Biology

3-30 thru 4-3

2020

Biology Daily Lesson Log

Week of 3/30/2020 - 4/3/2020

Each day

1. Check out the lesson for the day
2. Complete the activities listed
3. Complete a learning log entry for the day. The learning log must be completed each day (even if you don't finish all the work, still state what you learned), make sure to write the date and activities completed, and what you learned from them.

Lesson #	Materials	Due @ the end of the lesson - check each item off as you complete it!
6 (Monday 3-30)	❏ Traits and probability reading ❏ Punnett Squares (MonoHybrid Practice) ❏ Punnett squares word problems	❏ Worksheet and practice problems ❏ Word problems ❏ Answer **box 2** of the Learning Tracker ❏ Learning Log (you should be on the back now) row 6
7 (Tuesday)	❏ Breast Cancer Fact Sheet ❏ Genetics vs. Environment	❏ Read breast cancer info sheet and mark the text ❏ Complete CER on Genetics vs. Environment (Breast Cancer Risk) Learning Log row 7
8 (Wednesday)	❏ Identifying DNA as genetic material ❏ Structure of DNA	❏ Read identifying DNA and answer questions ❏ Read structure of DNA and answer questions ❏ Learning Log row 8
9 (Thursday)	❏ DNA Double Helix pages 1 & 2 ❏ Construct a DNA Model ❏ Scissors ❏ Coloring utensils (crayons, markers, etc)	❏ Read & Mark text DNA Double Helix pages 1 & 2 ❏ Complete modeling activity ❏ Learning log row 9
10 (Friday)	❏ Lesson 10: 2 Week Assessment of Learning - One Pager instructions ❏ Coloring/writing Utensils	❏ Complete one-pager (go back through your previous assignments to do this!) ❏ Do your LAST learning log row, yay! You're all done!

Below are some video resources that you may find helpful. They aren't required, but you may find them useful!

Lesson 6:

Punnett square 1: https://youtu.be/PyP_5EgQBmE

Punnett Square 2: https://youtu.be/prkHKjfUmMs

Lesson 8&9:

DNA 1: https://youtu.be/o_-6JXLYS-k

DNA 2: https://youtu.be/zwibgNGe4aY

Name: Period:

Learning Log - Complete one row EVERY DAY

Date: What did you do today? (Bullet points okay)	What did you learn from these activities? (3 - 5 sentences) **I learned that...**
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Date: What did you do today? (Bullet points okay)	What did you learn from these activities? (3 - 5 sentences) **I learned that...**

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Learning Log

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SECTION

6.5 Traits and Probability

Student text pages 183–187

KEY CONCEPT The inheritance of traits follows the rules of probability.

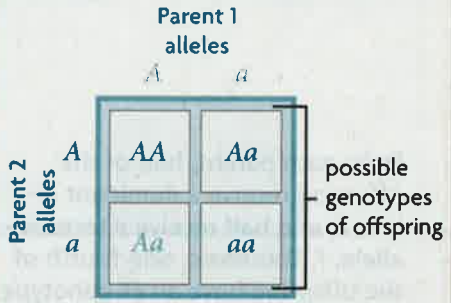
Punnett squares illustrate genetic crosses.

A **Punnett square** is a grid* system for predicting all possible genotypes resulting from a cross. The outside edges, or axes*, of the grid represent the possible genotypes of gametes from each parent. The grid boxes show the possible genotypes of offspring from those two parents.

Let's briefly review what you've learned about meiosis and segregation to examine how the Punnett square works. Both parents have two alleles for each gene. These alleles are represented on the axes of the Punnett square. During meiosis, the chromosomes—and therefore the alleles—are separated. Each gamete can receive only one of the alleles, but not both. When fertilization happens, gametes from each parent join together and form a diploid cell with two copies of each chromosome. The new cell has two alleles for each gene. This is why each box shows two alleles. One is from each parent.

VISUAL VOCAB

The **Punnett square** is a grid system for predicting possible genotypes of offspring.



INSTANT REPLAY

What do the letters on the axes of the Punnett square represent? _____

A monohybrid cross involves one trait.

Thus far, we have studied crosses of one trait. **Monohybrid crosses** are crosses that examine the inheritance of only one specific trait—for example, flower color. If we know the genotypes of the parents, we can use a Punnett square to predict the genotypes of the offspring.

The Punnett squares on the next page show the results of three different crosses:

- Homozygous dominant crossed with homozygous recessive ($FF \times ff$)
- Heterozygous crossed with heterozygous ($Ff \times Ff$)
- Heterozygous crossed with homozygous recessive ($Ff \times ff$)

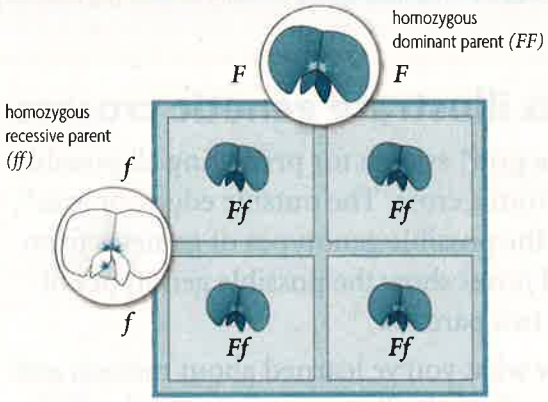
* ACADEMIC VOCABULARY

grid a layout of squares, like on graph paper

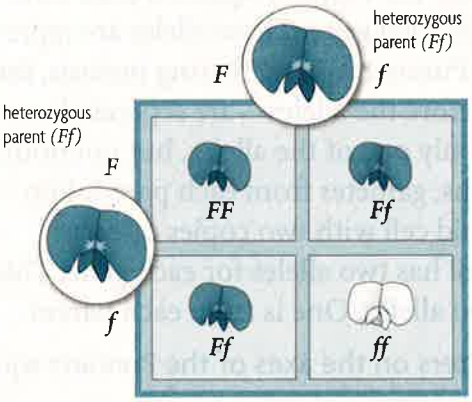
axes lines that act as points of reference

MONOHYBRID CROSSES

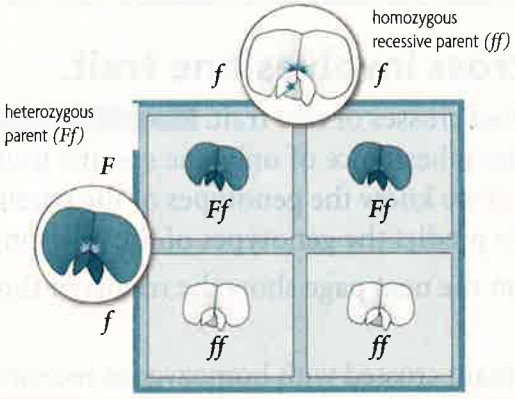
All offspring receive a dominant allele, *F*, from one parent and a recessive allele, *f*, from the other parent. So all offspring—100 percent—have the heterozygous genotype *Ff*. And 100 percent of offspring have purple flowers.



