DNA

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Unit Plan I: Introduction

Introduction

a. This understanding by design unit plan will focus on various aspects of DNA, specifically looking at how it was discovered, and the structure and function of this crucial component of all living organisms. Throughout this unit, I will have my students working towards answering this question; **"What is DNA, and why is it so important to the processes of life?"**

b. I believe it is crucial for students to understand that DNA contains the instructions which are necessary for life to exist. At one point, DNA was overlooked by scientists because it was only comprised of several parts. We now know the information in DNA strands are crucial for hereditary information to be passed along. Today there continues to be research done on DNA to better understand the human body itself, and problems it is plagued with such as cancer. Students need to have a good grasp of what exactly DNA is, where it is found, and how valuable it is, to be scientifically literate adults. Having a basic understanding of DNA, and the processes it is part of, will help students to comprehend how information is passed from cell to cell, and what happens when things go wrong. DNA is fundamental to life, and as living organisms, students should have a solid understanding of the makeup and processes of their own bodies, in order to be scientifically literate adults in a continually developing society.

c. To help my students grasp the importance of DNA, I will work to discover what prior knowledge they have of this concept, and work to help correct any misconceptions they may have. Listed below are several misconceptions I have found, and the goal conceptions we will work toward in this unit.

Pre-Conception	Goal Conception
• Not all organisms have DNA	• DNA is necessary for life to exist, so it is found in all organisms.
• DNA is only found in certain parts of the body.	• DNA is found everywhere in the body, because it is organized into stretches of genes, that coil into chromosomes found in each human cell.
• Each chromosome is made up of a single DNA molecule.	• DNA is not just a single molecule. DNA is a very long strand of genetic material that is made up of hundreds of nucleotides. This long strand coils into a chromosome.
• The information in the DNA molecules of an organism does not affect the organism's behavior or physical attributes.	• DNA is organized into stretches of genes that carry instructions to make proteins that determine what each cell will do and look like, affecting all aspects of an organisms attributes.
• There are only a couple amino acids that are used to make protein molecules.	• There are 20 different amino acids that are each made up of three nucleotides in a set code. Amino acids work together to make one protein.
• RNA is the same as DNA.	• RNA contains a different type of sugar and a different type of nitrogen base than DNA. It also tends to be single stranded and shorter in length.

Understanding by Design Unit PlanTemplate		
Topic: DNA		**Subject Areas included: Biology**
Grade: 10	**Designer(s): Jen Wierzba**	

Stage 1 – Desired Results

STANDARDS (Wisconsin Model Academic Standards / District benchmarks)

A.8.5 Show* how models* and explanations*, based on systems*, were changed as new evidence* accumulated (the effects of constancy*, evolution*, change*, and measurement* should all be part of these explanations)

B.8.5 Explain* ways in which science knowledge is shared, checked, and extended, and show* how these processes change over time

F.8.1 Understand* the structure and function* of cells, organs, tissues, organ systems, and whole organisms

F.8.5 Show* how different structures both reproduce and pass on characteristics of their group

F.12.4 State the relationships between functions* of the cell and functions of the organism as related to genetics and heredity

Enduring Understandings:

Students will understand that…

- The discovery of DNA was crucial in understanding how genetic material is passed from one cell to another.
- DNA has a specific structure and composition.
- The replication of DNA is multi-stepped process that is important in the production of proteins which are necessary for life.

Essential Questions:

- What is DNA?
- How was DNA first discovered?
- Where is DNA found in the body?
- What researchers were responsible for discovering the structure of DNA?
- What is the shape of a strand of DNA?
- What are the three parts of a nucleotide?
- How do bases pair up and bond together in DNA?
- What are the steps in DNA replication?
- What is the result of a mistake in a DNA replication?
- How does DNA differ from RNA?
- What are the types and functions of the 3 major RNA strands?
- What are the steps involved in making proteins from RNA?
- What do proteins do in the body?
- How many amino acids are there?

Knowledge:

Students will know…

- Students will know that DNA stands for deoxyribose nucleic acid.
- Students will know that the discovery of DNA was developed by several scientists, using various test methods.
- Students will know that transformation is the passing of genetic material from one cell to another.
- Students will know that DNA are long strands that coil up into chromosomes, which are found in the nucleus of a cell.
- Students will know that DNA has a double helix structure and it is comprised of a five carbon sugar, a phosphate group, and a nitrogenous base.
- Students will know which nitrogen bases pair up and how they are bonded together.
- Students will know that DNA acts as a template for RNA, and RNA is different from DNA in its composition and size.
- Students will know that the 3 major types of RNA are messenger RNA, ribosomal RNA, and transfer RNA, and each has a different role in making proteins.
- Students will know the steps of RNA transcription and translation.
- Students will know that there are 20 amino acids.

Skills:

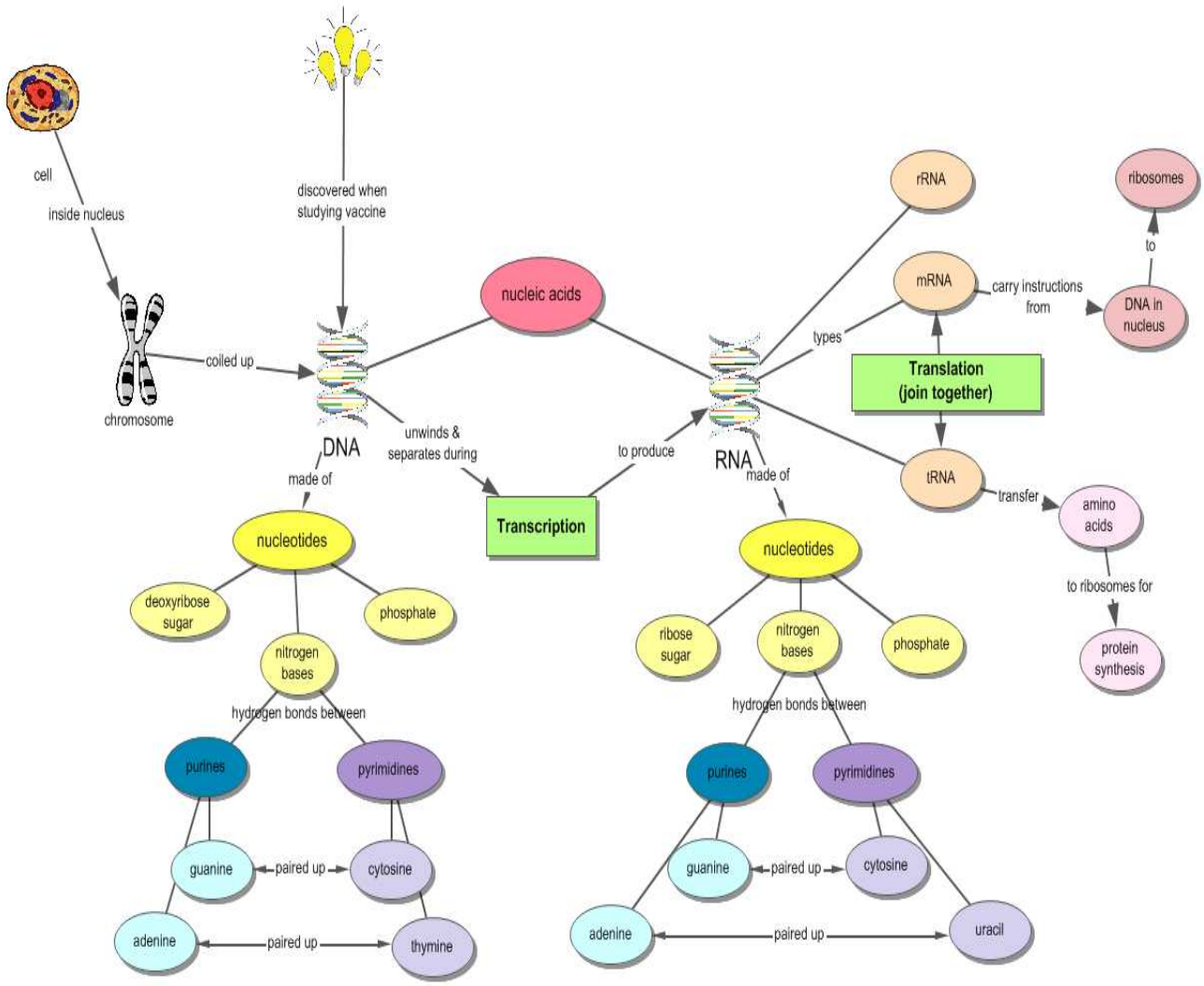
Students will be able to…

- Students will be able to construct a DNA model.
- Students will be able to explain how DNA replication works.
- Students will be able to explain how mutations occur during DNA replication.
- Students will be able to explain that proteins are responsible for a wide variety of things in an organisms body, and be able to give examples.

Dispositions:
Students will value…

- Students will value the role DNA plays in a living organism.

Concept Map



Text Analysis

The text I am referencing is *Modern Biology,* written by Postlethwait and Hopson, published by Holt, Rinehart, and Winston, 2009. Chapter 10, DNA, RNA, and Protein Synthesis is the chapter that relates best to the unit I am teaching.

Science facts and generalizations

I would define a science fact as an event or occurrence that has been verified through observation, and each time the same outcome is produced, proving its relevance. Generalizations tend to be statements or understandings that are derived from a particular or specific event, but are applied in a broader sense. These terms are similar in that often generalizations may be derived from facts, but applied to situations that may not be as comparable. An example in the text of a science fact was provided in Frederick Griffith's experiment, where he ran numerous tests involving mice, and discovered that something inside the cells was transferring genetic material from disease causing cells to healthy cells, and killing mice in his experiment. An example of a generalization in this chapter is when mutations are discussed. Mutations are mentioned briefly and the book states simply that they can have serious effects on a gene and cell function, and may even lead to cancer.

Concepts, laws, and theories

I would define concept as a general idea. Scientific law is something that is observed in nature, such as a set of actions, occurring over and over again, and no exceptions have been found in regards to the application of the law. A scientific theory is an idea or accepted hypothesis believed to be true, because it has been tested over and over again, and it has yet to have been disputed by other tests or evidence. These terms are similar in that they all relate to ideas, however the depth of each term varies. Concepts can be very broad, such as the concept of how DNA is responsible for the transformation of genetic material from cell to cell. There are a lot more pieces of information that can be added to a discussion on transformation, but this is the general idea of the purpose of DNA. Scientific laws are more concrete than just a general idea or concept. They are applicable in the same conditions, such as the law of gravity. A scientific theory is different from a concept, in that it is more concrete in detail and evidence, but it is not a law. Scientific theories are groups of hypotheses that have

been tested over and over again, they tend to explain more than a law does, and are often more complex than a law.

The chapter I am referencing for this unit does not mention much in regards to scientific laws. However, the chapter does discuss the theory of the structure of DNA, and how it was developed with research done by several different scientists. There are concepts found throughout this chapter. The chapter is broken down into four sections, and each section focuses on a specific concept such as how DNA was discovered, what the structure of DNA is, how DNA replicates, and how proteins are produced.

Empirical and theoretical entities

I define empirical entity as something that can be observed and /or measured by experiments and application. Theoretical entities are ideas or theories that may not have a practical application, or an observable way of being measured. These entities vary by application. I believe someone may start with a theoretical entity, such as an idea of the structure of DNA, and this entity may be supported with an empirical entity, such as Rosalind Franklin's x-ray diffraction photographs which provided observable evidence of the double helix shape of DNA.

An important question asked in a section review of this text asked: How do the base-pairing rules relate to the structure of DNA? I thought this question was important to look at, because it lies at the heart of why DNA is set up the way it is. This question can be developed into a lab activity where students create their own DNA model, correctly pairing up the nitrogen bases. The model students create, can be used at a later point in the unit when looking at coding of nucleotides in mRNA, to determine amino acids in their RNA strand. I believe adding hands on activities to this unit will help students to grasp the various concepts this unit covers.

