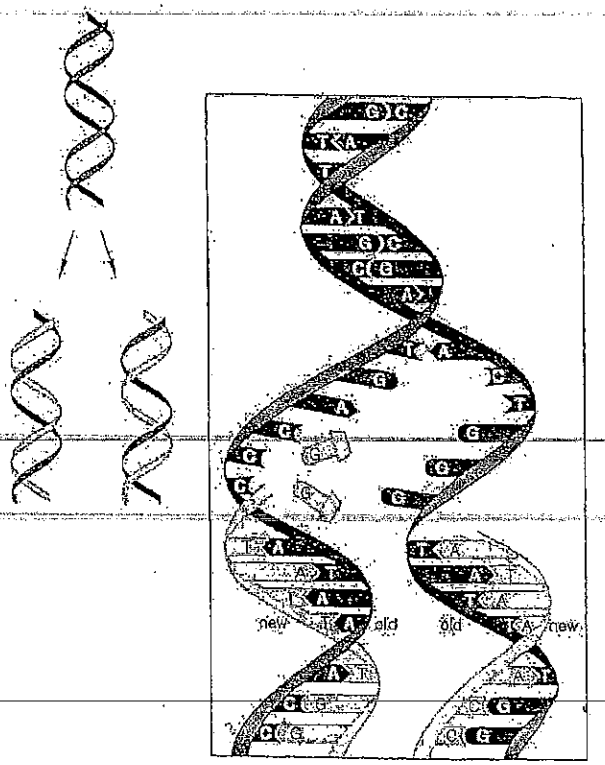
Question Set 2: DNA Replication

New cells are formed when a cell divides into two daughter cells. For example, cell division in the lining of your mouth makes the new cells that replace the cells that are rubbed off whenever you chew food. Before a cell can divide, the cell must make a copy of all the DNA in each chromosome; this process is called **DNA replication.**

The process of DNA replication is shown in the figure on the right. During DNA replication, the two strands of the DNA helix are separated and each old strand provides the instructions for making a new matching strand. The nucleotides in the new strand are added one at a time. Each new nucleotide is matched to a nucleotide in the old strand using the base-pairing rules.

DNA replication results in two new DNA molecules that are identical to the original DNA molecule. Thus, each of the new DNA molecules has the same genetic information as the original DNA molecule.

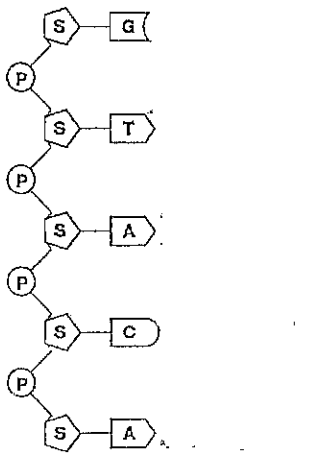
DNA polymerase is an enzyme that helps to make the new matching DNA strand by adding nucleotides one at a time and joining each new nucleotide to the previous nucleotide in the growing DNA strand.



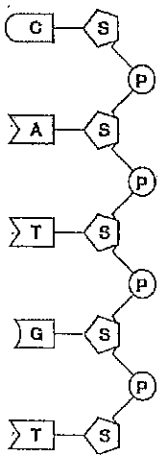
(From Biology – A Human Emphasis, Sixth Edition by Starr)

2. Each new nucleotide added by the enzyme DNA _____ matches the corresponding nucleotide in the old strand of DNA, in accord with the _____ rules.

3. In the drawing below, the small segment of plant DNA from page 3 is shown after the two strands of the DNA molecule have been separated. Your job is to play the role of DNA polymerase and create the new matching strands of DNA to make two pieces of double-stranded DNA in the drawing below. Use the base-pairing rules to write in the nucleotides for both new strands of DNA.



Old Strand New Strand



New Strand Old Strand

STEP 5: Once you observe DNA start to precipitate in between the layers, try to tease up the DNA using your pipette and record your observations. Once you see it completely, squeeze out the air in your pipette and insert the pipette down into only the alcohol layer. Try to suck in some of the DNA in a VERY SMALL AMOUNT OF LIQUID

OBSERVATIONS:

Written description –

Drawing of DNA –

STEP 6: Drop the DNA onto a blank slide. Cover with a cover slip and then view under the microscope. Remember to start with the lowest magnification (smallest objective) and only use the small adjustment knob on the high objective lens.

CONCLUSION QUESTIONS

1. Which cells in your body contain DNA?

2. Why do these cells need DNA?

3. Which of the following do you think will contain DNA?
   Bananas ____ concrete ____ fossils ____ meat ____ metal ____spinach ____
   Explain your reasoning.

4. Describe the function of DNA polymerase.

5. Why is it necessary to replicate DNA and what part of the cell cycle does this happen in?

Name _____

Date_____ Period_____

Strawberry DNA Extraction Lab Post-Lab Questions

1. Why did we add detergent to the bag of smashed strawberries?

2. Why did we add meat tenderizer to the strawberries?

3. Why did we add cold alcohol on top of the strawberry solution?

4. What did the DNA that we extracted look like in the test tube? (Color, shape, etc)

5. During replication, what gets added to the template DNA strand?

Name _____

Date_____ Period_____

Strawberry DNA Extraction Lab Post-Lab Questions

1. Why did we add detergent to the bag of smashed strawberries?

2. Why did we add meat tenderizer to the strawberries?

3. Why did we add cold alcohol on top of the strawberry solution?

4. What did the DNA that we extracted look like in the test tube? (Color, shape, etc)

5. During replication, what gets added to the template DNA strand?

DNA EXTRACTION VIRTUAL LAB – Make Up for Strawberry DNA Lab

http://learn.genetics.utah.edu/

DNA is extracted from human cells for a variety of reasons. With a pure sample of DNA you can test a newborn for a genetic disease, analyze forensic evidence, or study a gene involved in cancer. Try this virtual laboratory to perform a cheek swab and extract DNA from human cells.

Scientists isolate human DNA for a variety of reasons including:

1.
2.
3.

Where is DNA located?

What cells are typically used for DNA Extraction?

What are the steps to purifying a DNA sample?

1.
2.
3.
4.

List the materials needed to purify a DNA sample

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Explain (in detail) how to purify a DNA sample.

1. Swab _____
2. Place the swab _____
3. The end of the swab must be _____so_____
4. Using the micropipettor_____

Lysis means _____

5. Place the tube _____

The lytic solution contains 2 important ingredients _____ &

_____

The detergent disrupts the _____and _____ causing the cell to _____

The proteinase K cuts _____

6. Add some _____

The salt causes _____

7. Place the tube _____

Why is this step necessary? _____

_____

8. Use the micropipettor to _____ and place it _____
9. Add some _____
10. Inverting (turning the tube upside down) several times _____

_____

Why can you now see the DNA using your naked eye? _____

_____

11. Place the tube _____.

Why? _____

12. Once the liquid is removed, the DNA is allowed _____
13. You can store it _____ or you can _____

SAY IT WITH DNA: PROTEIN SYNTHESIS WORKSHEET: Practice Pays

Having studied the process by which DNA directs the synthesis of proteins, you should be ready to decode some DNA "secret" messages. To do this, you must follow the procedure of protein synthesis as this is taking place right now in your cells; no short cuts! Practice these steps by following and finishing the **partially solved message** below.