From each parent, half of the offspring receive a dominant allele, *F*, and half receive a recessive allele, *f*. Therefore, one-fourth of the offspring have an *FF* genotype, one-half are *Ff*, and one-fourth are *ff*. In other words, the genotypic ratio is 1:2:1 of *FF*:*Ff*:*ff*. Remember that both *FF* and *Ff* genotypes have a purple phenotype. The phenotypic ratio is 3:1 of purple:white flowers.



All of the offspring receive a recessive allele, *f*, from the homozygous recessive parent. Half receive a dominant allele, *F*, from the heterozygous parent, and half receive the recessive allele, *f*. The resulting genotypic ratio is 1:1 of *Ff*:*ff*. The phenotypic ratio is 1:1 of purple:white.



Suppose that we had a purple-flowered pea plant but did not know its genotype. It could be *FF* or *Ff*. We could figure out its genotype by crossing the purple-flowered plant with a white-flowered plant. We know that the white-flowered plant is *ff*, because it has the recessive phenotype. If the purple-flowered plant is *FF*, the offspring will all be purple. If the purple-flowered plant is *Ff*, half of the offspring will have purple flowers, and half will have white flowers. Crossing a homozygous recessive organism with an organism of unknown genotype is called a **testcross.**

What are the genotypes of offspring from an *FF* × *ff* cross?

Name: Date: Period:

Practice with Monohybrid Punnett Squares

Read the following passage and answer the questions.

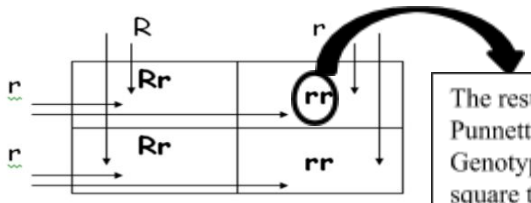
Often times, people will refer to a trait or characteristic such as eye color or hair color as being genetic, but what does the word genetic really mean?

Genetics is termed as the study of heredity and how traits in offspring are based upon those of the parents. **Heredity** is the process in which traits (characteristics that can be passed only from a living thing to its young) are passed from parents to offspring. A **Punnett square** is a grid system that can be set up and used to predict the possible outcomes that may result from the mating process between two individuals, when their genotypes are known. Each cell within the square is representative of one possible genotypic outcome for any offspring. The term **genotype** refers to the genetic make-up of an organism. Genotype is represented by using letters of the alphabet to stand for each allele that has been passed from the parents. A capital letter represents the dominant allele and a lower case letter represents the recessive allele. **Alleles** are all the forms of a gene for any given trait. There are usually two allele possibilities for every trait. For example: B and b are both alleles for the trait of hair color. Since genotype is the genetic make-up, **phenotype** is the physical result of a gene combination. **Dominance** is when one allele can mask the presence of another (B is the dominant gene for brown hair). **Recessive** refers to a characteristic that is masked by the presence of a dominant allele (b is a recessive gene for blonde hair). The only way to have a recessive trait expressed is to have both alleles be recessive (bb, resulting in the blond hair color). Homozygous is defined by the occurrence where the paired alleles for a specific trait, in this case hair color, are identical (BB or bb). If both parents are homozygous, they can each only pass on one allele type to their offspring. This means that all the offspring will have one B and one b allele and will be Bb genotype. This Bb genotype is termed as **heterozygous**. A heterozygous genotype is when the genes that an offspring receives are different, Bb. In this instance, dominance will also be expressed because the offspring will have the dominant trait of brown hair.

1. Genetics is the study of _____.
2. Traits are characteristic that can be passed only from a _____ thing to its _____.
3. The process in which traits are passed from parents to offspring is _____.
4. Each cell of a Punnett square represents one possible _____ outcome for any offspring of two specific parents.
5. Genotype refers to the _____ make-up of an organism.

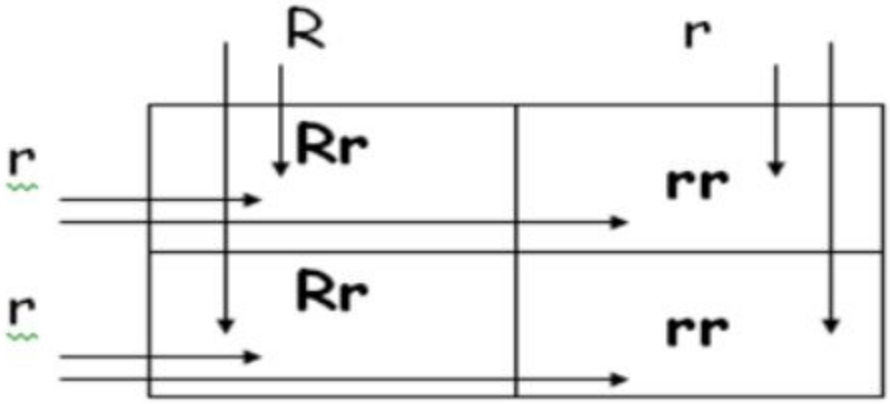
6. _____ is the physical trait that is expressed in an individual.
7. _____ are the different forms of a gene for any given trait.
8. For each trait, there are _____ allele possibilities.
9. When the expression of one allele is masked by the presence of another, it is said to be _____.
10. When an allele masks the presence of another allele, it is said to be _____.
11. When both alleles of a parent or offspring are identical, one is said to be _____.
12. A heterozygous genotype is when the alleles present are _____, such as Bb.
13. It is proper to put the _____ allele before a recessive allele when determining the genotype of the offspring in a Punnett square.
14. For an offspring to _____ a recessive trait, both parents must have at least one _____ allele in their genotype.

A Punnett square is a diagram that is used to predict an outcome of a particular cross or breeding experiment. It is named after Reginald C. Punnett who devised the approach. The diagram is used by biologists to determine the probability of an offspring having a particular genotype



The results in the Punnett Square are the Genotypes. For this square the Genotypes are Rr and rr

The Phenotype is determined as a percent chance of inheriting the trait. It is given as a percentage. If R = Red and r = is white, then, from this cross you would have a 50% chance of Red and a 50% chance of white. This is calculated by taking 2 divided by 4 (2 Rr out of 4 boxes), or 50%



For the following pairs of traits, conduct a monohybrid cross to determine the genotype and phenotype of the offspring.