The text I chose is a very current edition that is presently being used in a classroom I observe in. This text is broken down into units, chapters, and sections. I am referencing Chapter 10: *DNA, RNA, and Protein Synthesis* for this unit. This chapter is broken down into four sections, and covers pages 192-210.

This text gives a good overview of DNA, RNA, and protein synthesis. I found it informative and a good refresher for myself on these topics. The layout for each section of the text contains the same format which helps the reader to know how to navigate through the reading. At the start of each section objectives and vocabulary are given, to help students clue into what they need to focus on. There are a good number of vocabulary terms in each section, but they are defined well in the context of each section. The last section on protein synthesis has a larger number of new terms, but due to the importance of the information in this section, I would devote more time to going over these words with my students. Aside from the text, there are also good diagrams, photos, and figures found throughout the unit. I myself found these visuals very helpful, and I believe they would be beneficial to students as well, if they took the time to study the visuals and correlate them to their readings. Several visuals I think are extremely helpful is the DNA double helix figure on page 197, and the replication and translation visuals on pages 201, 208, and 209.

I believe it is important to incorporate a textbook into a class, and help students to learn how to utilize this resource. I say this because sometimes students may have questions when you are not around, or may need to do work on their own, and having a text to reference is invaluable to them at these times. Also if students continue on in their education, they will need to know how to read and understand different forms of text, and a Science textbook can be very intimidating if never used.

I will utilize this textbook often when preparing and teaching this unit. The vocabulary, figures, and descriptions given in this text offer a good base on the subjects of DNA, RNA, and protein synthesis. I will make sure that my students first understand how to navigate through the sections, focusing on the objectives and key words. I will assign portions of the text to be read ahead of class, and will hold discussions with students on what they read, to figure out if they are reading, and if so, what they are not understanding. I will also work with my students to understand the various figures in the text, helping them to understand what they mean and how they relate to the reading. I have found that in Science texts, diagrams and figures can often teach students more than the actual written text. The review questions provided in the text prompt students to explain what they understand from the readings, so I may use some of these questions for open review in class or even on a test.

Resources

AAAS Science Assessment. Retrieved Oct 8, 2011.
http://assessment.aaas.org/topics/RH#/

DNA Introduction from Eureka Science. Retrieved Oct 8, 2011.
http://www.eurekascience.com/ICanDoThat/dna_intro.htm

Postlethwait, H. John, and Hopson, L. Janet, (2009) *Modern Biology* (pgs 192-210). Holt, Rinehart, and Winston

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct 1, 2011.
http://www.dpi.state.wi.us/standards/

Unit Plan II: Learning Outcomes and Teaching Strategies

Intended Learning Outcomes

Lower cognitive level outcomes

Higher cognitive level outcomes

1. Students will recall what they understand about DNA through a brainstorming activity

2. Students will work together to create a concept map that will act as their study guide throughout this unit.

3. Students will be able to apply an interactive reading guide to their text reading.

4. Students will be able to describe how scientists used mice to discover how genetic material transfers from one cell to another.

6. Students will be able to identify how the structure of DNA was discovered.

7. Students will be able to recognize the shape of DNA, what it is comprised of, and how it is held together.

8. Students will demonstrate which nitrogen bases pair up.

9. Students will create their own DNA model.

10. Students will be able to explain the different components of their model, and identify how the nitrogen bases pair up.

11. Students will be able to illustrate what happens in the three steps of DNA replication.

12. Students will be able to differentiate between prokaryotic and eukaryotic replication.

13. Students will identify the link between mutations and cancer.

14. Students will be to illustrate how genetic information flows from DNA to RNA to protein synthesis in a cell.

15. Students will be able to differentiate between the characteristics of DNA and RNA.

16. Students will be able to list the three major types of RNA.

17. Students will be able to describe what transcription is, and the 3 steps it involves.

18. Students will be able to define the terms genetic code and codon.

19. Students will be able to encode what amino acids they have in the DNA models they created.

20. Students will be able to describe what translation is, and the 5 steps it involves.

21. Students will be able to define the terms anticodon, and recognize it is complementary to a codon.

22. Students will be able to identify the roles of mRNA and tRNA in translation.

23. Students will be able to describe the role of restriction enzymes and how they function.

24. Students will be able to express what gel electrophoresis is, and how it separates DNA molecules present in a mixture.

25. Students will be able to describe the relationship between fragment size and the migration rate of DNA.

26. Students will be able to analyze a simulated DNA fragment they create in comparison to those created by their colleagues.

27. Students will be able to list the steps involved in a gel electrophoresis experiment.

28. Students will be able to justify the use of gel electrophoresis for DNA profiling and realize the application in a real world setting.

Cognitive skills

1. Students will develop a concept map, and add to it throughout this unit to help them keep track of the different terms, and see the relationships between them.

2. Students will create their own DNA model, and use this model to illustrate their understanding of the structure of DNA and the function of encoding amino acids.

Affective objectives

1. Students will gain a true understanding and value of the importance of DNA in regards to living organism and their existence.

2. Students will appreciate the significance of new biotechnology applications such as gel electrophoresis, realizing its use in regards to DNA profiling for helping to solve crimes.

Lesson 1: What do you know about DNA?

Outcomes:
-Students will demonstrate what they understand about DNA.
-Students will work together to create a concept map that will act as their study guide throughout this unit.

Rationale:
Prior to starting any unit, an instructor needs to become familiar with what her students already know in an area, as well as any misconceptions, interests, and questions they may have. Taking the time to explore current knowledge will give an educator a good idea of what areas of the unit to focus on.

Standards Addressed:
C.8.2 Identify* data and locate sources of information including their own records to answer the questions being investigated

Duration: 50 min

Materials Needed:
Blank concept map
Work board
Vocabulary words for the unit

Procedure:
Introduction: Greet class. Go over any announcements. Explain we will be starting a new unit on DNA, which we will be covering for the next two weeks. (5 min)

Activity: Advise students that since each person may have different understanding or background in this area, going to start out unit with a game opener to see what everyone knows about DNA. Divide class into groups of 4, have one person on each team bring along paper and pen to write. Before allowing students to move, advise them that each team is going to brainstorm for 3 minutes as many things they know, remember, believe, or don't understand about DNA. At the end will tally which team has

the most. *(transition)* While they are moving to be with their team, need to start thinking of things to add to their list.

Allow students to work for 3 minutes. (maybe more depending on how quickly things go)

Bring class back together, have each group tally up their words/ideas, inventory what was found. Go around the class round-robin like and have each group say one thing at a time, until all of their ideas are addressed. (15 min)

Make sure to ask these questions if they are not prompted during discussion.
-Where is DNA found? *nucleus*
-What does DNA do? *code for genetic material*
-What does it look like? *Double helix strand*
-What does DNA stand for? *Deoxyribonucleic acid*
-Why are we studying DNA? *It is cornerstone for understanding how we exist, without DNA cells would not know what to do*

Explain to students that this unit, like most of our units is very vocabulary rich, so to help them keep track of words, and understand what they mean, we will work together to create a concept map that we will develop over the course of the next 2 weeks. This map will be a good study guide for them to follow.

Give students list of words we will start out with on concept map, and ask them where they think they may go. (allow students to come up to front of room-working on board to put up their ideas) (15 min)

cell
Nucleic acids
chromosome
DNA
RNA
Nucleotides
Nitrogen bases
Amino acids
Protein Synthesis

Walk students through the outline of the concept map, starting with DNA and branching out. Give them blank concept map to fill in. Work with students to fill in the map details. (15 min)

Assessments:
During brainstorming activity, circulate through the room, making sure all students are participating. When discussing what groups had down on their list, go around the class and have each student mention some item. Advise students that tomorrow, each one of their concept maps will be checked for the items we went over today.

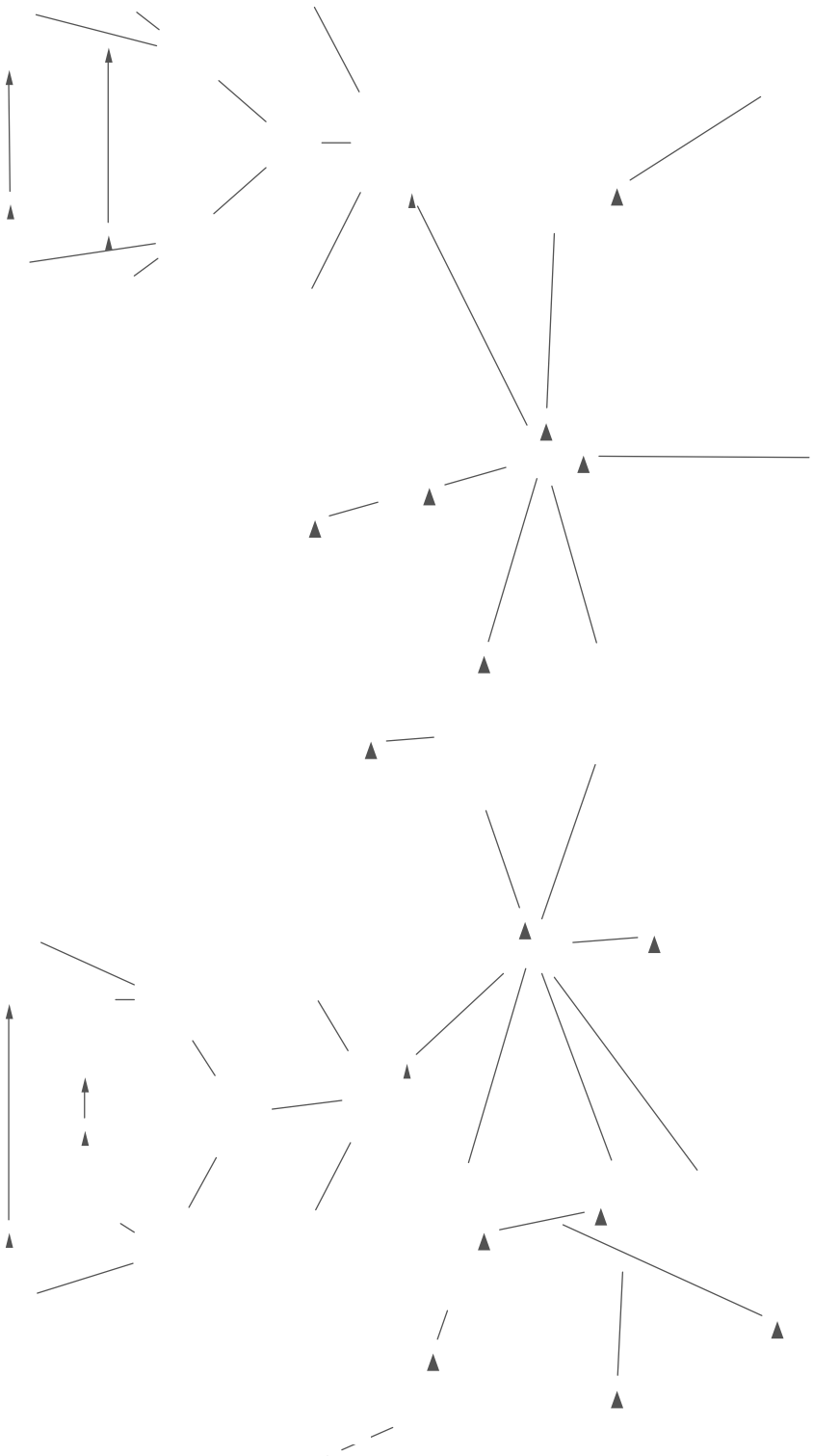
Accommodations:

Group students together that may be able to help each other during brainstorm activity, example group a struggling student with one or more who understand the concepts. To help students who understand things better visually, write student's responses on board when discussing the list of ideas they came up with regarding DNA. Create a concept map along with students to act as visual example.

Extensions:
For students who require more of a challenge, ask them to add their own notes or information to the concept map, or to develop some of the topics more.

References:
Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011. http://www.dpi.state.wi.us/standards/



Lesson 2: How was DNA discovered?