STEP 1: "Build" the mRNA molecule, matching the RNA nucleotides to the DNA nucleotides properly, letter by letter.
(For purposes of simplicity, it will be assumed that this mRNA is bacterial; there are no introns to cut out!)

STEP 2: Figure out the tRNA triplets (codons) which would fit the mRNA triplets (letter by letter).

STEP 3: Look up each tRNA codon in the **tRNA Dictionary** (below), and find the corresponding symbol and amino acid abbreviation for that codon. Record that one-letter symbol (and its amino acid) below each codon. "Spc" = "space". If you have done this correctly, the symbols should spell out a meaningful message in English.

Remember, C always pairs with G, G always pairs with C, A pairs with T (in DNA) or U (in RNA), T pairs with A, and U (in RNA) pairs with A (in DNA). Clues: C & G are curved letters; A & T are angular; U is used in RNA in place of T.

When you finish the sample message below, decode the special message assigned to you (from the sheet with many messages). Be sure to show the details of your solution on the **Practice Sheet** provided, and hand it in. In your DNA exam, you will be expected to do this from memory (provided with the tRNA Dictionary).

PARTIALLY SOLVED MESSAGE

GIVEN: DNA code message --> GAA TAG AAA CTT ACT TAG AGC ATT CCT GCC CTT CGA TGC ATC

SOLUTION (steps 1-4)

1. **mRNA** (built to match the DNA message, letter for letter----------> CUU AUC UUU GAA UGA AUC UCG ... ...

2. **tRNA** (determined by matching letters (bases) with those in mRNA)----------> GAA UAG AAA CUU ACU UAG ... ...

3. **Amino acids** carried by each tRNA (according to dictionary, below)----------> L e u | I s o | P h e | G l u | | I s o

4. **Symbols** of amino acids:----> L I F E I . . . . . .

DICTIONARY OF tRNA CODONS & THEIR AMINO ACIDS (SYMBOLS & ABBREVIATIONS)

tRNA	sym	AA
AAA	F	Phe
AAC	L	Leu
AAG	F	Phe
AAU	L	Leu
ACA	C	Cys
ACC	W	Trp
ACG	C	Cys
ACU	-	spc
AGA	S	Ser
AGC	S	Ser
AGG	S	Ser
AGU	S	Ser
AUA	Y	Tyr
AUC	-	spc
AUG	Y	Tyr
AUU	-	spc

tRNA	sym	AA
CAA	V	Val
CAC	V	Val
CAG	V	Val
CAU	V	Val
CCA	G	Gly
CCC	G	Gly
CCG	G	Gly
CCU	G	Gly
CGA	A	Ala
CGC	A	Ala
CGG	A	Ala
CGU	A	Ala
CUA	D	Asp
CUC	E	Glu
CUG	D	Asp
CUU	E	Glu

tRNA	sym	AA
GAA	L	Leu
GAC	L	Leu
GAG	L	Leu
GAU	L	Leu
GCA	R	Arg
GCC	R	Arg
GCG	R	Arg
GCU	R	Arg
GGA	P	Pro
GGC	P	Pro
GGG	P	Pro
GGU	P	Pro
GUA	H	His
GUC	Q	Glu
GUG	H	His
GUU	Q	Glu

tRNA	sym	AA
UAA	I	Iso
UAC	M	Met
UAG	I	Iso
UAU	I	Iso
UCA	S	Ser
UCC	R	Arg
UCG	S	Ser
UCU	R	Arg
UGA	T	Thr
UGC	T	Thr
UGG	T	Thr
UGU	T	Thr
UUA	N	Asn
UUC	K	Lys
UUG	N	Asn
UUU	K	Lys

Name_____ SN_____ Date_____ Per._____

SAY IT WITH DNA: PROTEIN SYNTHESI PRACTICE SHEET

First Message Assigned:
Number of DNA Message Assigned:_____ (carefully copy below the DNA message assigned):

Practice DNA message:_____

Names of molecules for each step:

Decoded Message (English word or words):_____

Second Message Assigned:
Number of DNA Message Assigned:_____ (carefully copy below the DNA message assigned):

DNA message:_____

Names of molecules for each step:

Decoded Message (English word or words):_____

Name _____
Date _____ Period _____

Honors Biology Chapter 12 Closed Notes Quiz

____ 1. The process of making new DNA molecules is **semiconservative**. This means that every new DNA molecule is composed of
a. two completely identical strands of DNA.
b. one original and one new strand of DNA.
c. one strand of DNA and one strand of RNA.
d. two strands that mix original and new DNA.

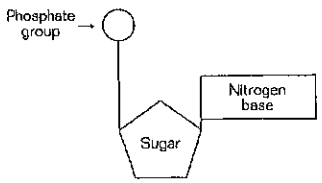
____ 2. The **central dogma** of molecular biology states that information flows in one direction from
a. nuclei to RNA to cytoplasm.
b. ribosomes to proteins to DNA.
c. genes to nuclei to ribosomes.
d. DNA to RNA to proteins.

____ 3. Choose the nucleotide sequence of the **RNA strand** that would be complementary to the following DNA strand: GTAGTCA.
a. UATUAGA
b. ACGACTG
c. CAUCAGU
d. CATCAGT

____ 4. Which of the following events occurs **directly after RNA polymerase recognizes the transcription start site** of a gene?
a. The polymerase strings amino acids into a polypeptide.
b. Free-floating nucleotides pair up with exposed DNA bases.
c. A complementary RNA strand detaches itself from the DNA.
d. The DNA strand begins to unwind, separating the two strands.

____ 5. During **DNA replication**, a DNA strand that has the bases CTAGGT produces a strand with the bases
a. TCGAAC.
b. GATCCA.
c. AGCTTG.
d. GAUCCA.

____ 6. AUG is the codon for the
a. start signal for translation.
b. binding site for RNA polymerase.
c. start signal for transcription.
d. binding site for DNA polymerase.



____ 7. The **entire molecule** shown in the diagram above is called a(n)
a. amino acid.
b. nucleotide.
c. polysaccharide.
d. pyrimidine.