1. Dominant trait: B (brown hair)
Recessive trait: b (blond hair)
Possible Genotypes: **B B and b b**

Possible Phenotypes: **75% brown hair, 25% blond hair**

	B	b
B	**B B**	**B b**
b	**B b**	**b b**

2. Dominant trait: C (circular flower)
Recessive trait: c (square flower)

Possible Genotypes: _____

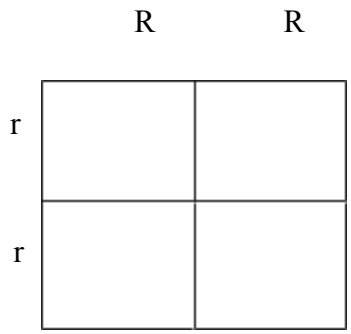
Possible Phenotypes:

	C	c
c		
c		

3. Dominant trait: R (round seed)
   Recessive trait: r (wrinkled seed)

Possible Genotypes: _____

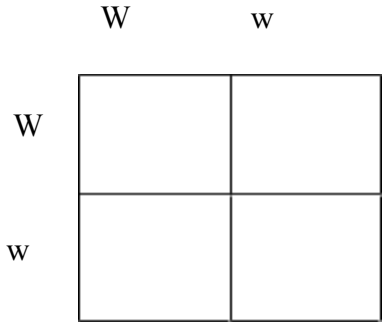
Possible Phenotypes:



4. Dominant trait: W (white fur)
Recessive trait: w (black fur)

Possible Genotypes: _____

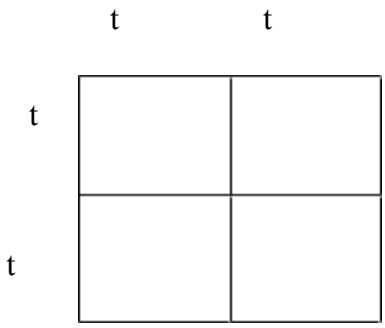
Possible Phenotypes:



5. Dominant trait: T (tall height)
Recessive trait: t (short height)

Possible Genotypes: _____

Possible Phenotypes:



For each problem, draw a Punnett square and write the genotypes and phenotypes of the offspring using the alleles given.

1. Predict the genotypic and phenotypic outcome (offspring) of a cross between two heterozygous tall pea plants. Use T for Tall and t for short.

2. In pea plants, yellow peas are dominant over green peas. Predict the genotypic and phenotypic outcome of a cross between a plant heterozygous for yellow peas and a plant homozygous for green peas. Use P for Yellow and p for green.

3. Predict the phenotypic and genotypic outcome (offspring) of a cross between two plants heterozygous for yellow peas. Use the alleles from question 2 above.

4. In pea plants, round peas are dominant over wrinkled peas. Predict the phenotypic and genotypic outcome (offspring) of a cross between a plant homozygous for round peas and a plant homozygous for wrinkled peas. Use R for Round and r for wrinkled.

5. Predict the phenotypic and genotypic outcome (offspring) of a cross between two plants heterozygous for round peas. Use the alleles listed in question 4.

6. One cat carries heterozygous, long-haired traits (Ss), and its mate carries homozygous short-haired traits (ss). Use a Punnett square to determine the probability of their offspring having long hair and the probability of their offspring having short hair. S for Long hair and s for short hair.

7. One flower is heterozygous red and it is crossed with a homozygous white plant. Use a Punnett square to determine the probability of their offspring having a red color and the probability of their offspring having a white color. R is Red and r is white.

8. A woman who is a carrier (heterozygous) for Cystic Fibrosis marries a man who has Cystic Fibrosis, a recessive disease. What are the genotypes? What is the probability that their children will have the disease? What is the probability that their children will not have the disease? Show a Punnett square! Use C for Cystic Fibrosis and c for no cystic fibrosis.

9. A woman who is a carrier (heterozygous) for Huntington's Disease, which is a dominant disease, marries a man who is also a carrier for the disease. What are the genotypes? What is the probability that their children will have the disease? What is the probability that their children will not have the disease? Show a Punnett square! Use H for Huntington's disease and h for no Huntington's disease.

BRING YOUR brave.

BREAST CANCER IN YOUNG WOMEN

Cancer is a disease in which cells in the body grow out of control. When cancer starts in the breast, it is called breast cancer. Except for skin cancer, breast cancer is the most common cancer in American women.

Most breast cancers are found in women who are 50 and older, but breast cancer also affects younger women. About 11% of all new cases of breast cancer in the United States are found in women younger than 45 years of age. While breast cancer diagnosis and treatment are difficult for women of any age, younger women may find this experience overwhelming.

WHO HAS A HIGHER RISK?

Some young women are at a higher risk for getting breast cancer at an early age compared with other women their age. If you are a woman younger than age 45, you may have a higher risk if—

- You have close relatives who were diagnosed with breast or ovarian cancer (particularly at age 45 or younger).
- You have changes in certain breast cancer genes (BRCA1 and BRCA2).
- You are of Ashkenazi Jewish heritage.
- You were treated with radiation therapy to the breast or chest in childhood or early adulthood.
- You have had breast cancer or other breast health problems such as lobular carcinoma in situ (LCIS), ductal carcinoma in situ (DCIS), atypical ductal hyperplasia, or atypical lobular hyperplasia.

If you think you are at higher risk, talk to your doctor. Your doctor may refer you to a genetic counselor, recommend that you get screened earlier and more frequently, and consider medicines or surgeries that can lower your risk.

You have an average risk of getting breast cancer at a young age if the risk factors listed don't apply to you. If you are at average risk, it is important for you to know how your breasts normally look and feel. Talk to your doctor if you notice any changes in your breasts. Aside from genetics, little is known about what causes breast cancer in women younger than 45 years of age.

WHAT CAN I DO TO **REDUCE MY RISK OF BREAST CANCER?**

Many factors can influence your breast cancer risk, and most women who develop breast cancer do not have any known risk factors or a history of the disease in their families. However, you can help lower your risk of breast cancer in the following ways—

- Keep a healthy weight.
- Exercise regularly (at least four hours a week).
- Don't drink alcohol, or limit alcoholic drinks to no more than one per day.
- Avoid exposure to chemicals that can cause cancer (carcinogens).
- Try to reduce your exposure to radiation during medical tests like mammograms, X-rays, CT scans, and PET scans.
- If you are taking, or have been told to take, hormone replacement therapy or oral contraceptives (birth control pills), ask your doctor about the risks and find out if it is right for you.
- Breastfeed your babies, if possible.

More Information

www.cdc.gov/BringYourBrave | Facebook: CDCBreastCancer Twitter: @CDC_Cancer
(800) CDC-INFO (800-232-4636) | TTY: (888) 232-6348

U.S. Department of Health and Human Servic
Centers for Disease Control and Prevention

Explore

Name: _____ Date: _____

Genetics vs. Environment

Directions

Breast cancer is one of the most common cancers among women. The exact cause of breast cancer is unknown, and very few women will know the reason why they got it. We do know that breast cancer is always caused by damage to DNA. When the cell's DNA is damaged, mutated cells begin to grow uncontrollably. These abnormal cells can progress into a disease such as breast cancer. Women with certain risk factors are more likely to get breast cancer than others. Some risk factors caused by the environment can be avoided, while others, such as family history, cannot. Below are three different women's stories and their history in relation to breast cancer. Read each scenario and familiarize yourself with each one. For additional background, you can refer to the following website: http://www.nationalbreastcancer.org.