Outcomes:
-Students will be able to apply an interactive reading guide to their text reading.
-Students will be able to describe how scientists used mice to discover how genetic material transfers from one cell to another.
-Students will be able to explain how scientists determined that DNA, not proteins, carries genetic information.

Rationale:
Teaching students how and when DNA was discovered gives them a better idea of how new this discovery is. Going over the tests and experiments run by various scientists gives students a good example of the scientific process in action. Discussing the outcomes of these experiments, students will be able to comprehend how vital this discovery was in the field of genetics.

Standards Addressed:
B.12.1 Show* how cultures and individuals have contributed to the development of major ideas in the earth and space, life and environmental, and physical sciences
F.12.3 Explain* current scientific ideas and information about the molecular and genetic basis of heredity

Duration: 50 min

Materials Needed:
Textbook
Interactive reading guide worksheet

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions such as:
-What does DNA stand for? *Deoxyribonucleic acid*
-What does DNA do? *Code for genetic information*
-Where can it be found? *Nucleus of cell* (5 min)

Activity: Following this short review, explain we will be continuing our unit on DNA, today focusing on how it was actually discovered. Advise students that not just one scientist was responsible for this discovery, but there were several who contributed to the research done. Explain that the first section of Chapter 10 in their text does a good job of explaining some of the researchers involved, and today we will work with our texts to understand what they did.

Have students bring out their books and turn to correct section. Explain that students will be working with a reading guide that will help them to focus on key points in this part of the text. Students are to pair up and work on this together, and then afterwards we

will go over what they have found. (*transition)* Prior to moving, ask students to start brainstorming how DNA may have been discovered. Once students are settled, work together as a class on the first item on the guide, giving them an example of how to begin on the guide.

(10 min)

Have students continue to work in partners on the following steps, reading, discussing, and taking notes. As they are working, I will be circulating throughout the classroom answering questions, observing, and assisting when needed. I will let students know they have 20 minutes to work on this. (20 min)

Bring class back together. Go over each step with the class, ask to see their work, and ask them to verbally explain what they learned in each paragraph, using the reading guide to help them. Also have students pull out their concept maps and fill how DNA was discovered. (15 min)

Assessments:
Circulate around class during work time to evaluate who is working on the assignment. Advise students that this reading guide is due at the beginning of class tomorrow and it will be collected and graded.

Accommodations:
Prior to handing out reading guide, pair strong readers with weaker readers so they may help each other along.

Extensions:
Have students who finish ahead of time, write up short one page summary of what they read, describing which scientific experiment they liked the best, and explain why.

References:

Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011. http://www.dpi.state.wi.us/standards/

Interactive Reading Guide for Text Section on Discovery of DNA

Open your textbook to "Discovery of DNA" on pages 193-195. Work together, following the directions for each question, and then write your answers in the areas given below. Each pair only needs to hand in 1 guide, but both people will be responsible for knowing this information.

1. This section of the textbook will discuss how DNA was discovered. Entire group: Brainstorm anything you may know about DNA, or your ideas on how it may have been discovered.

2. Look at the pictures and figures on these pages, read the captions about viruses and bacteria. Partners: Predict what experiments were done involving viruses and bacteria that led to the discovery of DNA.

3. Partners: Read paragraph 1 & 2 silently, focusing on the key word virulent. Discuss what virulent means; predict why this word may be important in this section. What is an S strain, what is an R strain?

4. Partner A: Read paragraph 3 silently, and then aloud to your partner.
   Partner B: Read paragraph 4 silently, and then aloud to your partner. Look at figure 10-2 for clarification. What were the outcomes of the four experiments runs? What did Griffith discover? (looking for key term)

5. Partners: Read paragraph 5 & 6. What was Avery testing for? Why did he destroy the three molecules in heat killed S cells? What were his results?

6. Partners: Read paragraph 7 silently, then one person read it aloud. Look at figure 10-3 to understand how DNA carries hereditary information from bacteriophages to bacteria. What are bacteriophages? Explain how Hershey and Chase proved that DNA carries the genetic material.

Interactive Reading Guide for Text Section on Discovery of DNA

Discovery of DNA (pages 193-195)

1. This section of the textbook will discuss how DNA was discovered. Entire group: Brainstorm anything you may know about DNA, or your ideas on how it may have been discovered.
   Answer: DNA is basis unit of life. Found inside cell, discovered when scientist trying to create medicine.

2. Look at the pictures and figures on these pages, read the captions about viruses and bacteria. Partners: Predict what experiments were done involving viruses and bacteria that led to the discovery of DNA.
   Answer: Mice were used to see what type of cells injected in them would kill them.

3. Partners: Read paragraph 1 & 2 silently, focusing on the key word virulent. Discuss what virulent means; predict why this word may be important in this section. What is an S strain, what is an R strain?
   Answer: Virulent is a disease causing strain of bacterium. This word is important because Griffith is testing both types of bacteria to see which one kills mice, to try to develop a vaccine. S strain bacteria are virulent and smooth edged. R strain bacteria are rough edged and don't cause disease.

4. Partner A: Read paragraph 3 silently, and then aloud to your partner.
   Partner B: Read paragraph 4 silently, and then aloud to your partner. Look at figure 10-2 for clarification. What were the outcomes of the four experiments runs? What did Griffith discover? (looking for key term)
   Answer:
   Exp 1 - mouse injected with live R cells (good), mouse lives
   Exp 2 - mouse injected with live S cells (bad), mouse dies
   Exp 3 – mouse injected with heat killed S cells (neutral), mouse lives
   Exp 4 – mouse injected with heat killed S cells and live R cells, mouse dies
   Griffith discovered that the heat killed S cells (the ones that carry the virus) transferred the genetic material into the live R cells, and transformed those cells which led to the death of the mouse.

5. Partners: Read paragraph 5 & 6. What was Avery testing for? Why did he destroy the three molecules in heat killed S cells? What were his results?
   Answer: Avery was testing to see if the transforming agent in Griffith's experiment was protein, RNA, or DNA. Avery destroyed protein, RNA, and DNA separately in 3 different

trials, and then mixed the batch with heat killed S cells and live R cells, and injected them into mice. He destroyed protein, RNA, and DNA in separate mixes to test them each separately, to determine what he transform agent was in Griffith's test. He found that cells missing RNA and protein still transformed and killed mice, helping him to conclude that DNA was the transforming agent in bacteria.

6. Partners: Read paragraph 7 silently, then one person read it aloud. Look at figure 10-3 to understand how DNA carries hereditary information from bacteriophages to bacteria. What are bacteriophages? Explain how Hershey and Chase proved that DNA carries the genetic material.
   Answer: Hershey and Chase were trying to determine if DNA or protein was the genetic material viruses transfer when viruses enter bacterium. Bacteriophages are viruses that infect bacteria. Hershey and Chase used radioactive isotopes to label DNA and protein, then infected a bacteria cell, blended the mix, and found that DNA entered the bacteria cell by the material left in the E coli cells they were working with.

Lesson 3: Structure of DNA

Outcomes:
-Students will be able to describe how the structure of DNA was discovered.
-Students will be able to explain the shape of DNA, what it is comprised of, and how it is held together.
-Students will demonstrate which nitrogen bases pair up.

Rationale:
Walking students through how the structure of DNA was discovered, and what it is comprised of, will help them to realize the complexity of DNA. Asking students to label the parts of DNA will give them visual recognition of these components.

Standards Addressed:
B.8.3 Explain* how the general rules of science apply to the development and use of evidence* in science investigations, model*-making, and applications*
F.12.4 State the relationships between functions* of the cell and functions of the organism as related to genetics and heredity

Duration: 50 min

Materials Needed:
DNA Structure Power point
Projector
Computer
Work board
notebooks
DNA Structure Worksheet

Procedure:
Introduction: Greet class. Go over any announcements. Collect reading guide assignment from yesterday. Do quick review with students on what we covered yesterday. Ask questions:
-Who can explain to me one experiment they read about yesterday?
Griffith-bacteria-mice-transformation, Avery-determine it was DNA rather than RNA or protein, Hershey-Chase-bacteriophage/virus using E. coli
-What did the first scientist, Avery find out ?
Something in cells was transforming disease causing bacteria to transfer to healthy cells (7 min)

Lecture: Bring up power point, walk students through the slides. Have students take notes in their notebooks during lecture. Slides discuss the scientists who discovered the structure of DNA (Franklin, Wilkins, Crick, and Watson), properties of DNA, and a breakdown of nucleotides and complementary bases. (25 min)

Hand out worksheet. Allow students time to work on sheet in class. Move around the class while they are working to answer any questions they may have. (15 min)

Wrap up: Have students start packing things up. Ask if they have any questions, see how far most of them have gotten on assignment. Advise them we will be continuing to work on DNA structure tomorrow, and having this assignment done will help them in class tomorrow. (3 min)

Assessments:
Circulate around the classroom during work time, answering questions and making sure all students are working. Advise students that worksheet will be checked in class tomorrow, and will be handed in for grading, with their DNA model they will be creating shortly.

Accommodations:
Provide copy of power point slides for those students who may have difficulties taking down notes during class. Allow students to work together on worksheet if some seemed to be struggling on their own.

Extensions:
Ask students to brainstorm on ways they could create their own DNA model, what materials would they use?

References:
Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Below site provided DNA outline used in worksheet.
http://www.biologycorner.com/worksheets/DNAcoloring.html

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011.
http://www.dpi.state.wi.us/standards/

Name_____
Hour_____

DNA Structure Worksheet

Answer the following questions, using your notes as a reference. If you are unable to find the answer in your notes, refer to your textbook. The diagram question of this worksheet will act as your blue print for creating a DNA model, so make sure to have this portion completed before class tomorrow.

1. Name two Scientists who helped to discover the structure of DNA.

   _____

2. What is DNA comprised of? Please list the three parts of it. _____

   _____

3. What shape is DNA? _____

4. Where is it found in the body? _____

5. What comprises the backbone of DNA? How are these molecules held together?

   _____

   _____

6. How many nucleotide pairs make up a full turn of DNA? _____

7. Why are nitrogen base pairs called complementary?

   _____

   _____

8. What are the two types of nitrogen base classes?

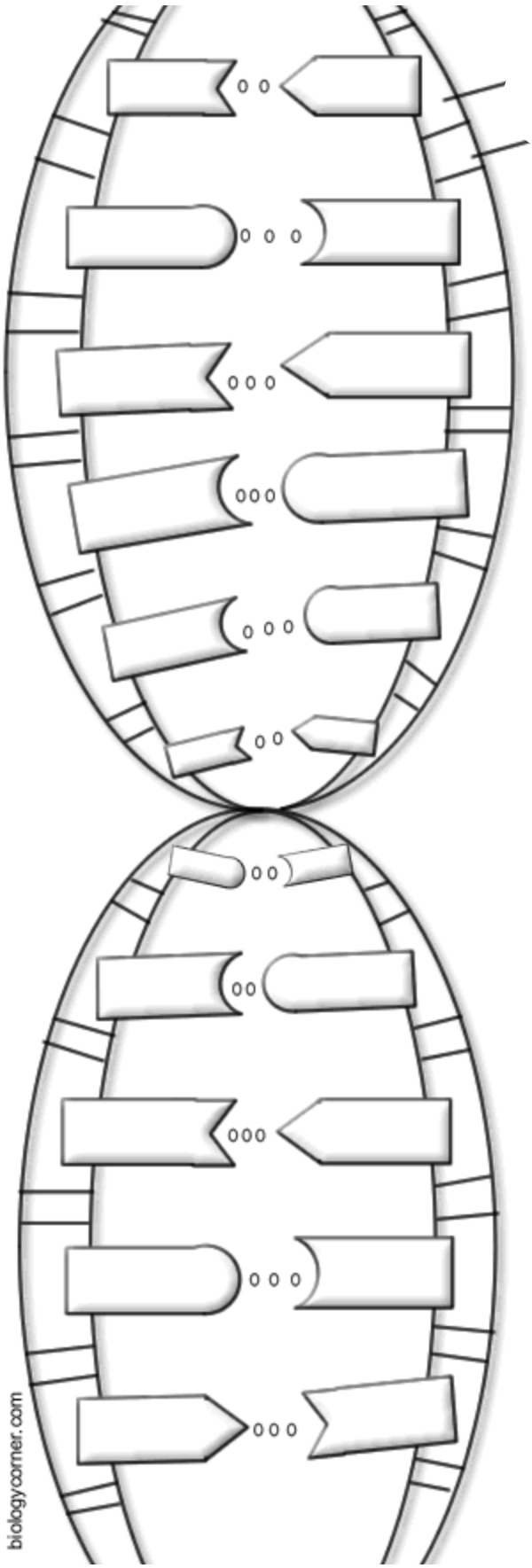
   _____

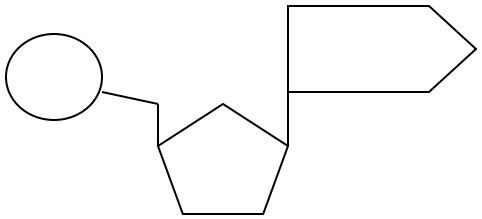
9. Which bases pair up with each other? What bonds are found between the nitrogen pairs?