____ 8. **adenine : thymine ::**
a. protein : DNA
b. Watson : Crick
c. guanine : cytosine
d. guanine : thymine

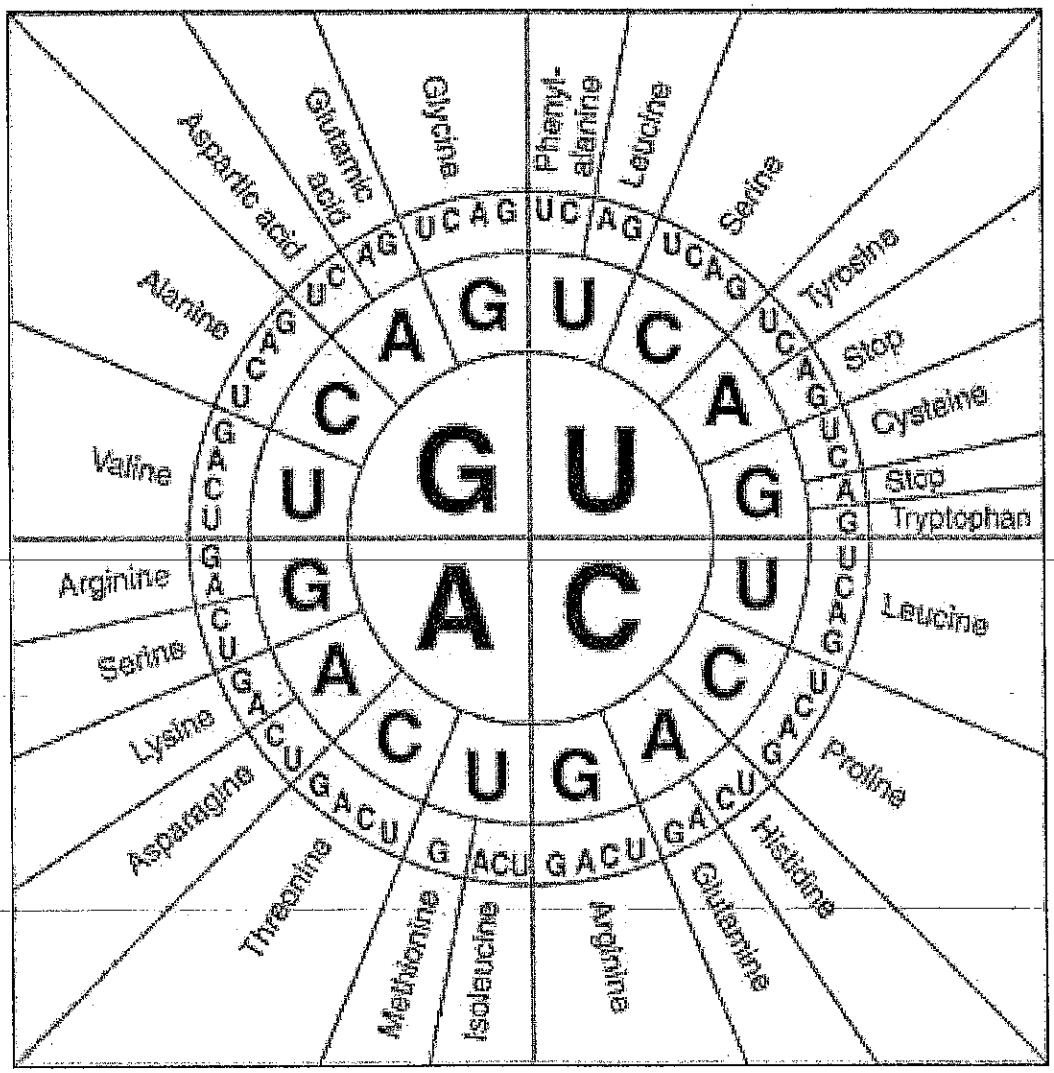
____ 9. The enzymes that **unwind DNA during replication** are called
a. double helixes.
b. DNA helicases.
c. helix destabilizing proteins.
d. DNA polymerase.

____ 10. Refer to the illustration on the back. What is the portion of the protein molecule coded for by a piece of mRNA with the sequence **CUC-AAG-UGC-UUC**?
a. Ser—Tyr—Arg—Gly
b. Val—Asp—Pro—His
c. Leu—Lys—Cys—Phe
d. Pro—Glu—Leu—Val

Name _____

Date _____ Period _____

Honors Biology Chapter 12 Closed Notes Quiz



Name _____ Date _____ Period _____

UNIT 10 NOTEBOOK CHECK

1. **12-1 Notes, page 2, second bullet under heading 'Hershey and Chase'**
   - _____ -- virus that takes … …

2. **12-1 Notes, page 4**

   What bond holds the sugar to the phosphate? _____

3. **Chargaff's DNA Data classwork, page 125**

   Correct answer to #3 _____

4. **Chargaff's DNA Data classwork, page 126**

   Correct answer to #2 in *Piecing It Together* _____

5. **12-2 Notes, page 6**

   The site … … are called _____

6. **12-2 Notes, page 9**

   In humans, _____ nucleotides are added every second.

7. **12-3 Notes, page 12**

   Step 3 of Transcription – completed _____ strand

8. **Strawberry DNA Extraction Lab**

   Correct answer to the blank in the *Why am I adding detergent?* Section _____

9. **Strawberry DNA Extraction Lab**

   Question Set #2, correct answer to the first blank in question #2 _____

10. **12-4 Notes**

    The four types of Chromosome Mutations in the order that they appear in the notes

    _____

Honors Biology
Unit 10 Test Study Guide

B-4.1, B-4.2, B-4.3, B-4.4, B-4.8, B-4.9 Ch 12 and 13

DUE: Monday, March 19

VOCABULARY – *the following terms are essential for you to know and understand completely. Terms may be tested specifically or may be important for understanding other conceptual questions.*

- Transformation
- Bacteriophage
- Frederick Griffith
- Oswald Avery
- Hershey & Chase
- Rosalind Franklin
- Watson & Crick
- X-ray crystallography
- Double helix
- DNA
- Nucleotides
- Chargaff's Rule
- Hydrogen bonds
- Covalent bonds
- Process of Replication
- Prokaryotic cell replication
- Eukaryotic cell replication
- Chromatin
- Histone
- Nucleosome
- Chromosome
- Replication
- Replication fork
- Semi-conservative
- DNA helicase
- Helix-destabilizing proteins
- DNA polymerase
- Antiparallel
- Direction of replication
- 5' end
- 3' end
- Leading strand
- Lagging strand
- Okazaki fragment
- DNA ligase
- RNA
- Differences between DNA and RNA
- mRNA
- tRNA
- rRNA
- transcription
- translation
- central dogma
- protein synthesis
- uracil
- RNA polymerase
- Promoter
- Template strand
- Intron
- Exon
- Codon
- Start codon (know the letters)
- Stop codons (know the letters)
- Amino acid
- Peptide bond
- Anticodon
- Ribosome
- Mutation
- Mutagen
- Mutant cell
- Point mutation
- Frameshift mutation
- Chromosome mutation
- Insertion
- Inversion
- Deletion
- Genetic engineering
- Gene map