Scenario One:
Jennifer is a 40-year-old Caucasian woman who has a history of breast cancer in her family. Her grandmother and mom both had breast cancer. This prompted Jennifer to have genetic testing done to see if she was a carrier for a gene mutation. She tested positive for a gene mutation on genes BRCA1 and BRCA2. Jennifer is a healthy young lady who doesn't smoke, eats a healthy diet, exercises, and doesn't take any hormone replacement therapy.

Scenario Two:
Tiffany is a 50-year-old Asian woman who has no family history of breast cancer. She is currently taking estrogen replacement therapy to help with her menopause symptoms. She doesn't exercise and eats poorly. She is also extremely overweight.

Scenario Three:
Susie is a 58-year-old African American woman who is a carrier for the gene mutation on genes BRCA1 and BRCA2. Her grandmother died of breast cancer at age 55. Susie started her menstrual cycle at age 11. She is a smoker and has a sedentary lifestyle. She is overweight, and the doctor tells her she needs to lose at least 50 pounds.

After reading the three scenarios above, state a claim for the prompt below, using evidence and reasoning to support it.

Explore

Prompt
If each of the women were to have a daughter, which daughter would be in a higher risk category for developing breast cancer later in life? Be sure to include statistics, facts, and evidence from research to support your claim.

Claim:

Evidence:
Make sure to include empirical evidence to support your answer.

Reasoning:

Explore

Genetics vs. Environment

Rubric for Writing a Scientific Explanation

Points Awarded	2	1	0
Claim	Answers the question and is accurate based on data.	Answers the question but is inaccurate based on data.	No claim, or does not answer the question.
Evidence	Cites data and patterns within the data and uses labels accurately.	Cites data from the data source, but not within the context of the prompt.	No evidence, or cites changes, but does not use data from the data source.
Reasoning	Cites the scientifically accurate reason, using correct vocabulary, and connects this to the claim. Shows accurate understanding of the concept.	Cites a reason, but it is inaccurate or does not support the claim. Reasoning does not use scientific terminology or uses it inaccurately.	No reasoning, or restates the claim but offers no reasoning.

Identifying DNA as genetic material

Introduction

Your DNA, or deoxyribonucleic acid, contains the genes that determine who you are. How can this organic molecule control your characteristics? DNA contains instructions for all the proteins your body makes. Proteins, in turn, determine the structure and function of all your cells. What determines a protein's structure? It begins with the sequence of amino acids that make up the protein. Instructions for making proteins with the correct sequence of amino acids are encoded in DNA.

The vocabulary of DNA: chromosomes, chromatids, chromatin, transcription, translation, and replication is discussed at http://www.youtube.com/watch?v=s9HPNwXd9fk (18:23).

Central Dogma of Molecular Biology

DNA is found in chromosomes. In eukaryotic cells, chromosomes always remain in the nucleus, but proteins are made at ribosomes in the cytoplasm. How do the instructions in DNA get to the site of protein synthesis outside the nucleus? Another type of nucleic acid is responsible. This nucleic acid is RNA, or ribonucleic acid. RNA is a small molecule that can squeeze through pores in the nuclear membrane. It carries the information from DNA in the nucleus to a ribosome in the cytoplasm and then helps assemble the protein. In short:

DNA → RNA → Protein

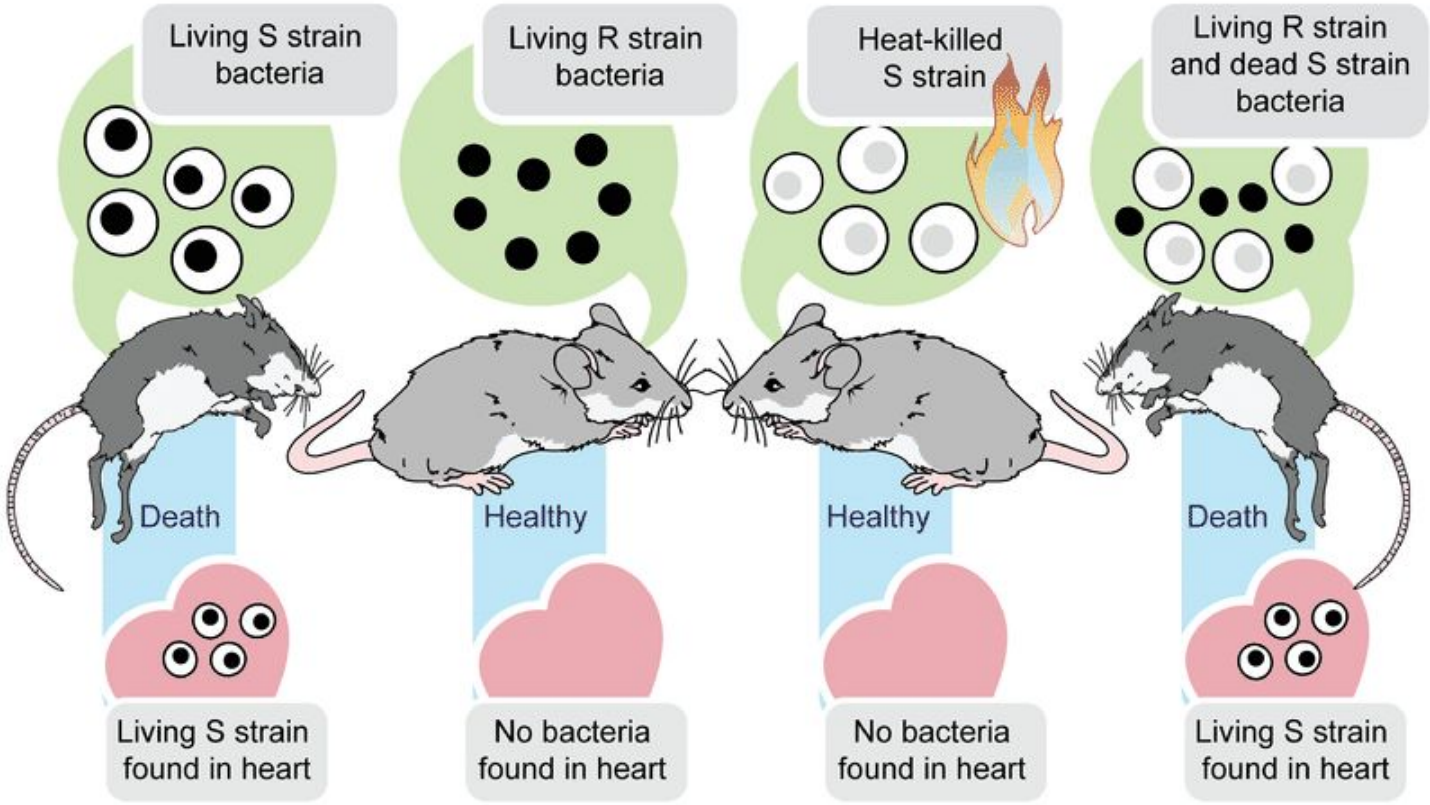
Discovering this sequence of events was a major milestone in molecular biology. It is called the **central dogma of molecular biology**. You can watch a video about the central dogma and other concepts in this lesson at this link: http://www.youtube.com/watch?v=ZjRCmU0_dhY (8:07). An overview of protein synthesis can be viewed at http://www.youtube.com/watch?v=-ygpqVr7_xs (10:46).