   _____

   _____

10. Fill in the diagrams below labeling each base pair, the parts of the backbone of the DNA structure, and the bonds found between the different parts. Create a key identifying the 4 different nitrogen bases.


biologycorner.com



Lesson 4: Building DNA Model

Outcomes:
-Students will create their own DNA model.
-Students will be able to explain the different components of their model, and identify how the nitrogen bases pair up.

Rationale:
Lecturing students about a subject only applies to one or two types of learning styles; incorporating a hands-on activity allows students to take what they understand and apply it. In this situation they get to create a DNA model just like the scientists Crick and Watson.

Standards Addressed:
A.8.3 Defend explanations* and models* by collecting and organizing evidence* that supports them and critique explanations and models by collecting and organizing evidence that conflicts with them
G.12.2 Design, build, evaluate, and revise models* and explanations related to the earth and space, life and environmental, and physical sciences

Duration: 50 min

Materials Needed:
Pipecleaners (5-6 several different colors)
Beads (2 different colors)
Wire cutters
Instruction sheet
DNA structure worksheet
Blank sheet of notebook paper (note sheet)

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What are the subunits of DNA? *nucleotides*
-What are the three different parts of a nucleotide? *Deoxyribose sugar, phosphate group, nitrogen base*
-How many different nitrogen bases are there? *4, adenine, guanine, cytosine, thymine*
-What is the shape of DNA? *Spiral double helix*
Have students pull out their concept maps and add the information under the nucleotides bubbles. (5 min)

Activity: Ask students to bring out their DNA structure worksheet from yesterday. Explain they will be using this sheet as a blue print for a DNA model they will be creating today, advise students that if they did not have diagram fully labeled, I would give them 3 minutes to finish things up, then we would start on activity. (3 min)

After three minutes have students clear desks of everything but their DNA structure worksheet. Explain they will be provided with supplies and directions on how to create a 12 base-pair rung DNA model. They will have roughly 25-30 minutes to work on their models. At the end of class, they will exchange models with a fellow student, double checking each other's model for 6 main parts. I will request that students do not copy the exact letter sequence as on their worksheet, but create a new one, and write what it is on a separate sheet of paper, making sure to have proper bases paired up.

Hand out instructions, direct students on where supplies are and let them work. While they are working, I will go around to each student making sure they understand how to construct their structure, and making sure they have the correct parts on their DNA worksheet. (27 min)

After 30 min bring class back together, advise that now they will be sharing their model with another student. I will pair students up. *Transition*: While they are moving to be with their partner, have them think about what nitrogen bases pair up. Once partners are seated together have them exchange models, and write on the opposite side of their sheet who they are partnered with, and what that person's 12 base pairs are. While working together, partners should check each other's work for 12 base pair rungs, 2 backbone pieces, 24 beads that represent the phosphate/sugar that make up the backbone, and a key that indicates the color for each of the four nitrogen bases. Write outline on board so students are aware of what is needed on their note sheet. (10 min)

Wrap up: Ask students to go back to their original desk. (*transition*) Prior to moving, ask students to start thinking about how this lab went. Ask for feedback once class is settled. Ask if this lab should be done in the future or are there any suggestions they may have. As they are leaving class have them hand in their models and their note sheet for grading. (5 min)

Assessments:
Circulate during class to make sure students are staying on task, and answer questions when needed. Ask students to explain the different components they have in their models. At the end of the period collect the DNA worksheet given yesterday, and the DNA model students created.

Accommodations:
For students who need visuals to comprehend concepts, the questions I ask at the beginning of class, I can write on the board and have students come and answer on the board. I can also show visuals while we are discussing the answers to help students prepare for the activity. I may have a sample model available for students to look at, for those who are having a difficult time understanding how to start constructing their model.

Extensions:
For students who finish with activity quickly, they can exchange their model with several classmates to get more practice with reading and pairing nitrogen bases.

References:

The pipe cleaner activity was adapted from the following website:
http://www.ehow.com/how_6400571_make-model-pipe-cleaners-beads.html

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011.
http://www.dpi.state.wi.us/standards/

DNA Model Instructions

Materials Needed:
8 Pipe cleaners (2 of same color-backbone, 6 of other colors-need at least 4 different colors for nitrogen bases)
24 Beads
Wire cutters
Instruction sheet
Blank sheet of paper
DNA structure worksheet

1. Write down on your blank sheet the 12 base pairs in your model. (Remember to be creative, and do not copy from your DNA worksheet) Determine what pipe cleaner color you would like to represent each of the 4 nitrogen bases. Write this down on your blank sheet of paper, this will be your key. (keep this sheet for later)

2. Gather required supplies. Determine what color pipe cleaner you are using for the backbone of DNA, get two pipe cleaners of that color. Pick up 6 other different colored pipe cleaners, need to have at least 4 different colors to represent base pairs. (keep in mind your key)

3. Cut the nitrogen base pipe cleaners into fourths. If you have extra pieces or need extras (depending on your model) share with your classmates.

4. Match the correct colors up together, those that are indicative of the base pair you are working on. *REMEMBER: Adenine pairs with Thymine, Cytosine pairs with Guanine.* There needs to be 12 base pairs in this model. Connect the colors together by wrapping the ends of each around each other. At this point you should have 12 pieces, each comprised of two colors, ready to be connected to the backbone.

5. Lay the two backbone pipe cleaners (same color) parallel to each other on the table. Lay the two-colored pieces (all 12) across the backbone pieces, spacing them evenly so they look like rungs on a ladder.

6. Wrap the ends of the two-colored pieces around the backbone. Slip one bead onto each backbone pipe cleaner directly below the two-colored piece. Continue to attach each two-colored piece to the backbone, and slip a bead in between

each one. Each bead represents the sugar portion of the backbone. There should be 12 base pairs on your model.

7. Wrap pieces of masking tape around the end of the each of the backbone pipe cleaners.

8. Twist the backbone pipe cleaners at each end in separate directions to make a spiral or double helix shape.

Lesson 5: DNA Replication

Outcomes:
- Students will be able to describe what happens in the three steps of DNA replication.
- Students will be able to tell the difference between prokaryotic and eukaryotic replication.
- Students will identify the link between mutations and cancer.

Rationale:
Up until this point students have been told that DNA is vital to the existence of living things. This lesson explains to students how DNA is actually replicated and passed from cell to cell, allowing them to understand how this crucial piece is passed on. Within this lesson, students are also taught the difference between prokaryotic and eukaryotic replication, showing them how much more complex we are as eukaryotic organisms. Concluding this lesson with information about cancer and its link to DNA gives students a better idea of a concept they are all likely affected by.

Standards Addressed:
F.8.3 Differentiate between single-celled and multiple-celled organisms (including humans) through investigations, comparing the cell functions of specialized cells for each type of organism
F.12.4 State the relationships between functions* of the cell and functions of the organism as related to genetics and heredity

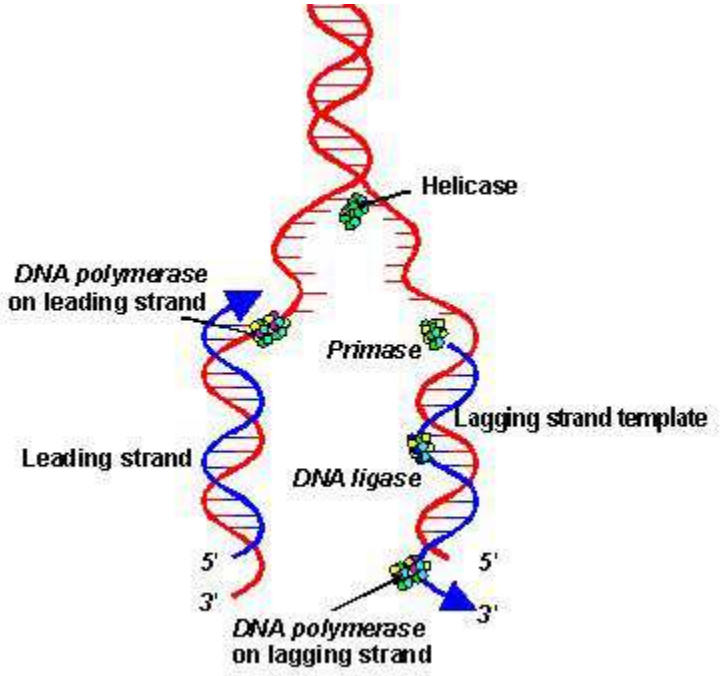
Duration: 50 min

Materials Needed:
DNA Replication Power point
Projector
Computer
Work board
notebooks
picture of replication to draw from
You Tube video clips

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What model did you create in class yesterday? *DNA*
-What materials did you use, what did they represent? *Pipe cleaners and beads; pipe cleaners represented nitrogen bases and the phosphate group of backbone. Bead represented sugar part of backbone.*
-What are the four nitrogen bases in DNA? *Adenine, guanine, cytosine, thymine*

Explain to students we will be looking further at DNA, ask them how it is possible that there is DNA in each of our cells? How does DNA actually move around? Have students remember back to Griffith's experiment. (7 min)

Lecture: Bring up power point, walk students through the slides. Have students take notes in their notebooks while I lecture. Slides go over the three steps of DNA replication, the difference between replication in prokaryotes vs. eukaryotes, and what happens when errors occur in replication. While showing the specific steps of DNA I will draw the below diagram on the board, and have students copy this into their notes as well, and then go over each part with them. (35 min)



Show students two videos of DNA replicating. One video shows them the process in motion. The other video shows what several students created to remember the DNA replication steps.

DNA replication process—created by Science text author
http://www.youtube.com/watch?v=teV62zrm2P0&feature=related

DNA replication student created song
http://www.youtube.com/watch?v=dIZpb93NYIw

(5 min)

Wrap up: Have students pull out their concept maps and add the information under DNA replication. (3 min)

Assessments:
While lecturing try to monitor who is taking notes, slow down or speed up pace of lecture depending on students reactions. Ask questions of students as going through lecture, especially when drawing the process on the board to reiterate the steps of replication. Have them walk me through the process as I draw.

Accommodations:
Provide printed off copy of power point slides for those students who have difficulty keeping up with note taking, or comprehend better when just listening to lecture.

Extensions:
Challenge students to create their own DNA replication song or poem, anything that may help them to remember the steps. Ask students to share this with the rest of the class.

References:

DNA replication diagram
http://www.google.com/imgres?q=dna+replication+steps&hl=en&sa=X&tbm=isch&prmd=imvnsfd&tbnid=wyeC75XYrd14zM:&imgrefurl=http://universe-review.ca/F11-monocell.htm&docid=A2hTby8kxqG4gM&imgurl=http://universe-review.ca/I11-20-DNAreplication.jpg&w=404&h=342&ei=1xWqTqepKYTm0QHFhPiuDw&zoom=1&iact=rc&dur=510&sig=117642224878562738069&page=2&tbnh=119&tbnw=141&start=15&ndsp=17&ved=1t:429,r:8,s:15&tx=77&ty=71&biw=1024&bih=640

DNA replication process—created by Science text author
http://www.youtube.com/watch?v=teV62zrm2P0&feature=related

DNA replication student created song
http://www.youtube.com/watch?v=dIZpb93NYlw

Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011.
http://www.dpi.state.wi.us/standards/

Lesson 6: Flow of Information

Outcomes:
-Students will be to illustrate how genetic information flows from DNA to RNA to protein synthesis in a cell.
-Students will be able to describe the differences between DNA and RNA.
-Students will be able to identify the three major types of RNA.