Honors Biology
Unit 10 Test Study Guide

B-4.1, B-4.2, B-4.3, B-4.4, B-4.8, B-4.9 Ch 12 and 13

- Genome
- Cloning
- Gene therapy
- Stem cell
- Stem cell therapy
- Selective breeding
- Hybridization

CONCEPT CHECKLIST – *the following is a list of all concepts and ideas that you should know and understand completely. Concepts may be tested specifically (knowing what the concept is, parts of it, why we need it, etc) or may be important for understanding application questions that we may or may not have seen before in class.*

DNA

- Structure of DNA
- Parts of a nucleotide
- Frederick Griffith's experiment and conclusion
- Oswald Avery's experiments and conclusion
- Hershey & Chase's experiments and conclusion
- Rosalind Franklin's contribution to structure
- Watson & Crick's conclusion about structure
- Chargaff's rules about base pairs
- Purine vs pyrimidine
- How DNA is condensed into chromosomes
- Replication in prokaryotic cells
- Replication in eukaryotic cells
- Steps of replication
- Enzymes and proteins involved in replication – name and function
- Why DNA needs to be replicated
- When replication happens
- Where replication happens – where on the chromosome and where in the cell
- End result of replication
- Understand the leading and lagging strand
- Antiparallel nature of DNA

RNA

- Structure of RNA
- Differences between RNA and DNA
- Central dogma
- Protein synthesis – what is it and why do we need it
- 3 types of RNA molecules and functions

Honors Biology
Unit 10 Test Study Guide

B-4.1, B-4.2, B-4.3, B-4.4, B-4.8, B-4.9 Ch 12 and 13

Protein Synthesis

- Steps of transcription
- Where it happens
- Why it happens
- Enzymes involved in the process
- End result of transcription
- Promoters and terminators
- RNA editing
- Codons
- How to determine the amino acid from the codon
- Steps of translation
- Where it happens
- Why it happens
- The major components (parts of the ribosome complex)
- Role of each component of translation
- End result of translation

Mutations

- What a mutation is
- What can cause mutations
- Types of gene mutations
- Types of chromosome mutations

Genetic Engineering

- What genetic engineering is
- Why it is important
- Types of genetic engineering (cloning, gene therapy, stem cells)
- Selective breeding – definition and process
- Inbreeding
- Hybridization – definition and process
- Benefits and drawbacks of genetic engineering

Gel Electrophoresis Virtual Lab

Go to the website: http://learn.genetics.utah.edu/units/biotech/gel/
Answer the following questions as you complete the virtual lab.

1. How do you sort and measure DNA strands even though they are so small?
2. What other molecules does electrophoresis come in handy for separating?
3. Explain in your own words how the gel works.
4. Do you think the DNA has a positive or a negative charge?
5. _____the sorted groups makes them visible to the naked eye.
6. After doing electrophoresis can we see a single DNA strand?
7. List the 5 major steps used in electrophoresis?
   a.
   b.
   c.
   d.
   e.
8. What materials will you need to make the gel?
   a.
   b.
   c.
   d.
   e.
   f.
9. What is the comb used for?
10. What is the use of the buffer in the electrophoresis box?
11. What does the DNA size standard contain?
12. What do the bubbles on the electrodes tell you?
13. What is the approximate length of the strands in the DNA sample that you ran?
    a.
    b.
    c.
14. What units are used to measure DNA strand length?

History

What is a transformation?

What did Frederick Griffith find through his experiments?

What part of his experiments determined there was a "transforming principle"?

What was Oswald Avery's contribution to the discovery of DNA as the genetic material?

How did Oswald Avery determine that DNA was the transforming principle?

What is a bacteriophage?

What did Hershey and Chase confirm?

Describe Hershey & Chase's experiments.

How did Hershey & Chase determine that DNA was the genetic material?

What did Rosalind Franklin contribute to the discovery of DNA structure?

What is an x-ray crystallography?

What structure did the x-ray crystallography image suggest?

What was the structure that Watson & Crick determined for DNA?

What does double helix mean?

What does DNA stand for?

What are the three parts of a nucleotide?

Where in the double helix are the nitrogen bases located?

Does the phosphate or the sugar bond with the nitrogen base?

What are the four nitrogen bases of DNA?

What are the base pair rules?

Which nitrogen bases are purines?

Which nitrogen bases are pyrimidines?

Replication

What is replication?

What is the first step to replication?

What does DNA helicase do?

What is the role of the helix-destabilizing proteins?

What gets added in to the old strand to make the new strand of DNA?

What does DNA polymerase do?

What is the direction of replication?

Why is there a leading strand and a lagging strand?

What is a replication fork?

In which direction does replication go?

In prokaryotes, how many points of replication are there?

In eukaryotes, how many points of replication are there?

What does it mean that DNA replication is semi-conservative?

What does anti-parallel mean?

What are Okazaki fragments?

Which enzyme seals the Okazaki fragments?

What does RNA stand for?

What are the three major differences between DNA and RNA?

What are the three types of RNA?

What is the purpose of the messenger RNA?

What is the purpose of the transfer RNA?

What is the purpose of the ribosomal RNA?

Transcription

What is the central dogma?

What is the purpose of transcription?

Where in the cell does transcription take place?

What indicates to the RNA polymerase the spot on DNA to start transcription?

What gets added to the template DNA strand to form the RNA strand?

What indicates to the RNA polymerase to stop transcription?

What is an intron?

What is an exon?

Why are introns cut out and exons spliced together?

Translation

What is a codon?

Codons code for what molecule?

What is the start codon?

Which amino acid does the start codon code for?

What are the three stop codons?

What is the purpose of translation?

What are the major parts of the ribosome?

How many binding sites are on the ribosome?

What occurs at each binding site?

What does the small subunit of the ribosome bind to?

What does the large subunit of the ribosome bind to?

What is the role of the tRNA?

Why does the tRNA have an anticodon?

What is an anticodon?

After the ribosome complex is assembled, which amino acid is brought first to the ribosome by tRNA?

What type of bond is made between the amino acid in the 1^{st} and 2^{nd} site?

The ribosome pulls the mRNA strand down by the length of how many codons?

How many nucleotides is one codon?

What happens to the tRNA when it gets pushed into the 3rd binding site?

What indicates to the ribosome complex that translation is finished?

Is an amino acid added when the ribosome gets to a stop codon?

Mutations

What is a mutation?

What can cause a mutation?

What is a mutagen?

What does it mean if a cell is a mutant cell?

If a somatic cell is a mutant, will it pass on the mutation to daughter cells through mitosis?

If a somatic cell is a mutant cell, will the organism pass the mutation to offspring?

If a gamete is a mutant cell, will the organism pass the mutation to offspring?

What are the two main types of mutations?

What is a point mutation?

What is a substitution (gene mutation)?

What is a deletion (gene mutation)?

What is an insertion (gene mutation)?