DNA

DNA is the genetic material in your cells. It was passed on to you from your parents and determines your characteristics. The discovery that DNA is the genetic material was another important milestone in molecular biology.

Griffith Searches for the Genetic Material

Many scientists contributed to the identification of DNA as the genetic material. In the 1920s, Frederick Griffith made an important discovery. He was studying two different strains of a bacterium, called R (rough) strain and S (smooth) strain. He injected the two strains into mice. The S strain killed (virulent) the mice, but the R strain did not (nonvirulent) (see **Figure** below). Griffith also injected mice with S-strain bacteria that had been killed by heat. As expected, the killed bacteria did not harm the mice. However, when the dead S-strain bacteria were mixed with live R-strain bacteria and injected, the mice died.



Griffith's Experimental Results. Griffith showed that a substance could be transferred to harmless bacteria and make them deadly.

Based on his observations, Griffith deduced that something in the killed S-strain was transferred to the previously harmless R-strain, making the R-strain deadly. What was that something? What type of substance could change the characteristics of the organism that received it?

Avery's Team Makes a Major Contribution

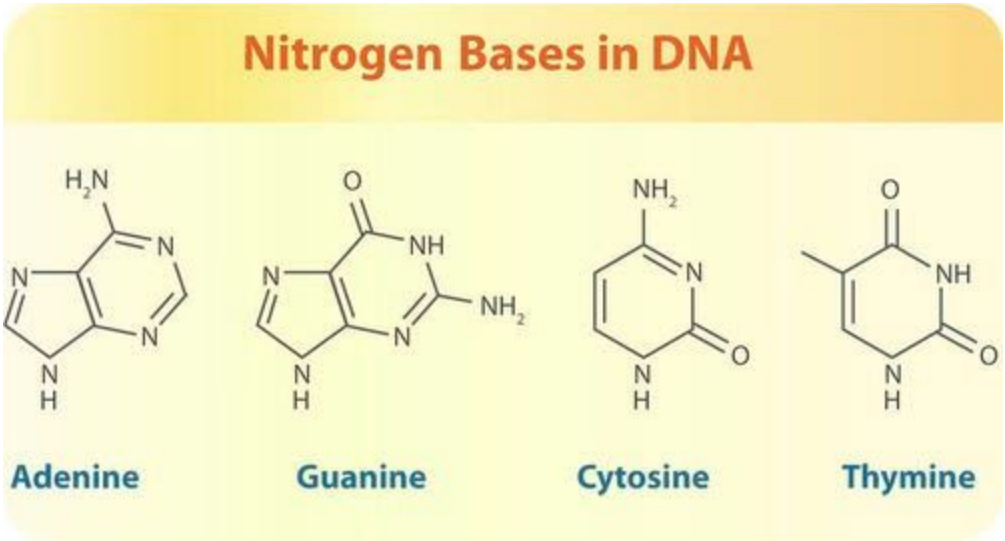
In the early 1940s, a team of scientists led by Oswald Avery tried to answer the question raised by Griffith's results. They inactivated various substances in the S-strain bacteria. They then killed the S-strain bacteria and mixed the remains with live R-strain bacteria. (Keep in mind, the R-strain bacteria usually did not harm the mice.) When they inactivated proteins, the R-strain was deadly to the injected mice. This ruled out proteins as the genetic material. Why? Even without the S-strain proteins, the R-strain was changed, or transformed, into the deadly strain. However, when the researchers inactivated DNA in the S-strain, the R-strain remained harmless. This led to the conclusion that DNA is the substance that controls the characteristics of organisms. In other words, DNA is the genetic material. You can watch an animation about the research of both Griffith and Avery at this link: http://www.dnalc.org/view/16375-Animation-17-A-gene-is-made-of-DNA-.html.

Hershey and Chase Seal the Deal

The conclusion that DNA is the genetic material was not widely accepted at first. It had to be confirmed by other research. In the 1950s, Alfred Hershey and Martha Chase did experiments with viruses and bacteria. Viruses are not cells. They are basically DNA inside a protein coat. To reproduce, a virus must insert its own genetic material into a cell (such as a bacterium). Then it uses the cell's machinery to make more viruses. The researchers used different radioactive elements to label the DNA and proteins in viruses. This allowed them to identify which molecule the viruses inserted into bacteria. DNA was the molecule they identified. This confirmed that DNA is the genetic material.

Chargaff Writes the Rules

Other important discoveries about DNA were made in the mid-1900s by Erwin Chargaff. He studied DNA from many different species. He was especially interested in the four different nitrogen bases of DNA: adenine (A), guanine (G), cytosine (C), and thymine (T) (see **Figure** below). Chargaff found that concentrations of the four bases differed from one species to another. However, within each species, the concentration of adenine was always about the same as the concentration of thymine. The same was true of the concentrations of guanine and cytosine. These observations came to be known as **Chargaff's rules**. The significance of the rules would not be revealed until the structure of DNA was discovered.



Nitrogen Bases in DNA. The DNA of all species has the same four nitrogen bases.

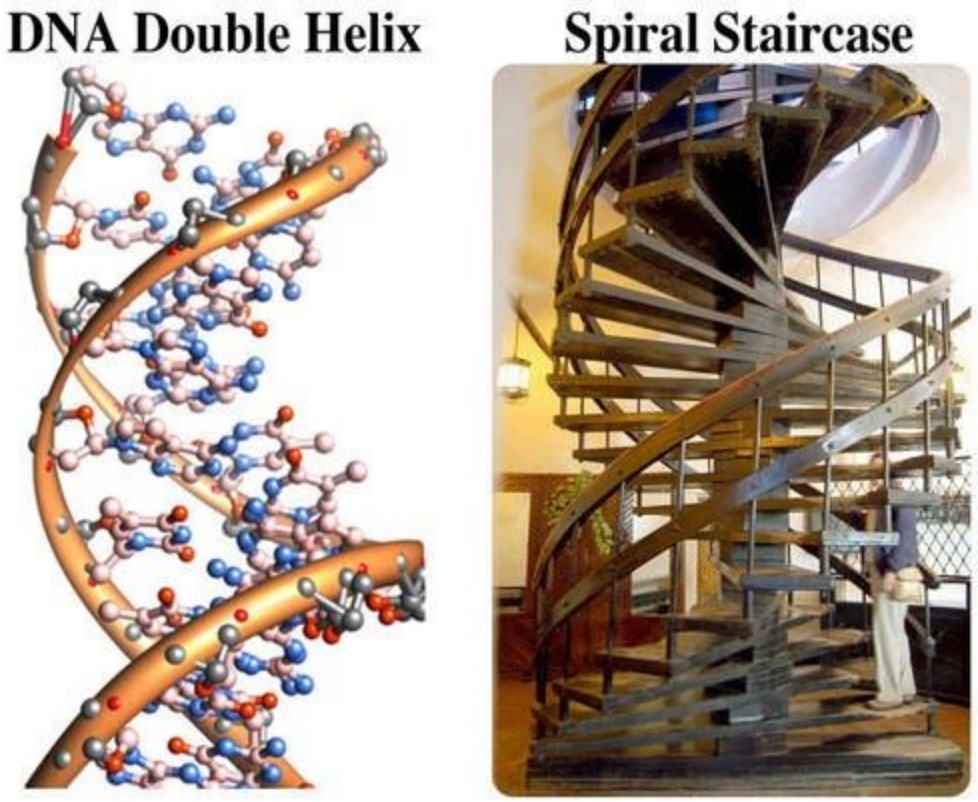
1. State the central dogma of molecular biology.