Rationale:
The way genetic information flows in a eukaryotic cell is a multi-stepped process that doesn't end with understanding what DNA is, it actually begins there. These lessons build upon each other to help students grasp the concept of the role of DNA in their bodies, and how that DNA is encoded. This lesson introduces RNA and its relationship to DNA and protein synthesis.

Standards Addressed:
F.12.2 Understand* how cells differentiate and how cells are regulated

F.12.4 State the relationships between functions* of the cell and functions of the organism as related to genetics and heredity

Duration: 50 min

Materials Needed:
Flow of Genetic Information Power point
Projector
Computer
Work board
notebooks
Flow of Genetic Info worksheet

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What enzyme separates the two strands of the DNA molecule? *Helicase*
-In what direction does synthesis occur on each DNA strand, in regards to the other parent strand? *Opposite directions*
-What is a mutation? *Change in nucleotide sequence of DNA molecule* (5 min)

Lecture: Bring up power point, walk students through the slides. Have students take notes in their notebooks while I lecture. Slides discuss the hierarchy of cell structure, the relationship between DNA, RNA, and protein, and the processes that happen after DNA replication. The differences between DNA and RNA are addressed, as well as the three main types of RNA students will need to know. (30 min)

Following lecture I will hand out a worksheet about RNA for students to work on, I will give students 10 minutes to work on sheet. The sheet will be due in two days. (10 min)

Wrap up: Have students pull out their concept maps and walk them through adding the information about transcription, translation, types of RNA, and the 4 characteristics of RNA. (5 min)

Assessments:
While lecturing try to monitor who is taking notes, slow down or speed up pace of lecture depending on students reactions. Ask questions of students as going through lecture. During work time, circulate around the class answering questions. Collect assigned worksheet in 2 days, make corrections and return to students within day or two. Address any areas that students seemed to struggle with on worksheet.

Accommodations:
Provide printed off copy of power point slides for those students who have difficulty keeping up with note taking, or comprehend better when just listening to lecture. To help visual learners, bring out my own concept map and show them where I would add the different terms.

Extensions:
If there is time left in the class period, assign students to create a chart in their notes showing the differences between DNA vs. RNA.

References:
Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011. http://www.dpi.state.wi.us/standards/

Name_____

Hour_____

Flow of Genetic Information Worksheet

Answer the following questions, using your notes as a reference. If you are unable to find the answer in your notes, refer to your textbook.

1. List the hierarchy of a cell down to a gene.

_____

2. What is the role of a gene? _____

_____

3. What part of the cell cycle does DNA replication occur during? _____

4. Define what happens during transcription: _____

_____

_____

5. Define what happens during translation: _____

_____

_____

6. List 4 ways RNA is different from DNA?

_____

_____

_____

_____

7. Match the type of RNA with its function. In area below, draw simple sketch of each type of RNA.

mRNA	transfer amino acids
rRNA	part of ribosome
tRNA	carries information from DNA to ribosome

Lesson 7: Transcription

Outcomes:
-Students will be able to describe what transcription is, and the 3 steps it involves.
-Students will be able to define the terms genetic code and codon.
-Students will be able to encode what amino acids they have in the DNA models they created.

Rationale:
The importance of this lesson is to help students begin to understand the relationship between DNA and RNA. The process of transcription is where DNA is used as a template for RNA; RNA then is used for the making of proteins. Understanding the connection between DNA and RNA brings us closer to understanding how genetic instructions are encoded in a cell.

Standards Addressed:
F.12.2 Understand* how cells differentiate and how cells are regulated

F.12.4 State the relationships between functions* of the cell and functions of the organism as related to genetics and heredity

Duration: 50 min

Materials Needed:
Transcription Power point
Projector
Computer
Work board
notebooks
DNA models
The Genetic Code worksheet

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What is the role of a gene? *Code for a hereditary character trait*
-What are the 4 ways RNA differs from DNA? *Composed of ribose, uracil instead of thymine nitrogen base, single strand, shorter in length*
-What are the three main terms in the flow of genetic information in a cell?
DNA → RNA → protein (5 min)

Lecture: Bring up power point, walk students through the slides. Have students take notes in their notebooks while I lecture. Slides discuss the three steps of transcription and the genetic code. The relationship between the DNA template strands and the RNA strand created from this template are discussed. The specific sequence of RNA nucleotides and the codons they encode for is also covered. (25 min)

Activity: Hand students back their DNA models that were turned in the other day. Have students use the DNA models they created to fill in The Genetic Code worksheet handed out. Walk students through the directions and how to code for their first amino acid. (12 min)

Wrap Up: Bring class back together. (*transition*) Prior to allowing students to move, have them think of how this activity went. Once class is settled, ask for their feedback on this activity. Was it worthwhile, did it help them to tie all of the concepts together? Advise class that the Genetic Code worksheet will be due at the beginning of class tomorrow. (3 min)

Assessments: While lecturing try to monitor who is taking notes, slow down or speed up pace of lecture depending on students reactions. Ask questions of students as going through lecture. During work time, circulate around the class answering questions. Collect assigned worksheet tomorrow, make corrections and return to students within day or two. Address any areas that students seemed to struggle with on worksheet.

Accommodations: Provide printed off copy of power point slides for those students who have difficulty keeping up with note taking, or comprehend better when just listening to lecture. During the introduction to the activity, bring out my own DNA model and use this as a visual aid for students. Write on a blank worksheet the results I get so students can see where I am getting my information from.

Extensions: If students finish encoding one side of their DNA model, I will have them encode the other side. For further extension, I can have them pick one of the amino acids and research what it is primarily responsible for in the body.

References:

Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011. http://www.dpi.state.wi.us/standards/

Name_____
Hour_____

The Genetic Code

Fill in the following chart according to the DNA model you created. Indicate below and also on your model which side of your model you are using (left or right). The codon chart in your book on page 207 will assist you in determining what amino acids your model is coding for.

Side of model used _____

DNA	RNA	Codon	Amino Acid
_____	_____		
_____	_____		
_____	_____	_____	_____
_____	_____		
_____	_____		
_____	_____	_____	_____
_____	_____		
_____	_____		
_____	_____	_____	_____
_____	_____		
_____	_____		
_____	_____	_____	_____
_____			
_____			

Lesson 8: Translation

Outcomes:
-Students will be able to describe what translation is, and the 5 steps it involves.
-Students will be able to define the terms anticodon, and recognize it is complementary to a codon.
-Students will be able to identify the roles of mRNA and tRNA in translation.

Rationale:
The actual making of a protein is the end product to this series of lectures. Each lecture has built on the previous, walking students through the purpose behind DNA, then RNA, and now the lectures come full circle, explaining in detail how proteins are made. This lecture is important because proteins are important, without them, we would not function.

Standards Addressed:
F.12.2 Understand* how cells differentiate and how cells are regulated

F.12.4 State the relationships between functions* of the cell and functions of the organism as related to genetics and heredity

Duration: 50 min

Materials Needed:
Translation Power point
Projector
Work board
computer
notebooks

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What is a codon? *Three nucleotide sequence that encodes an amino acid*
-What is happening during transcription? *RNA strand is being created using DNA strand as a template.*
-What is the nucleotide sequence for a start codon?
AUG (5 min)

Collect the Flow of Genetic Information worksheet and The Genetic Code worksheet. Work as a class to finish encoding the rest of my DNA model. Post my answers as we go along so the class can see the steps. (5 min)

Lecture: Bring up power point, walk students through the slides. Have students take notes in their notebooks while I lecture. Explain to students what translation is, and walk them through the five steps to this process (30 min)

Wrap up: Have students pull out their concept maps and walk them through adding the steps of transcription and translation. (10 min)

Assessments:
When we are working as a class on going over the homework and filling in the concept map, ask for feedback from different students each time. Address any areas that students seemed to struggle with on worksheet. While lecturing try to monitor who is taking notes, slow down or speed up pace of lecture depending on students reactions. Ask questions of students as going through lecture.

Accommodations:
Provide printed off copy of power point slides for those students who have difficulty keeping up with note taking, or comprehend better when just listening to lecture. When we are going over the homework, bring out my own DNA model and use this as a visual aid for students. Continue filling in my worksheet and post it while we are going over the results, so students can visually follow along.

Extensions:
Challenge students to create their own way of remembering the various steps of translation. An example would be a pneumonic device. Ask students to share this with the rest of the class.

References:
Postlethwait, John. H and Janet L Hopson. *Modern Biology*. Austin. Holt, Rinehart and Winston. 2009.

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011. http://www.dpi.state.wi.us/standards/

Lesson 9: Gel Electrophoresis Simulation (day 1)

Outcomes:
-Students will be able to describe the role of restriction enzymes and how they function.
-Students will be able to explain what gel electrophoresis is, and how it separates DNA molecules present in a mixture.
-Students will be able to describe the relationship between fragment size and the migration rate of DNA.

Rationale:
This is an extended lab that will span over two class periods. Gel electrophoresis is a molecular biology technique that is widely used today. I believe it is important for students to understand what this process is, and what it does, giving them an example of real world application of a currently used Scientific technique.

Standards Addressed:
C.8.1 Identify* questions they can investigate* using resources and equipment they have available

G.8.2 Explain* how current scientific and technological discoveries have an influence on the work people do and how some of these discoveries also lead to new careers

Duration: 50 min

Materials Needed:
Scissors (enough for every student)
Tape
Pencils
Computer
Projector
Gel Electrophoresis worksheet
Simulate gel table

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What is translation, where does it occur? *Actual building of proteins, ribosomes*
-What is the hierarchy of proteins? *Proteins → polypeptides → amino acids*
-What are the steps in translation?
Initiation, elongation, termination, dissembly (5 min)

Activity:
Advise students we are going to work together to solve a crime today. Explain that a wallet was stolen from a locker near the classroom. A small drop of blood was found on the locker, assumed to be left by the guilty party. Tell the class that someone in the room is

suspected of taking the wallet, and that the police gave you a sample of the blood to run a DNA fingerprint on, using gel electrophoresis.

Background info on activity: Advise students that before we can start solving crime they need to know a little bit more about what gel electrophoresis is. Bring up power point, walk students through the slides. Have students take notes in their notebooks while I lecture. (10 min)

Activity: Hand out Gel Electrophoresis worksheet to students. Walk students through each step, advising them we will pretend that we each only have 20 nucleotide base pairs for this activity. Each person has the restriction site AATT somewhere along their DNA so they need to include this in their fragment, and they can include it as often as they like. (5 min)

Walk students thru shading in the restriction site areas, and then have them draw a thick line between the two A's. This line indicates where the restriction enzyme will cut the DNA. Then have students cut their DNA fragments from the paper, and then follow the lines they drew in and cut the DNA into fragments created by the restriction enzymes. Have them record the number of restriction sites and total number of fragments they have on their paper. On the back of each fragment, have them write their names. (10 min)

Bring up image of Simulate Gel on board for entire class to see. Indicate negative and positive sides of the gel. Ask for a student volunteer to come to front of class with their DNA fragments to see if they match the blood taken from the crime scene. Help the student demonstrate how to figure out how his fragments create a banding pattern specific to that student. Each fragment has a set number of nucleotide pairs. The number of pairs in each fragment is indicative of that fragment size. The number on the simulation gel sheet that corresponds to the number of pairs in that fragment should be shaded in to represent that fragment for the student. All of the student's fragments need to be accounted for on the simulation gel sheet. If two or more fragments have the same number of pairs, only the one square corresponding to that number is shaded in. (10 min)

The simulation gel sheet provides for multiple students to come up and add their data. Select or ask for more students to come up and fill in their information. Once the data table is filled in ask students to compare the various banding patterns. Explain to students that in real life DNA consists of 3 billion base pairs, the chances of two people (other than identical twins) having the same exact banding pattern is very slim. (10 min)

Show students the banding pattern collected from the crime scene. (You will need to create this ahead of time) Ask them to pretend that this is a real set of DNA fingerprints. Have them start answering the questions on the back of their Gel Electrophoresis worksheet, under the section "To Catch A Criminal". Advise students that this worksheet (front and back) is due tomorrow. (5 min)

Assessments:
While lecturing try to monitor who is taking notes, slow down or speed up pace of lecture depending on students reactions. Ask questions of students as going through lecture. During activity circulate around the room answering questions from students. Assign students a worksheet to go along with lab and collect the sheet the following day.