What can an insertion or deletion result in?

What is a frameshift mutation?

What is the result of a frameshift mutation?

What is a chromosomal mutation?

What are the four types of chromosomal mutations?

What is a deletion (chromosome mutation)?

What is a duplication (chromosome mutation)?

What is an inversion (chromosome mutation)?

What is a translocation (chromosome mutation)?

Genetic Engineering

What is the name of the process of replacing specific genes in an organism to ensure a certain trait?

What is the name for all of the genetic material an organism has?

What must be known in order for genetic engineering to be possible?

What is the result of cloning?

What is gene therapy?

What is the name of an undifferentiated cell (not specialized yet)?

What is selective breeding?

What is an example of an organism that is the product of selective breeding?

How is selective breeding accomplished?

What is hybridization?

What is the result of hybridization?

Honors Biology – Unit 10 Test

____ 1. Which result of **Frederick Griffith's** experiments led him to believe in a "**transforming principle**"?
a. Mice injected with live S bacteria died.
b. Mice injected with live R bacteria lived.
c. Mice injected with dead S bacteria lived.
d. Mice injected with dead S *and* live R bacteria died.

____ 2. As a result of the **Hershey and Chase** experiments, scientists believe that
a. radioactive isotopes can be used safely.
b. viruses use bacterial DNA to reproduce.
c. the "transforming principle" is DNA.
d. bacteriophages can be grown in culture medium.

____ 3. The four types of **nucleotides** that make up DNA are named for their
a. hydrogen bonds.
b. nitrogen-containing bases.
c. phosphate groups.
d. ring-shaped sugars.

____ 4. Which of the following **DNA sequences** is complementary to the base sequence ACCGTAT?
a. GTTACGC
b. UCCGTAT
c. TGGCATA
d. CAATGCG

____ 5. Combining the work of other scientists with their own research, **Watson and Crick** discovered that two strands of DNA join together to form a(n)
a. nucleotide.
b. X in a circle.
c. double helix.
d. covalent bond.

____ 6. What holds **base pairs** together?
a. hydrogen bonds
b. sugar-phosphate backbones
c. pairs of double-ringed nucleotides
d. nitrogen-carbon bonds

____ 7. The process that makes **an exact copy of a cell's DNA** is called
a. conservation.
b. preservation.
c. replication.
d. synthesis.

____ 8. What are the main functions of **DNA polymerase**?
a. breaks hydrogen bonds and exposes bases
b. holds DNA strands apart and attracts bases
c. zips and unzips the double-stranded DNA
d. binds nucleotides and corrects base pair errors

____ 9. Which of the following events occurs **directly after a DNA molecule is unzipped**?
a. Mismatched nucleotide bases are identified and replaced.
b. Free-floating nucleotides pair up with exposed bases.
c. Identical double-stranded DNA molecules are formed.
d. Enzymes break hydrogen bonds between base pairs.

____ 10. The process of making new DNA molecules is **semiconservative**. This means that every new DNA molecule is composed of
a. two completely identical strands of DNA.
b. one original and one new strand of DNA.
c. one strand of DNA and one strand of RNA.
d. two strands that mix original and new DNA.

____ 11. When new DNA molecules are formed, almost all **errors are detected and fixed** by
a. the correct nucleotide.
b. the sugar-phosphate backbone.
c. DNA polymerase.
d. one DNA strand.

____ 12. The **central dogma** of molecular biology states that information flows in one direction from
a. nuclei to RNA to cytoplasm.
b. ribosomes to proteins to DNA.
c. genes to nuclei to ribosomes.
d. DNA to RNA to proteins.

____ 13. Choose the nucleotide sequence of the **RNA strand** that would be complementary to the following DNA strand: GTAGTCA.

a. UATUAGA
b. ACGACTG
c. CAUCAGU
d. CATCAGT

____ 14. The main function of **tRNA** is to

a. carry a message that, when translated, forms proteins.
b. form a portion of ribosomes, a cell's protein factories.
c. string together complementary RNA and DNA strands.
d. bring amino acids from the cytoplasm to the ribosomes.

____ 15. Which of the following events occurs **directly after RNA polymerase recognizes the transcription start site** of a gene?

a. The polymerase strings amino acids into a polypeptide.
b. Free-floating nucleotides pair up with exposed DNA bases.
c. A complementary RNA strand detaches itself from the DNA.
d. The DNA strand begins to unwind, separating the two strands.

____ 16. What is the term for a **three-nucleotide sequence** that codes for an amino acid?

a. base
b. codon
c. amine
d. serine

____ 17. Which phrase best describes **translation**?

a. converts mRNA into a protein
b. catalyzes bonds between amino acids
c. produces RNA from DNA molecules
d. recycles tRNA molecules for reuse

____ 18. Which of the following is the **site of translation**?

a. vacuole
b. lysosome
c. nucleus
d. ribosome

____ 19. Mutations that can **affect the offspring** of an organism occur in what cell type?

a. body
b. gametes
c. blood
d. brain

____ 20. Which of the following is an example of a **mutagen**?

a. repair enzyme
b. triglyceride
c. X-ray radiation
d. thymine

____ 21. Because of **base pairing in DNA**, the percentage of

a. adenine molecules in DNA is about equal to the percentage of guanine molecules.
b. pyrimidines in DNA is about equal to the percentage of purines.
c. purines in DNA is much greater than the percentage of pyrimidines.
d. cytosine molecules in DNA is much greater than the percentage of guanine molecules.

____ 22. During **DNA replication**, a DNA strand that has the bases CTAGGT produces a strand with the bases

a. TCGAAC.
b. GATCCA.
c. AGCTTG.
d. GAUCCA.

____ 23. Unlike DNA, **RNA** contains

a. adenine.
b. uracil.
c. phosphate groups.
d. thymine.

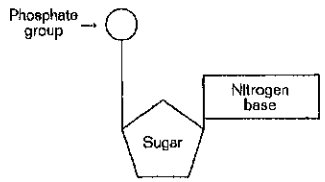
____ 24. What happens during the process of **translation**?

a. Messenger RNA is made from DNA.
b. The cell uses information from messenger RNA to produce proteins.
c. Transfer RNA is made from messenger RNA.
d. Copies of DNA molecules are made.

____ 25. A mutation that involves **one or a few nucleotides** is called a(an)
a. chromosomal mutation.
b. inversion.
c. point mutation.
d. translocation.

____ 26. A promoter is a
a. Binding site for DNA polymerase
b. Binding site for RNA polymerase
c. Start signal for transcription
d. Stop signal for transcription

____ 27. AUG is the codon for the
a. start signal for translation.
b. binding site for RNA polymerase.
c. start signal for transcription.
d. binding site for DNA polymerase.



____ 28. The **entire molecule** shown in the diagram above is called a(n)
a. amino acid.
b. nucleotide.
c. polysaccharide.
d. pyrimidine.