2. Outline research that determined that DNA is the genetic material.

3. What are Chargaff's rules?

The Double Helix

After DNA was found to be the genetic material, scientists wanted to learn more about it. James Watson and Francis Crick are usually given credit for discovering that DNA has a double helix shape, like a spiral staircase (see **Figure** below). The discovery was based on the prior work of Rosalind Franklin and other scientists, who had used X rays to learn more about DNA's structure. Franklin and these other scientists have not always been given credit for their contributions. You can learn more about Franklin's work by watching the video at this link: http://www.youtube.com/watch?v=s3whouvZYG8 (7:47).



The DNA molecule has a double helix shape. This is the same basic shape as a spiral staircase. Do you see the resemblance? Which parts of the DNA molecule are like the steps of the spiral staircase?

The double helix shape of DNA, together with Chargaff's rules, led to a better understanding of DNA. DNA, as a nucleic acid, is made from nucleotide monomers, and the DNA double helix consists of two

polynucleotide chains. Each nucleotide consists of a sugar (deoxyribose), a phosphate group, and a nitrogen-containing base (A, C, G, or T). The sugar-phosphate backbone of the double helix was discussed in the *Chemistry of Life* chapter.

Scientists concluded that bonds (hydrogen bonds) between complementary bases hold together the two polynucleotide chains of DNA. Adenine always bonds with its complementary base, thymine. Cytosine always bonds with its complementary base, guanine. If you look at the nitrogen bases in **Figure** above, you will see why. Adenine and guanine have a two-ring structure. Cytosine and thymine have just one ring. If adenine were to bind with guanine and cytosine with thymine, the distance between the two DNA chains would be variable. However, when a one-ring molecule binds with a two-ring molecule, the distance between the two chains is kept constant. This maintains the uniform shape of the DNA double helix. These *base pairs* (A-T or G-C) stick into the middle of the double helix, forming, in essence, the steps of the spiral staircase.

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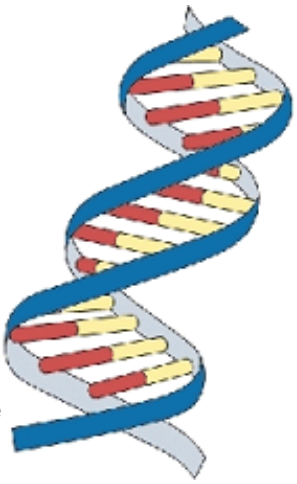
1. Identify the structure of the DNA molecule.

2. Explain why complementary base pairing is necessary to maintain the double helix shape of the DNA molecule.

DNA - The Double Helix



Recall that the nucleus is a small spherical, dense body in a cell. It is often called the "control center" because it controls all the activities of the cell including cell reproduction, and heredity. How does it do this? The nucleus controls these activities by the chromosomes. Chromosomes are microscopic, threadlike strands composed of the chemical DNA (short for **deoxyribonucleic acid**. In simple terms, DNA controls the production of proteins within the cell. These proteins in turn, form the structural units of cells and control all chemical processes within the cell.

Chromosomes are composed of genes. A **gene** is a segment of DNA that codes for a particular protein, which in turn codes for a trait. Hence you hear it commonly referred to as the gene for baldness or the gene for blue eyes. Meanwhile, DNA is the chemical that genes and chromosomes are made of. It stands for deoxyribonucleic acid. DNA is called a nucleic acid because it was first found in the nucleus. We now know that DNA is also found in organelles, the mitochondria and chloroplasts, though it is the DNA in the nucleus that actually controls the cell's workings.

In 1953, James Watson and Francis Crick established the structure of DNA. The structure is a double helix, which is like a twisted ladder. The sides of the ladder are made of alternating sugar and phosphate molecules. The sugar is deoxyribose. Color all the **phosphates** pink (one is labeled with a "p"). Color all the **deoxyriboses** blue (one is labeled with a "D").

The rungs of the ladder are pairs of 4 types of **nitrogen bases**. Two of the bases are **purines** - adenine and guanine. The **pyrimidines** are thymine and cytosine. The bases are known by their coded letters A, G, T, C. These bases always bond in a certain way. Adenine will only bond to thymine. Guanine will only bond with cytosine. This is known as the **Base-Pair Rule**. The bases can occur in any order along a strand of DNA. The order of these bases is the code the contains the instructions. For instance ATGCACATA would code for a different gene than AATTACGGA. A strand of DNA contains millions of bases. (For simplicity, the image only contains a few.) Note that the bases attach to the sides of the ladder at the sugars and not the phosphate.

Color the thymines orange.  Color the adenines green. 

Color the guanines purple.  Color the cytosines yellow. 

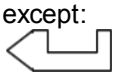
The combination of a single base, a deoxyribose sugar, and a phosphate make up a **nucleotide**. DNA is actually a molecule or repeating nucleotides. Examine the nucleotides closer. Two of the bases are purines - adenine and guanine. The pyrimidines are thymine and cytosine. Note that the pyrimidines are single ringed and the purines are double ringed. Color the nucleotides using the same colors as you colored them in the double helix.

The two sides of the DNA ladder are held together loosely by **hydrogen bonds**. **Color the hydrogen bonds gray**.

Messenger RNA

So, now, we know the nucleus controls the cell's activities through the chemical DNA, but how? It is the sequence of bases that determine which protein is to be made. The sequence is like a code that we can now interpret. The sequence determines which proteins are made and the proteins determine which activities will be performed. And that is how the nucleus is the control center of the cell. The only problem is that the DNA is too big to go through the nuclear pores. So a chemical is used to to read the DNA in the nucleus. That chemical is **messenger RNA**. The messenger RNA (mRNA) is small enough to go through the nuclear pores. It takes the "message" of the DNA to the ribosomes and "tells them" what proteins are to be made. Recall that proteins are the body's building blocks. Imagine that the code taken to the ribosomes is telling the ribosome what is needed - like a recipe.