Accommodations:
Provide printed off copy of power point slides for those students who have difficulty keeping up with note taking, or comprehend better when just listening to lecture. When we are doing the activity together, I am walking the students through each step with verbal directions, and also showing them with a visual model of my own.

Extensions:
Have students find a current news article involving DNA evidence used in solving a crime. Have students write a short summary of what they found.

References:

This lesson plan was adapted from the following website:
Gel Electrophoresis Simulation lesson plan
http://www.scienceteacherprogram.org/biology/NLee05.html

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011.
http://www.dpi.state.wi.us/standards/

Name: _____ Date: _____

Gel Electrophoresis Worksheet (side 1)

1) A certain restriction enzyme seeks out the base sequence AATT and cuts between the 2 A's. In the grid below, draw a row of 20 nucleotide base pairs and include this sequence randomly throughout as often as you wish.

2) Whenever you have the sequence AATT in the template strand, use a pencil to lightly shade in the sequence. This is known as a restriction site.

3) Now, for each restriction site, draw a thick line between the 2 A's. This indicates where the restriction enzyme will cut the DNA.

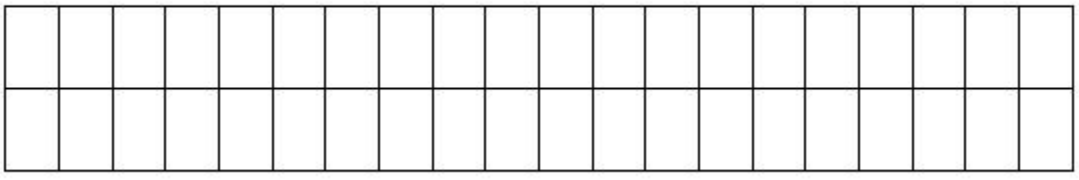
4) Indicate the total number of restriction sites you have in your entire DNA sequence: ___

5) Cut out your entire DNA sequence from the middle of this page so that it is one long rectangle. Then, following the lines you drew in for each restriction site, cut your DNA into the fragments created by the restriction enzyme.

6) Indicate the total number of fragments created by the restriction enzyme: ___

7) On the back of each fragment, write your name and the number of base pairs the fragment has.

DNA Fragment



To Catch a Criminal (side 2)

1. Is the person responsible for the theft present in the classroom? How do you know?

2. Ignoring the column for the criminal DNA on the Simulation Gel table, are there any two banding patterns that are exactly alike?

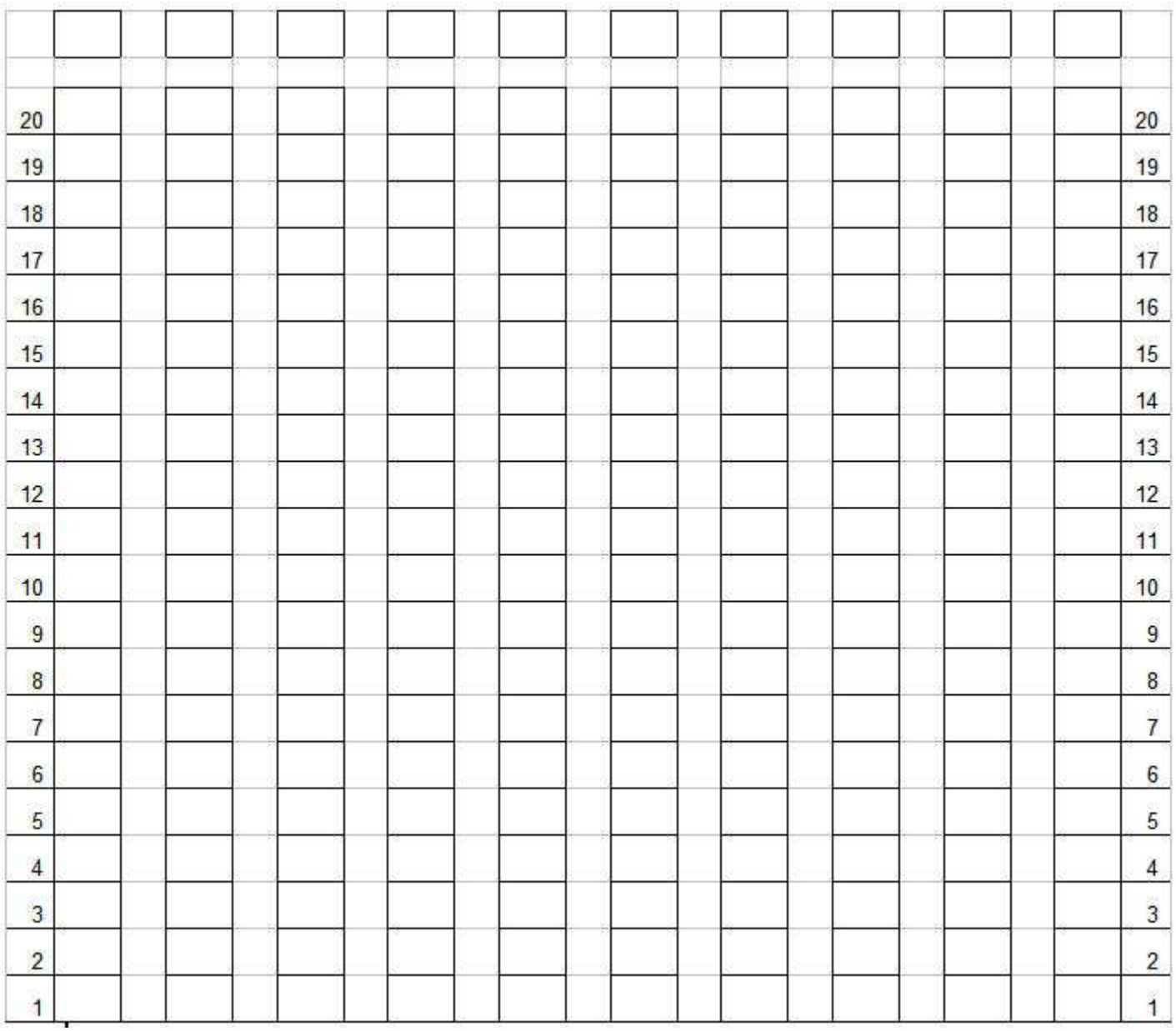
3. If no two banding patterns are alike, how would you explain this?

4. If there are banding patterns that are alike, how would you explain this?

5. Why was the Simulated Gel numbered in descending order starting from the top?

6. What do the positive (+) and negative (-) signs represent, and why was the positive placed at the bottom of the gel?

Simulated Gel



Lesson 10: Gel Electrophoresis Simulation (day 2)

Outcomes:
-Students will be able to list the steps involved in a gel electrophoresis experiment.
-Students will be able to justify the use of gel electrophoresis for DNA profiling and realize the application in a real world setting.

Rationale:
The second day of this lab, students will actually go through a gel electrophoresis simulation online that will show them all the materials and steps taken in an actual lab setting. This simulation is very realistic and interactive, helping students to apply what we discussed in the first portion of this class. The simulation is well done and very applicable in a classroom where you may not have the budget or resources to do the actual experiment. I think it is crucial that students do the simulation online so they get a better idea of all the steps taken, materials used, and outcomes in a lab setting.

Standards Addressed:
D.8.4 While conducting investigations*, use the science themes* to develop explanations* of physical and chemical interactions* and energy* exchanges

G.8.2 Explain* how current scientific and technological discoveries have an influence on the work people do and how some of these discoveries also lead to new careers

Duration: 50 min

Materials Needed:
Computer
Projector
Link to online simulation
http://learn.genetics.utah.edu/content/labs/gel/
Gel Simulation worksheet

Procedure:
Introduction: Greet class. Go over any announcements. Do quick review with students on what we covered yesterday. Ask questions:
-What is gel electrophoresis? *Procedure that separates molecules on the basis of their rate of movement through a gel under the influence of an electrical field*
-What is this process used for? *DNA profiling, to match DNA to evidence*
-How likely is it that someone else would have the same DNA fingerprint? Why? *Very unlikely since DNA has 3 billion base pairs and likelyhood of two people having the same DNA fingerprint would be very slim, unless they were identical twins*

(5 min)

Have students bring out homework due today and exchange. Go over each answer and have them grade each other's paper. Collect homework after this to enter into grade book. (10 min)

Activity:
Pull up the following web page and project it on the screen/board. Walk through each of the following steps with the students. This site is interactive so select students to come up to computer to perform each step on the page. Allow several students to come forward to do this. (20 min)

Explain to students this simulation shows them the steps taken in a real gel electrophoresis experiment. Ask students to make comparisons between this simulation and the paper one we did yesterday in class. (5 min)

Wrap up:
Summarize the primary steps taken in the gel electrophoresis experiment we just went through online. Ask students how this experiment is applicable to real life. (10 min)

Assessments:
While going through the simulation online, monitor the class to see that students are paying attention. Ask questions of them as we walk through the process to determine if they understand what is going on. Collect the worksheets they handed in today.

Accommodations:
For students who may struggle to follow along with the group, offer to set them up at a computer in another room, where they may go through the simulation on their own.

Extensions: If resources and time are available, try to set up a gel electrophoresis in the classroom, and allow students to assist.

References:
This lesson plan was adapted from the following website:
Gel Electrophoresis Simulation lesson plan
http://www.scienceteacherprogram.org/biology/NLee05.html

Link for the Gel Simulation program:
http://learn.genetics.utah.edu/content/labs/gel/

Wisconsin Dept of Instruction. Standards-All Subject Areas. Retrieved Oct, 2011.
http://www.dpi.state.wi.us/standards/

Unit Plan III: Assessment

Stage 2 – Assessment Evidence

Core Performance Task: *Summary in GRASPS form*

Goal: To create a unit test that assesses the learning outcomes for the DNA unit. The test will include multiple assessment styles and will stress application of concepts and skills learned.

Role: A formal written assessment at the conclusion of the unit.

Audience: Several classes of approximately 20 to 25 tenth grade biology students. Some of the students may have their test altered at the teacher's discretion, due to a learning disability or other exception.

Situation: The test will be taken during a single class period. Absent students will need to meet with teacher to set up an alter time to take the test.

Product / Performance/Purpose: This test will be roughly 25-30 questions long, and will consist of matching, multiple choice, short answer, and application questions. Each question will be individually weighted and assigned point values. Scores will be determined by using a key written by the teacher. The purpose of the test is to assess the student's knowledge of course outcomes.

Standards for Success: The test will be worth 100 points. Grade breakdowns will be 100-91= A, 90-81=B, 80-71=C, 70-61=D, 60 and below = F grade. Adjustments to grades received will only be made at the

teacher's discretion, but consideration is given if a student can provide proof of error or correcting information.

Unit outcomes addressed on test: 1, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 27, 28

Relationship to Enduring Understandings: The test will assess all of the enduring understandings with multiple questions about the structure and composition of DNA. The test will also assess how well students understand the processes that occur when DNA is passed from one cell to another, and the how vital this role is in human existence.