____ 29. The amount of **guanine** in an organism always equals the amount of
a. protein.
b. thymine.
c. adenine.
d. cytosine.

____ 30. **adenine : thymine ::**
a. protein : DNA
b. Watson : Crick
c. guanine : cytosine
d. guanine : thymine

____ 31. During DNA **replication**, a complementary strand of DNA is made from each original DNA strand. Thus, if a portion of the original strand is CCTAGCT, then the new strand will be
a. TTGCATG.
b. AAGTATC.
c. CCTAGCT.
d. GGATCGA.

____ 32. The enzymes responsible for **adding nucleotides to the exposed DNA bases during replication** are
a. replicases.
b. DNA polymerases.
c. helicases.
d. template enzymes.

____ 33. The enzymes that **unwind DNA during replication** are called
a. double helixes.
b. DNA helicases.
c. forks.
d. phages.

____ 34. All of the following are true about DNA **replication** in prokaryotic cells ***except***
a. replication begins at many sites along the DNA.
b. replication begins at one site along the DNA loop.
c. replication occurs in two opposite directions.
d. there are two replication forks.

____ 35. During **transcription**, the genetic information for making a protein is "**rewritten**" as a molecule of
a. messenger RNA.
b. ribosomal RNA.
c. transfer RNA.
d. translation RNA.

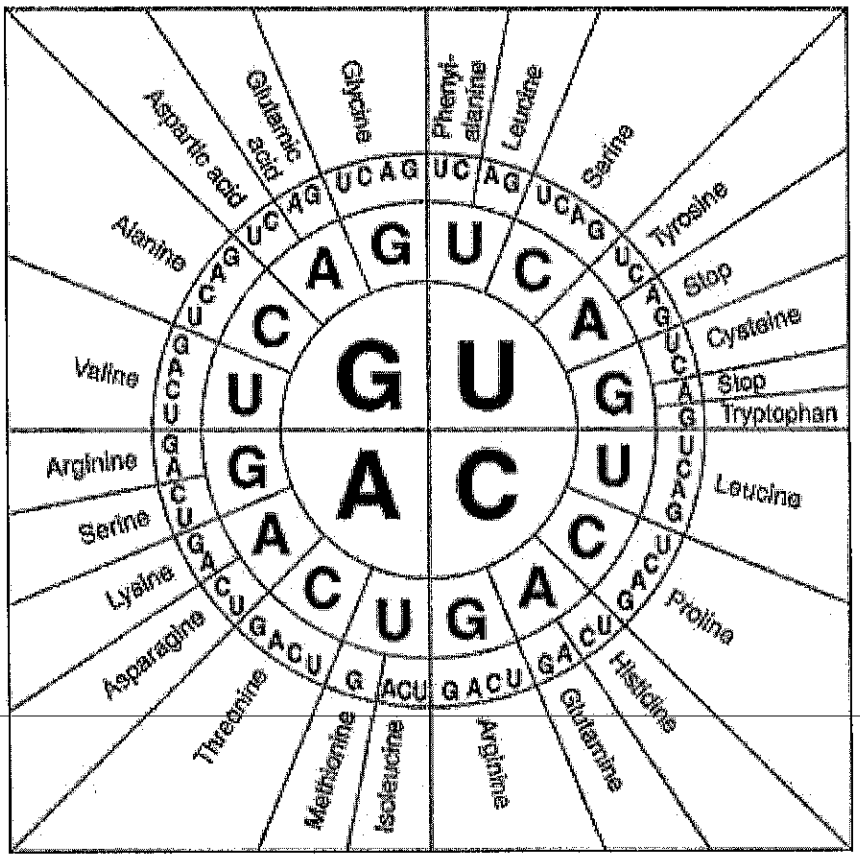
____ 36. **Transcription** begins when **RNA polymerase**
a. attaches to a ribosome.
b. unwinds a strand of DNA.
c. binds to a strand of RNA.
d. attaches to the promoter sequence of a gene.

37. The **anticodons** for the codons in the mRNA with the sequence CUCAAGUGCUUC are

a. GAG—UUC—ACG—AAG.
c. CUC—GAA—CGU—CUU.
b. GAG—TTC—ACG—AAG.
d. CUU—CGU—GAA—CUC.

38. Which of the following would represent the strand of **DNA** from which the mRNA strand CUCAAGUGCUUC was made?

a. CUCAAGUGCUUC
c. GAGTTCACGAAG
b. GAGUUCACGAAG
d. AGACCTGTAGGA



39. Refer to the illustration above. What is the portion of the protein molecule coded for by a piece of mRNA with the sequence **AGC-UAU-CGG-GGA**?

a. Ser—Tyr—Arg—Gly
c. Leu—Lys—Cys—Phe
b. Val—Asp—Pro—His
d. Pro—Glu—Leu—Val

40. Transfer RNA

a. carries an amino acid to its correct codon.
b. synthesizes amino acids as they are needed.
c. produces codons to match the correct anticodons.
d. converts DNA into mRNA.

Name _____
Date _____ Period _____

Honors Biology – Unit 10 Test – Open Response

Open Response – 20 points

Describe in as much detail as possible the **process of protein synthesis.**

An high level of detail would include the correct use of names of enzymes, proteins, locations, etc. You may draw diagrams or pictures to aid in your description but a diagram alone is not a description.

A high level of detail might use the following words correctly in the description. Some words may be used more than once and some words might not be used at all.

- DNA
- RNA
- 5'
- 3'
- Antiparallel
- Semi-conservative
- Leading
- Lagging
- Okazaki
- DNA helicase
- DNA ligase
- DNA polymerase
- RNA polymerase
- mRNA
- tRNA
- rRNA
- codon
- anticodon
- intron
- exon
- start codon
- stop codon
- promoter
- terminator
- helix-destabilizing proteins
- template strand
- amino acid
- peptide bond
- ribosome
- small subunit
- large subunit
- double helix
- nucleotide
- nitrogen base
- adenine
- guanine
- cytosine
- thymine
- uracil
- 5 carbon sugar
- Phosphate group
- Replication fork
- Polypeptide
- Protein