Messenger RNA is similar to DNA, except that it is a single strand, and it has no thymine. Instead of thymine, mRNA contains the base **Uracil**. In addition to that difference, mRNA has the sugar ribose instead of deoxyribose. RNA stands for **Ribonucleic Acid**. Color the mRNA as you did the DNA, except:

Color the ribose a DARKER BLUE, and the uracil brown. 

Name: _____Date:_____

The Blueprint of Life

Every cell in your body has the same "blueprint" or the same DNA. Like the blueprints of a house tell the builders how to construct a house, the DNA "blueprint" tells the cell how to build the organism. Yet, how can a heart be so different from a brain if all the cells contain the same instructions? Although much work remains in genetics, it has become apparent that a cell has the ability to turn off most genes and only work with the genes necessary to do a job. We also know that a lot of DNA apparently is nonsense and codes for nothing. These regions of DNA that do not code for proteins are called "introns", or sometimes "junk DNA". The sections of DNA that do actually code from proteins are called "exons".

DNA Replication

Each time a new cell is made, the cell must receive an exact copy of the parent cell DNA. The new cells then receive the instructions and information needed to function. The process of copying DNA is called replication. Replication occurs in a unique way – instead of copying a complete new strand of DNA, the process “saves” or conserves one of the original strand. For this reason, replication is called semi-conservative. When the DNA is ready to copy, the molecule “unzips” itself and new nucleotides are added to each side.

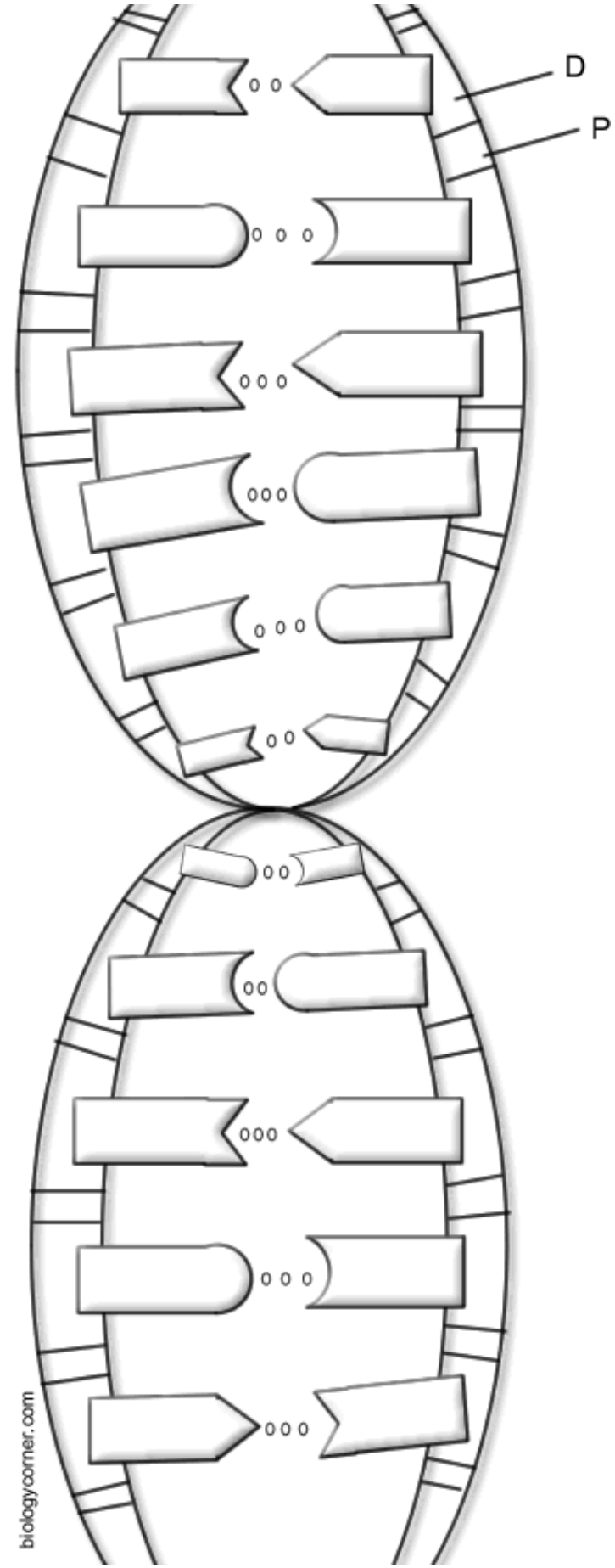
The image showing replication is similar to the DNA and mRNA coloring. Note the nucleotides are shown as their 3 parts – sugar (blue), phosphate (pink) and one of the four bases (color codes are above). Color the replication model on the second page. Notice that several **nucleotides** are floating around, they are waiting to pair up with their match.

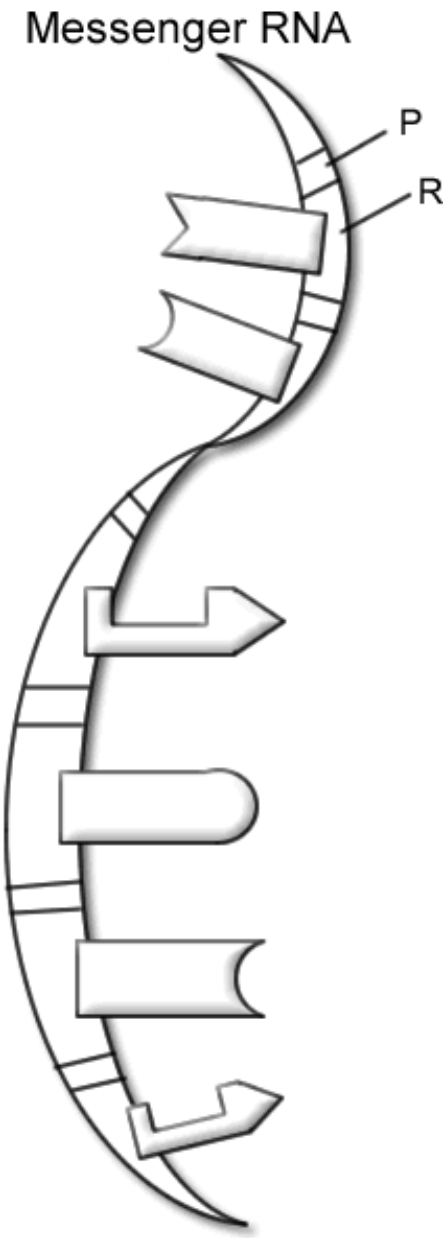
The boxed section shows two new strands of DNA. Color the old strand (including its base) red and the new strand (including its base) green.