Other Assessment Evidence:

- Interactive Reading Guide (25 points) 3, 4, 6
- DNA model (30 points) 9, 10
- The Genetic Code worksheet (15 points) 8, 19

Unit Assessment Breakdown

I chose to create a test that included multiple assessment strategies ranging from matching, multiple choice, short answer, and application. I believe that offering questions in a variety of ways applies to all different types of learners, and may ease some of the anxiety students have of tests. This test is worth 100 points. All of the graded activities in this unit add up to 250 points, so although the formal assessment given at the end of unit is important, it is not the only grade students will receive. The table below gives the breakdown on graded work for this unit.

DNA Unit Breakdown	Points
Concept Map	20
Interactive Reading Guide	25
DNA Structure Worksheet	15
DNA Model	30
Flow of Genetic Information Worksheet	15
The Genetic Code Worksheet	15
Gel Electrophoresis Lab	30
DNA Test	100
Total :	250

DNA Test

Matching (25 pts- 2.5 pts per question)
Write the corresponding letter that best matches the description on the right to the term on the left.

1._____Fredrick Griffith

2._____codon

3. _____purine

4. _____replication

5. _____DNA

6. _____gel electrophoresis

7. _____mutation

8. _____ protein synthesis

9. _____ G - C

10. _____mRNA

a. carries instructions from gene to make a protein

b. complementary base pair

c. gene expression

d. DNA profiling

e. Change in nucleotide sequence of DNA molecule

f. three nucleotide sequence that encodes an amino acid

g. Tried to develop a vaccine

h. deoxyribonucleic acid

i. DNA copied in cell before cell division

j. adenine

Multiple Choice (24 pts)
Circle the best possible answer for the corresponding multiple choice questions.

11. What is the nucleotide sequence for a start codon?
    a. AUG
    b. CUU
    c. GCU
    d. CGC

12. What enzyme separates the two strands of the DNA molecule?
    a. RNA polymerase
    b. Helicase
    c. Methionine
    d. Ligase

13. What are the four nitrogen bases in DNA?
    a. Thymine, adenine, cytosine, uracil
    b. Guanine, cytosine, uracil, adenine
    c. Cytosine, uracil, thymine, guanine
    d. Adenine, guanine, cytosine, thymine

14. Which of these scientists were <u>not</u> involved in the early research of the transformation of bacteria?
    a. Frederick Griffith
    b. Martha Chase
    c. Francis Crick
    d. Oswald Avery

15. What is the shape of a prokaryotic chromosome?
    a. Double helix
    b. Long line
    c. circular
    d. all of the above

16. What is the name for the y-shaped region where two DNA strands separate?
    a. Promoter
    b. Replication fork
    c. Thymine dimer
    d. Helicase

17. What is meant by complementary bases?
    a. Each pair contains one purine and one pyrimidine.
    b. Adenine always pairs with thymine
    c. Cytosine pairs with uracil
    d. None of the above

18. What part of the cell cycle does DNA replication occur during?
    a. G1
    b. S phase
    c. G2
    d. mitosis

Short Answer

Write out the answer for each of the following questions. Partial credit may be given for answers, so show all of your work and/or thoughts.

19. What is transformation? How does it relate to DNA? (3 pts)

20. Please list 3 ways that RNA is different than DNA. (3 pts)

21. List the hierarchy of a cell down to a gene. (5pts)

22. What are the 3 different types of RNA and their functions? (6 pts)

23. How is gel electrophoresis used in criminal investigations? Please give a detailed description of the process of gel electrophoresis. (7 pts)

24. In table below, please fill in the steps for transcription and translation. Make sure to explain each step. (7 pts)

Transcription	Translation
1	1
2	2
3	3
	4

Application Problems

25. Below you are given a DNA strand, write in the complementary RNA nucleotides, and then using the codon chart below, identify which amino acid is being coded for. (10 pts)

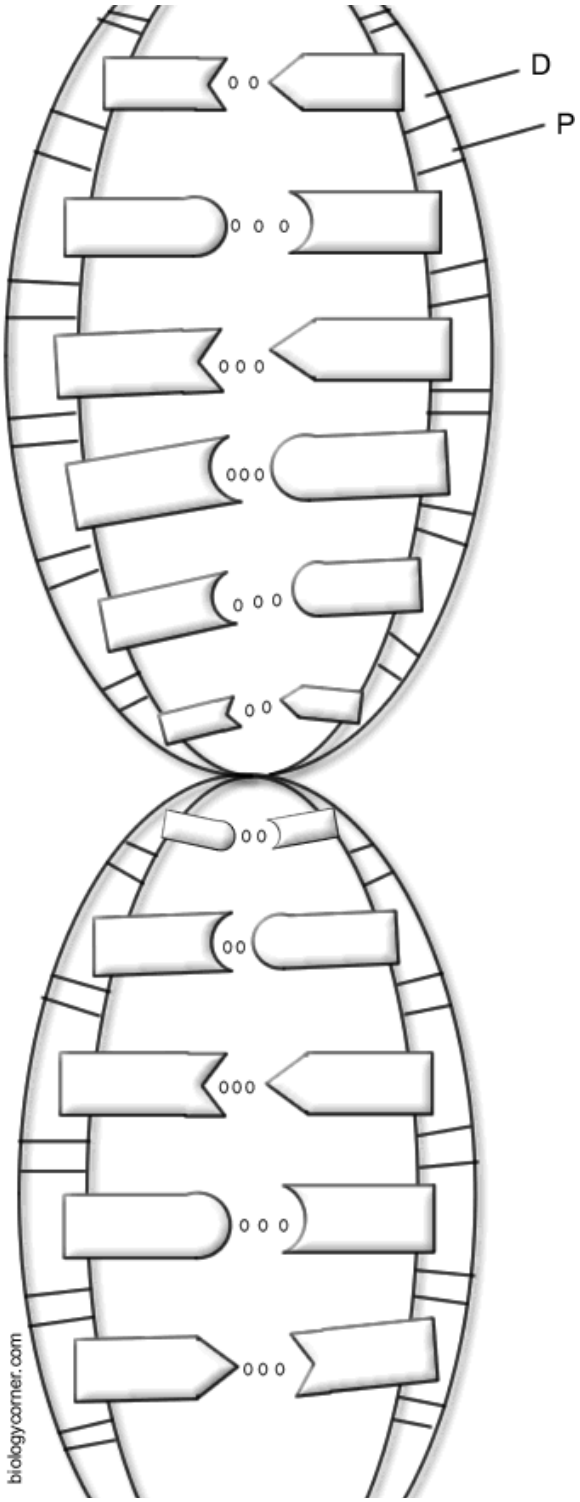
G	C	T	A	C	A	T	G	A	C	T	G
—	—	—	—	—	—	—	—	—	—	—	—

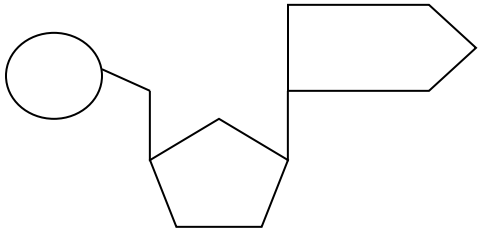
_____ _____ _____ _____

Table of mRNA codons

First Base	Second Base U	Second Base C	Second Base A	Second Base G	Third Base
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	STOP	STOP	A
	leucine	serine	STOP	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	START methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

26. Fill in the diagrams below labeling each base pair, the parts of the backbone of the DNA structure, and the bonds found between the different parts. Create a key identifying the 4 different nitrogen bases. (hint: There should be 8 terms labeled on these two diagrams, a key, and each nitrogen base identified by the key (coloring).) (10 pts)





DNA Test

Matching (25 pts- 2.5 pts per question)
Write the corresponding letter that best matches the description on the right to the term on the left.

1.__g___Fredrick Griffith

2.__f___codon

3. __j___purine

4. __i___replication

5. ___h__DNA

6. __d___gel electrophoresis

7. __e___mutation

8. __c___ protein synthesis

9. __b___ G - C

10. __a___mRNA

a. carries instructions from gene to make a protein

b. complementary base pair

c. gene expression

d. DNA profiling

e. Change in nucleotide sequence of DNA molecule

f. three nucleotide sequence that encodes an amino acid

g. Tried to develop a vaccine

h. deoxyribonucleic acid

i. DNA copied in cell before cell division

j. adenine

Multiple Choice (24 pts)
Circle the best possible answer for the corresponding multiple choice questions.

11. What is the nucleotide sequence for a start codon?
    a. AUG
    b. CUU
    c. GCU
    d. CGC

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    a. RNA polymerase
    b. Helicase
    c. Methionine
    d. Ligase

13. What are the four nitrogen bases in DNA?
    a. Thymine, adenine, cytosine, uracil
    b. Guanine, cytosine, uracil, adenine
    c. Cytosine, uracil, thymine, guanine
    d. Adenine, guanine, cytosine, thymine

14. Which of these scientists were not involved in the early research of the transformation of bacteria?
    a. Frederick Griffith
    b. Martha Chase
    c. Francis Crick
    d. Oswald Avery

15. What is the shape of a prokaryotic chromosome?
    a. Double helix
    b. Long line
    c. circular
    d. all of the above

16. What is the name for the y-shaped region where two DNA strands separate?
    a. Promoter
    b. Replication fork
    c. Thymine dimer
    d. Helicase

17. What is meant by complementary bases?
    a. Each pair contains one purine and one pyrimidine.
    b. Adenine always pairs with thymine
    c. Cytosine pairs with uracil
    d. None of the above

18. What part of the cell cycle does DNA replication occur during?
    a. G1
    b. S phase
    c. G2
    d. mitosis

Short Answer

Write out the answer for each of the following questions. Partial credit may be given for answers, so show all of your work and/or thoughts.

19. What is transformation? How does it relate to DNA? (3 pts)

Transformation is the transfer of genetic material from one cell to another. Early researchers were able to find that DNA was the genetic material being transferred from one cell to another. This was caused by viruses being spread to other organisms.

20. Please list 3 ways that RNA is different than DNA. (3 pts)

-Composed of ribose
-uracil instead of thymine nitrogen base
-single strand
-shorter in length

21. List the hierarchy of a cell down to a gene. (5pts)
Cell → nucleus → Chromosome → DNA → Gene

22. What are the 3 different types of RNA and their functions? (6 pts)

mRNA -- carries instructions from a gene to make a protein
tRNA -- transfers amino acids to ribosome to make a protein
rRNA – part of structure of ribosome

23. How is gel electrophoresis used in criminal investigations? Please explain how the process of gel electrophoresis works. (7 pts)

Gel electrophoresis is used in DNA profiling to try to match DNA to evidence when solving a crime. Electrophoresis is a process that separates molecules on the basis of their rate of movement through a gel, under an electric field.

DNA sample is taken from a crime scene. DNA strands that are the same will clump together, making them more visible. Strands are separated by restriction enzymes at specific points. Each person has unique DNA, the way their strands would group and travel through the gel would vary compared to another person's, making identification by DN A much easier to determine. The criminal's DNA would be the only one to match the DNA on the evidence.