Grading Rubric –
10 pts – Transcription
10 pts - Translation

1. ANS: D PTS: 1 REF: act0976aaf18007e117_33
TOP: 8.1 Quiz NOT: 978-0-618-78317-5
2. ANS: C PTS: 1 REF: act0976aaf18007e117_65
TOP: 8.1 Quiz NOT: 978-0-618-78317-5
3. ANS: B PTS: 1 REF: act0976aaf18007e119_33
TOP: 8.2 Quiz NOT: 978-0-618-78317-5
4. ANS: C PTS: 1 REF: act0976aaf18007e119_49
TOP: 8.2 Quiz NOT: 978-0-618-78317-5
5. ANS: C PTS: 1 REF: act0976aaf18007e119_57
TOP: 8.2 Quiz NOT: 978-0-618-78317-5
6. ANS: A PTS: 1 REF: act0976aaf18007e119_65
TOP: 8.2 Quiz NOT: 978-0-618-78317-5
7. ANS: C PTS: 1 REF: act0976aaf18007e11b_33
TOP: 8.3 Quiz NOT: 978-0-618-78317-5
8. ANS: D PTS: 1 REF: act0976aaf18007e11b_41
TOP: 8.3 Quiz NOT: 978-0-618-78317-5
9. ANS: B PTS: 1 REF: act0976aaf18007e11b_49
TOP: 8.3 Quiz NOT: 978-0-618-78317-5
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13. ANS: C PTS: 1 REF: act0976aaf18007e11d_41
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14. ANS: D PTS: 1 REF: act0976aaf18007e11d_49
TOP: 8.4 Quiz NOT: 978-0-618-78317-5
15. ANS: D PTS: 1 REF: act0976aaf18007e11d_57
TOP: 8.4 Quiz NOT: 978-0-618-78317-5
16. ANS: B PTS: 1 REF: act0976aaf18007e11f_33
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17. ANS: A PTS: 1 REF: act0976aaf18007e11f_57
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18. ANS: D PTS: 1 REF: act0976aaf18007e11f_65
TOP: 8.5 Quiz NOT: 978-0-618-78317-5
19. ANS: B PTS: 1 REF: act0976aaf18007e123_57
TOP: 8.7 Quiz NOT: 978-0-618-78317-5
20. ANS: C PTS: 1 REF: act0976aaf18007e123_65
TOP: 8.7 Quiz NOT: 978-0-618-78317-5
21. ANS: B PTS: 1 DIF: L2 REF: p. 294
OBJ: 12.1.2 NAT: B.2 | C.2.a STA: B-4.1 KEY: analysis
22. ANS: B PTS: 1 DIF: L1 REF: p. 299
OBJ: 12.2.2 NAT: V | C.2.a STA: B-4.2 KEY: application
23. ANS: B PTS: 1 DIF: L2 REF: p. 300
OBJ: 12.3.1 NAT: V | C.2.a STA: B-4.1 KEY: comprehension
24. ANS: B PTS: 1 DIF: L2 REF: p. 304
OBJ: 12.3.5 NAT: I STA: B-4.4 KEY: comprehension

25. ANS: C PTS: 1 DIF: L1 REF: p. 307
OBJ: 12.4.1 NAT: C.1.d STA: B-4.9| B-4.8 KEY: knowledge
26. ANS: A PTS: 1 DIF: L2 REF: p. 307
OBJ: 12.4.1 NAT: C.1.d STA: B-4.9| B-4.8 KEY: analysis
27. ANS: B PTS: 1 DIF: L1 REF: p. 309
OBJ: 12.5.1 NAT: C.2.c KEY: knowledge
28. ANS: B PTS: 1 DIF: I OBJ: 13.1.3
29. ANS: D PTS: 1 DIF: II OBJ: 13.1.4 | 13.1.3
30. ANS: C PTS: 1 DIF: III OBJ: 13.1.4
31. ANS: D PTS: 1 DIF: III OBJ: 13.2.1
32. ANS: B PTS: 1 DIF: I OBJ: 13.2.2
33. ANS: B PTS: 1 DIF: I OBJ: 13.2.2
34. ANS: A PTS: 1 DIF: III OBJ: 13.2.3
35. ANS: A PTS: 1 DIF: II OBJ: 13.3.3
36. ANS: D PTS: 1 DIF: II OBJ: 13.3.3
37. ANS: C PTS: 1 DIF: III OBJ: 13.3.4
38. ANS: A PTS: 1 DIF: III OBJ: 13.3.4
39. ANS: C PTS: 1 DIF: III OBJ: 13.3.4
40. ANS: C PTS: 1 DIF: II OBJ: 13.3.5
41. ANS: A PTS: 1 DIF: II OBJ: 13.3.5 |

Honors Biology – Unit 10 Test – Oper

Open Response – 20 points

Describe in as much detail as possible the **process of protein synthesis**.

An high level of detail would include the correct use of names of enzymes, proteins, locations, etc. You may draw diagrams or pictures to aid in your description but a diagram alone is not a description.

A high level of detail might use the following words correctly in the description. Some words may be used more than once and some words might not be used at all.

- DNA
- RNA
- 5'
- 3'
- Antiparallel
- Semi-conservative
- Leading
- Lagging
- Okazaki
- DNA helicase
- DNA ligase
- DNA polymerase
- RNA polymerase
- mRNA
- tRNA
- rRNA
- codon
- anticodon
- intron
- exon
- start codon
- stop codon
- promoter
- terminator
- helix-destabilizing proteins
- template strand
- amino acid
- peptide bond
- ribosome
- small subunit
- large subunit
- double helix
- nucleotide
- nitrogen base
- adenine
- guanine
- cytosine
- thymine
- uracil
- 5 carbon sugar
- Phosphate group
- Replication fork
- Polypeptide
- Protein

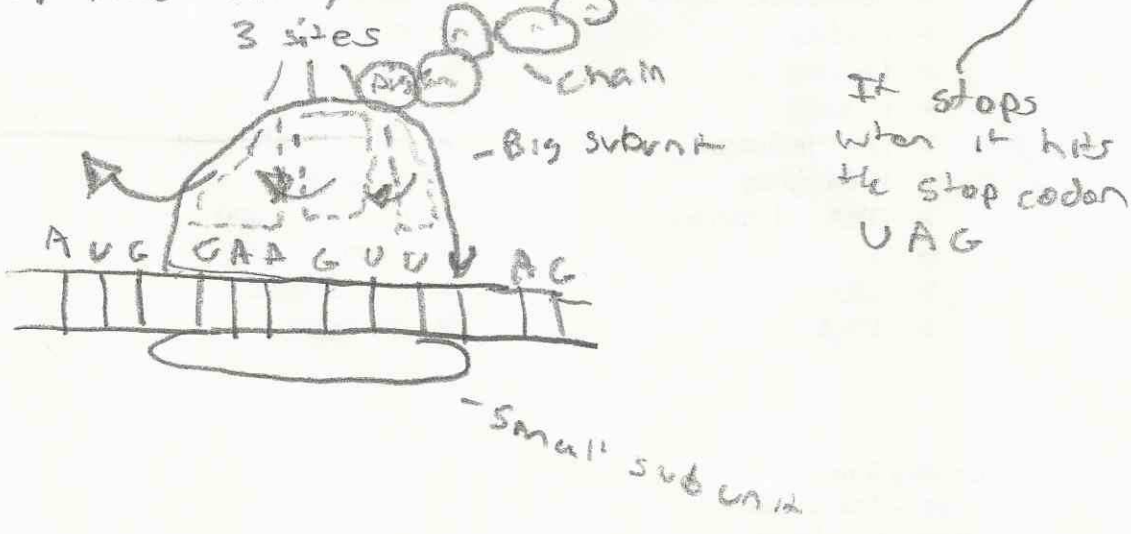
Grading Rubric –
10 pts – Transcription
10 pts - Translation

Transcription.
This occurs when DNA is trying to make a new copy of RNA. The first thing that happens is that the DNA polymerase hooks on the DNA and it starts at the promotor. Then it will start copies the RNA in antiparallel directions. What unzips the DNA is the DNA helicase. As it unzips it is making a copy at an anticodon of the RNA. And as it unzips it leaves two strands a leading strand, which needs no help, and a Lagging strand, which gets help from the Okazaki fragments. The DNA polymerase knows to stop when it hits the terminator, or stop codon, and then it detaches it self from the DNA. After all of this a RNA

strand is made new.