24. In table below, please fill in the steps for transcription and translation. Make sure to explain each step. (7 pts)

Transcription	Translation
1 DNA strands unwind and separate	1 Initiation—ribosomal subunits, mRNA, tRNA and carrying methionine bind together
2 Complementary RNA nucleotides are added and then joined	2 Elongation—tRNA carrying amino acid binds to codon, peptide bond forms btwn amino acids, ribosome moves, and first tRNA leaves, chain continues to develop
3 termination signal reached and new RNA strand released	3 termination—stop codon is reached and process ends
	4 Disassembly—ribosome complex falls apart, new polypeptide chain is released

Application Problems (10 pts)

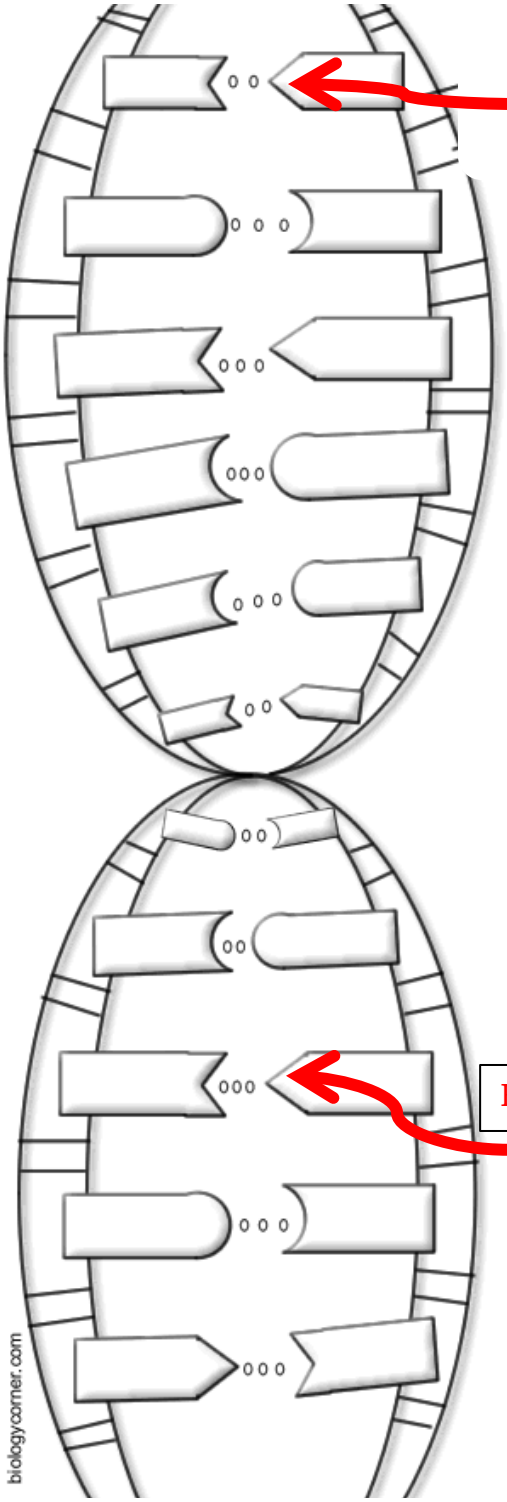
25. Below you are given a DNA strand, write in the complementary RNA nucleotides, and then using the codon chart below, identify which amino acid is being coded for.

G	C	T	A	C	A	T	G	A	C	T	G
C	G	A	U	G	U	A	C	U	G	A	C
Arginine		cysteine		threonine			aspartic acid				

Table of mRNA codons

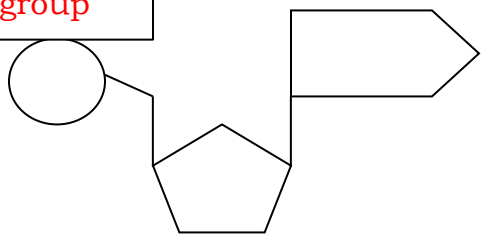
First Base	Second Base U	Second Base C	Second Base A	Second Base G	Third Base
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	STOP	STOP	A
	leucine	serine	STOP	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	START methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

26. Fill in the diagrams below labeling each base pair, the parts of the backbone of the DNA structure, and the bonds found between the different parts. Create a key identifying the 4 different nitrogen bases. (hint: There should be 8 terms labeled on these two diagrams, a key, and each nitrogen base identified by the key (coloring).) (10 pts)



Hydrogen double bonds

Phosphate group



Sugar (deoxyribose)

adeni

thymine

guanin

cytosine

Hydrogen triple bonds

Alternative Assessment Strategies

Interactive Reading Guide

a. This assessment or guide was created to help students read and understand a more difficult section in the chapter on DNA. I am evaluating how well the students were able to use this guide and comprehend what concepts and events were actually being discussed in this section.
b. I am looking to see that the questions in the guide are answered, in the students own words. I have read this section myself numerous times, if I see answers just copied out of the book, I will deduct points. However, I will also allow students to re-do this assignment and hand it in again for partial credit.
c. This assignment is worth 25 points, and it is part of the students overall grade in this unit.

Interactive Reading Guide for Text Section on Discovery of DNA

Open your textbook to "Discovery of DNA" on pages 193-195. Work together, following the directions for each question, and then write your answers in the areas given below. Each pair only needs to hand in 1 guide, but both people will be responsible for knowing this information.

This assignment is worth 25 points.

7. This section of the textbook will discuss how DNA was discovered. Entire group: Brainstorm anything you may know about DNA, or your ideas on how it may have been discovered.

8. Look at the pictures and figures on these pages, read the captions about viruses and bacteria. Partners: Predict what experiments were done involving viruses and bacteria that led to the discovery of DNA.

9. Partners: Read paragraph 1 & 2 silently, focusing on the key word virulent. Discuss what virulent means; predict why this word may be important in this section. What is an S strain, what is an R strain?

10. Partner A: Read paragraph 3 silently, and then aloud to your partner.
    Partner B: Read paragraph 4 silently, and then aloud to your partner. Look at figure 10-2 for clarification. What were the outcomes of the four experiments runs? What did Griffith discover? (looking for key term)

11. Partners: Read paragraph 5 & 6. What was Avery testing for? Why did he destroy the three molecules in heat killed S cells? What were his results?

12. Partners: Read paragraph 7 silently, then one person read it aloud. Look at figure 10-3 to understand how DNA carries hereditary information from bacteriophages to bacteria. What are bacteriophages? Explain how Hershey and Chase proved that DNA carries the genetic material.

Interactive Reading Guide for Text Section on Discovery of DNA

Discovery of DNA (pages 193-195)

7. This section of the textbook will discuss how DNA was discovered. Entire group: Brainstorm anything you may know about DNA, or your ideas on how it may have been discovered.
   Answer: DNA is basis unit of life. Found inside cell, discovered when scientist trying to create medicine.

8. Look at the pictures and figures on these pages, read the captions about viruses and bacteria. Partners: Predict what experiments were done involving viruses and bacteria that led to the discovery of DNA.
   Answer: Mice were used to see what type of cells injected in them would kill them.

9. Partners: Read paragraph 1 & 2 silently, focusing on the key word virulent. Discuss what virulent means; predict why this word may be important in this section. What is an S strain, what is an R strain?
   Answer: Virulent is a disease causing strain of bacterium. This word is important because Griffith is testing both types of bacteria to see which one kills mice, to try to develop a vaccine. S strain bacteria are virulent and smooth edged. R strain bacteria are rough edged and don't cause disease.

10. Partner A: Read paragraph 3 silently, and then aloud to your partner.
    Partner B: Read paragraph 4 silently, and then aloud to your partner. Look at figure 10-2 for clarification. What were the outcomes of the four experiments runs? What did Griffith discover? (looking for key term)
    Answer:
    Exp 1 - mouse injected with live R cells (good), mouse lives
    Exp 2 - mouse injected with live S cells (bad), mouse dies
    Exp 3 – mouse injected with heat killed S cells (neutral), mouse lives
    Exp 4 – mouse injected with heat killed S cells and live R cells, mouse dies
    Griffith discovered that the heat killed S cells (the ones that carry the virus) transferred the genetic material into the live R cells, and <u>transformed</u> those cells which led to the death of the mouse.

11. Partners: Read paragraph 5 & 6. What was Avery testing for? Why did he destroy the three molecules in heat killed S cells? What were his results?
    Answer: Avery was testing to see if the transforming agent in Griffith's experiment was protein, RNA, or DNA. Avery destroyed protein, RNA, and DNA separately in 3 different trials, and then mixed the batch with heat killed S cells and live R cells, and injected them into mice. He destroyed protein, RNA, and DNA in separate mixes to test them

each separately, to determine what he transform agent was in Griffith's test. He found that cells missing RNA and protein still transformed and killed mice, helping him to conclude that DNA was the transforming agent in bacteria.

12. Partners: Read paragraph 7 silently, then one person read it aloud. Look at figure 10-3 to understand how DNA carries hereditary information from bacteriophages to bacteria. What are bacteriophages? Explain how Hershey and Chase proved that DNA carries the genetic material.
    Answer: Hershey and Chase were trying to determine if DNA or protein was the genetic material viruses transfer when viruses enter bacterium. Bacteriophages are viruses that infect bacteria. Hershey and Chase used radioactive isotopes to label DNA and protein, then infected a bacteria cell, blended the mix, and found that DNA entered the bacteria cell by the material left in the E coli cells they were working with.

DNA Model Assessment

a. In lesson 4, students are given the task of building their own DNA model from pipe cleaners, tape, and beads. (see lesson 4 for activity instructions) This activity allows students to understand the different components of a strand of DNA, and it also leaves them with a great tool to study for their test. In order for me to ensure that students actually created their own model, I created this DNA model assessment that I will use when grading each of their models.
b. When assessing their models I will be looking for originality, background information (blueprint), and correct components, shape, and appearance of model. I will show students this assessment ahead of time so they will know what is expected of them. If I find students are not fulfilling the guidelines I ask for in their model, I can try to clarify with them what is expected and allow for a resubmission, depending on the situation.
c. This model is worth 30 points, and it is part of the students overall grade in this unit.

DNA Model Assessment

1. Originality _____(5 pts)
   (The sequence of base pairs in this model were created by you, not copied from text, worksheet, or a friend.)

2. Blue print with key _____ (5 pts)
   (On a separate piece of paper your sequence of base pairs, the phosphate group, sugar group, and a key of nitrogen base type to color pipe cleaner is given.)

3. Correct number of base pairs _____(5 pts)
   (Twelve base pairs should be on your model, no more, no less)

4. Beads incorporated into model _____ (5 pts)
   (Identify on your blue print what the beads represent, if they are not on the model, points will be deducted.)

5. Model is in correct shape _____ (5 pts)
   (DNA has a specific shape, think spiral, if model is flat, points will be deducted)

6. Appearance of model _____ (5 pts)
   (Model should be clean, and each part identifiable when looking at it with your key)

Total: _____ (30 pts)

The Genetic Code Worksheet

a. In lesson 4 students built their own DNA model, for this activity in lesson 7 students will bring out their models and use them as guidelines as they try to encode what amino acids they have in their strand of DNA. The purpose of this activity is to see how well students can pair a DNA strand with RNA nucleotides, and then determine the codons created, and the amino acids they code for.
b. I will check to see that students are using their own DNA model in this activity to encode for the amino acids. If they are having problems matching up the correct RNA nucleotides, or encoding for the wrong amino acids I can go over how to do these processes again.
c. This model is worth 15 points, and it is part of the students overall grade in this unit.

Name_____
Hour_____

The Genetic Code

Fill in the following chart according to the DNA model you created. Indicate below and also on your model which side of your model you are using (left or right). The codon chart in your book on page 207 will assist you in determining what amino acids your model is coding for.

This assignment is worth 15 points.

Side of model used _____

DNA	RNA	Codon	Amino Acid
_____	_____		
_____	_____		
_____	_____	_____	_____
_____	_____		
_____	_____		
_____	_____	_____	_____
_____	_____		
_____	_____		
_____	_____	_____	_____
_____	_____		
_____	_____		
_____	_____	_____	_____

For this worksheet the answers will vary by student, because each of their DNA models will be unique to them. Below is an example taken from a model I created.

The Genetic Code

Fill in the following chart according to the DNA model you created. Indicate below and also on your model which side of your model you are using (left or right). The codon chart in your book on page 207 will assist you in determining what amino acids your model is coding for.

This assignment is worth 15 points.

Side of model used left

DNA	RNA	Codon	Amino Acid
G	C		
C	G		
T	A	CGA	ARGININE
G	C		
A	U		
C	G	CUG	LEUCINE
T	A		
T	A		
C	G	AAG	LYSINE
G	C		
A	U		
A	U	CUU	LEUCINE

Test Question	Unit Outcomes
1	4,6
2	18
3	8
4	11
5	1
6	28
7	13
8	14
9	8
10	16
11	19
12	11
13	7
14	4
15	12
16	11
17	7
18	6
19	3,4,6
20	15
21	14
22	16,22
23	23,24,27,28
24	17,20
25	8,19
26	7,8,10