Translation -

Translation happens when RNA needs a code to make proteins in the Ribosores. This all begins when first a big and small subunit come to gather on the DNA. This DNA is in the nucleus, when the subunits come together it makes 3 sites within it. The last site is the exit site and thats where the amino acids will exit. So whats happens next is the first set of DNA will be AUG which is the start codon. (Met) Then it will go through the cycle of first a DNA comes in then a tRNA looks for that code within the cell. It will have a code to it, like Met to AUG, and pretty soon and entire chain with build up of codes. With this chain the ribosones now can make proteins. And every cell needs proteins to live.



Honors Biology – Unit 10 Test – Open Response

Open Response – 20 points

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Grading Rubric –
10 pts – Transcription
10 pts - Translation

Transcription

1. RNA polymerase comes to the DNA strand and seperates it at the promoter.

2. Helix-destabilizing protiens keep the DNA molecule from coming together. Free floating RNA nucleotide bases match to the complementary base pairs on DNA template strand.

3. This continues until RNA polyermase reaches the terminator and falls off. A single strand of RNA is then made.

Translation

1. Ribosome, made up of 2 subunits, binds to a mRNA strand and exposes binding sites for tRNA. tRNA molecule comes in from the first binding site and moves to second. Another tRNA molecule then comes in. (Connect to mRNA by matching complementary codons)

2. The amino acids on the tRNA molecules break from the 1st tRNA, moving to the 2nd. Amino Acids are connected by a peptide bond. (mRNA strand moves 1 codon)

3. The empty tRNA molecule exits from the ribosome in search of another amino acid. A new tRNA molecule comes in the 1st binding site. The process continues until the stop codon is reached. Then the chain of amino acids breaks off tRNA, to become a protein, the ribosome breaks apart, and tRNA finds more amino acids.

Honors Biology – Unit 10 Test – Open Response

Open Response – 20 points

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- Phosphate group
- Replication fork
- Polypeptide
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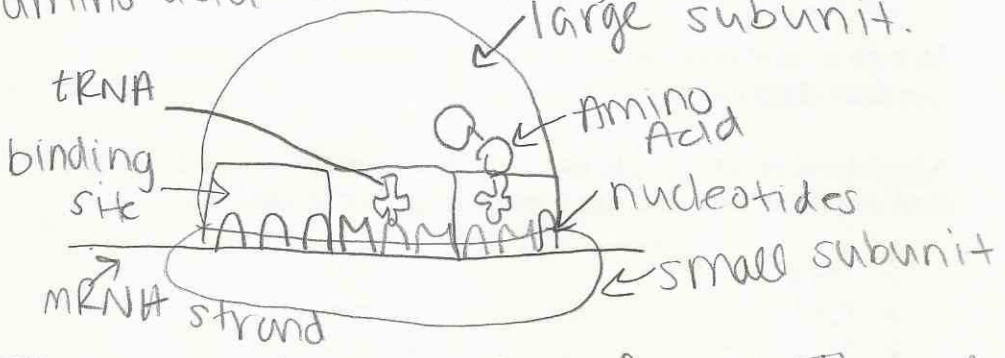
Grading Rubric –
10 pts – Transcription
10 pts - Translation

Transcription: RNA polymerase recognizes the start, and the DNA strand unwinds, Complementary base pairs attach to the template strand. Then, the new mRNA strand falls off & moves to the ribosomes.

DNA strand is held apart by helix destabilizing protiens.

Translation: mRNA strand finds a ribosome. A promotor goes on to the mRNA strand and a tRNA hooks on to it. There is a small subunit which the mRNA strand goes onto, and a large subunit which has 3 binding sites where the tRNA goes into & attaches to the nucleotides. A tRNA goes into the binding site bringing an Amino Acid & a 3 nucleotide anticodon which goes w/ the codon.

Once another tRNA strand comes in, the first tRNA moves over 3 nucleotides (to the second binding site). Then the Amino Acid from the first tRNA attaches to the new tRNAs amino acid & forms a peptide bond. Then the first tRNA moves to the last binding site, 3 spots over, and is released to find a new amino acid. And the process happens unit the amino acid codes for it to STOP and the amino acid breaks off, and folds up to form a protien.



Extra Notes on Transcription that I forgot: Thymine does NOT go into the mRNA strand. Instead, it is Uracil (U) Adenine. The mRNA strand is just one strand, Not a double helix.

Extra Notes on Translation: start codon (amino acid that tells translation to start) is AUG. which is methienene. (something spelt like that)

1. For transcription A DNA strand is unziped at the promoters. After that complementary nucleotides come an freely attach to the template strand. once that the floating nucleotides hit the terminator the newly formed complementary RNA strand just falls off. Also the RNA polymerase fixes the introns and turns them into exons.

2. Translation starts when a mRNA strand binds to the small subunit of a ribosome. Then the large subunit assembles. Once this happens tRNA strands carring amino acids come to the 3 "binding" spots. The first slot is for the tRNA to enter the ribosome. It carries 3 anticodons. The first tRNA to come in is (AUG) or the start codon. After the codons match up the ribosone knows to move down the length of one codon "3 places". The second slot is where the amino acid chain is. When a tRNA hits the third slot is gives the second slot it's acid forming a long chain. Once a tRNA is done it leaves to find another amino acid. When the ribosone reaches one of the stop codons "UAA, UGA, UAG" the ribosone falls apart to start the processe all over.

Honors Biology – Unit 10 Test – O[redacted]

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Grading Rubric –
10 pts – Transcription
10 pts - Translation

Translation - Translation is the process of turning RNA to proteins. The genetic information for making a protein is rewritten as a molecule of messenger RNA or mRNA. Transcription starts when RNA polymerase attatches to the promoter sequence of a gene. The result of translation is proteins made from RNA.

Transcription - During transcription, messenger RNA is made from DNA. RNA contains uracil. After a DNA molecule is unzipped, enzymes break hydrogen bonds between base pairs. The central dogma of molecular biology stats that info flows in one direction from DNA to RNA proteins. The ending result of transcription is RNA is made from DNA.