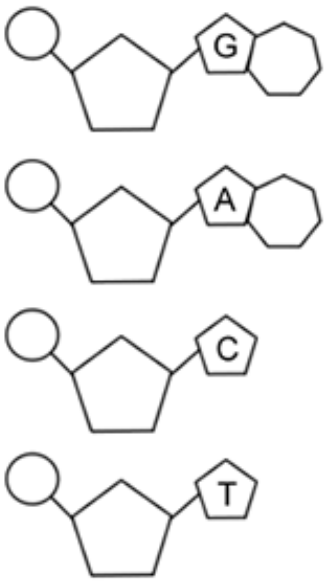
Questions:

1. Why is the nucleus called the "control center" of the cell?_____
2. What is a gene? _____
3. Where in the cell are chromosomes located? _____
4. DNA can be found in what **organelles**? _____
5. What two scientists established the structure of DNA? _____
6. Replication is called “semi-conservative” because half of the original strand is _____
7. What are the sides of the DNA ladder made of? _____
8. What three parts make up a single nucleotide: _____
9. What are the 4 bases that make up the rungs of the DNA ladder? _____
10. What sugar is found in DNA? _____ In RNA? _____
11. How do the bases bond together? A bonds with _____ G bonds with _____
12. Why is RNA necessary to act as a messenger? _____
13. Proteins are made where in the cell? _____
14. How is RNA different from DNA? (list 3 things) _____
15. The process of copying DNA is called _____
16. What is the shape of DNA? _____
17. How do some cells become brain cells and others become skin cells, when the DNA in ALL the cells is exactly the same. In other words, if the instructions are exactly the same, how does one cell become a brain cell and another a skin cell? _____
18. Why is DNA called the "Blueprint of Life"? _____

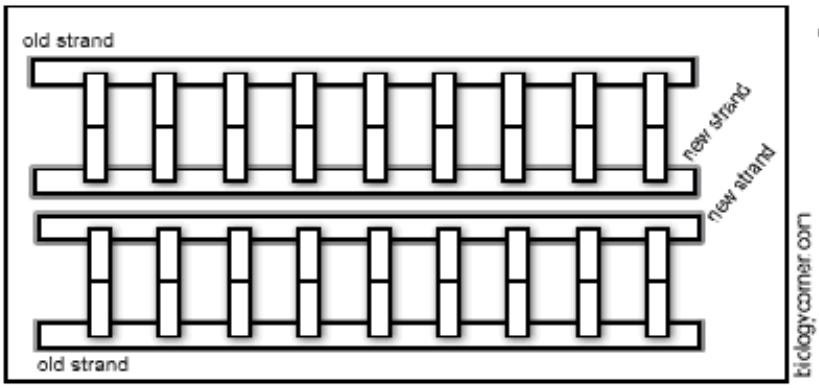
DNA - The Double Helix







DNA REPLICATION



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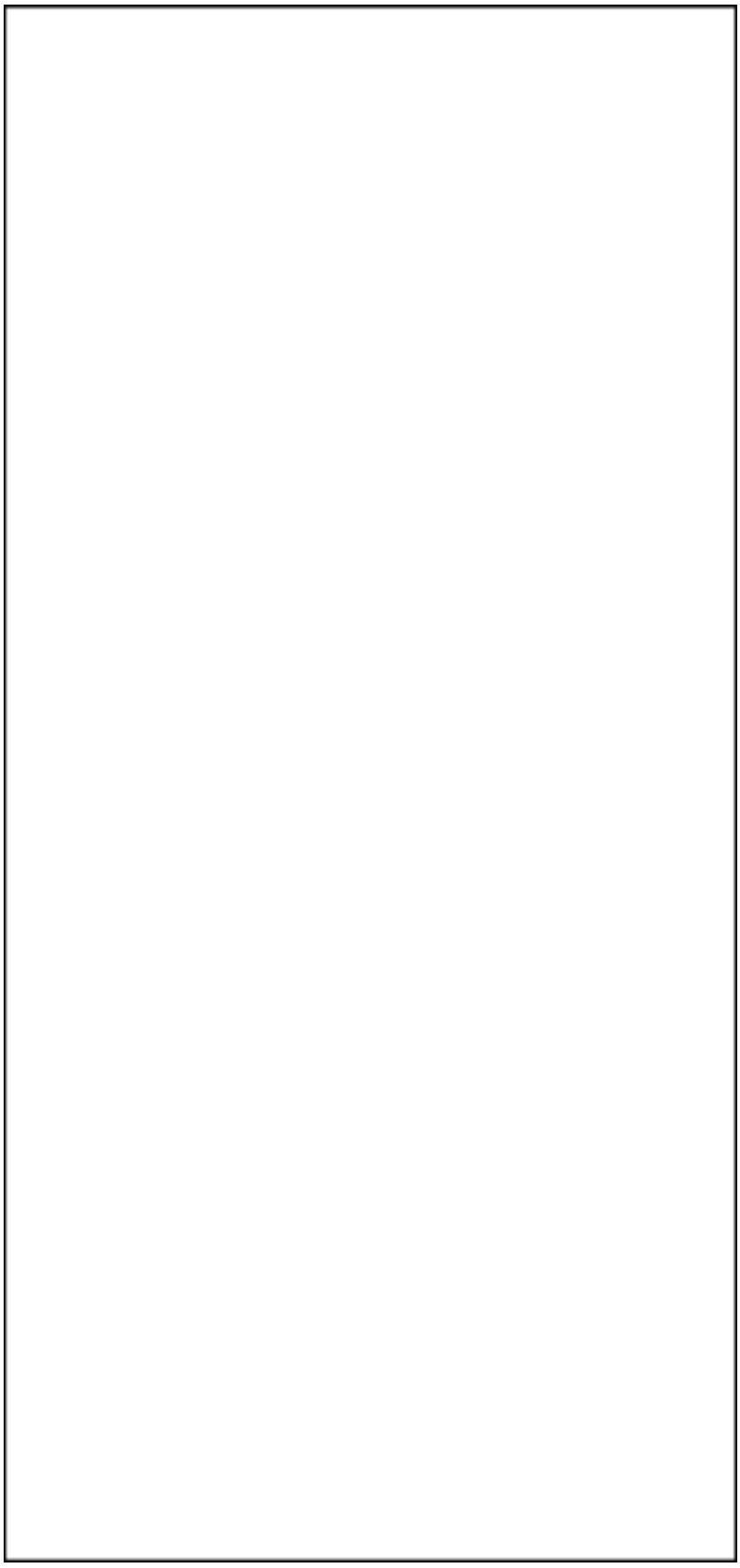
Lesson 9: Activity: Construct a DNA Model



Instructions

1. Cut out each of the nucleotides (used the dash lines as a guide) and arrange them on the grid. Remember the **Base-Pair Rule**. (You will have one set left over). Separate paper may also be used.

2. In order to match the pairs, one of the nucleotides must be arranged upside down. This is intended. The sides of the DNA double helix are arranged in an **antiparallel** fashion. Think of them like lanes on a highway going different directions.

3. Color each of the nucleotides

Thymine = orange | Adenine = green
Guanine = purple | Cytosine = yellow
Deoxyribose = blue
Phosphate = pink

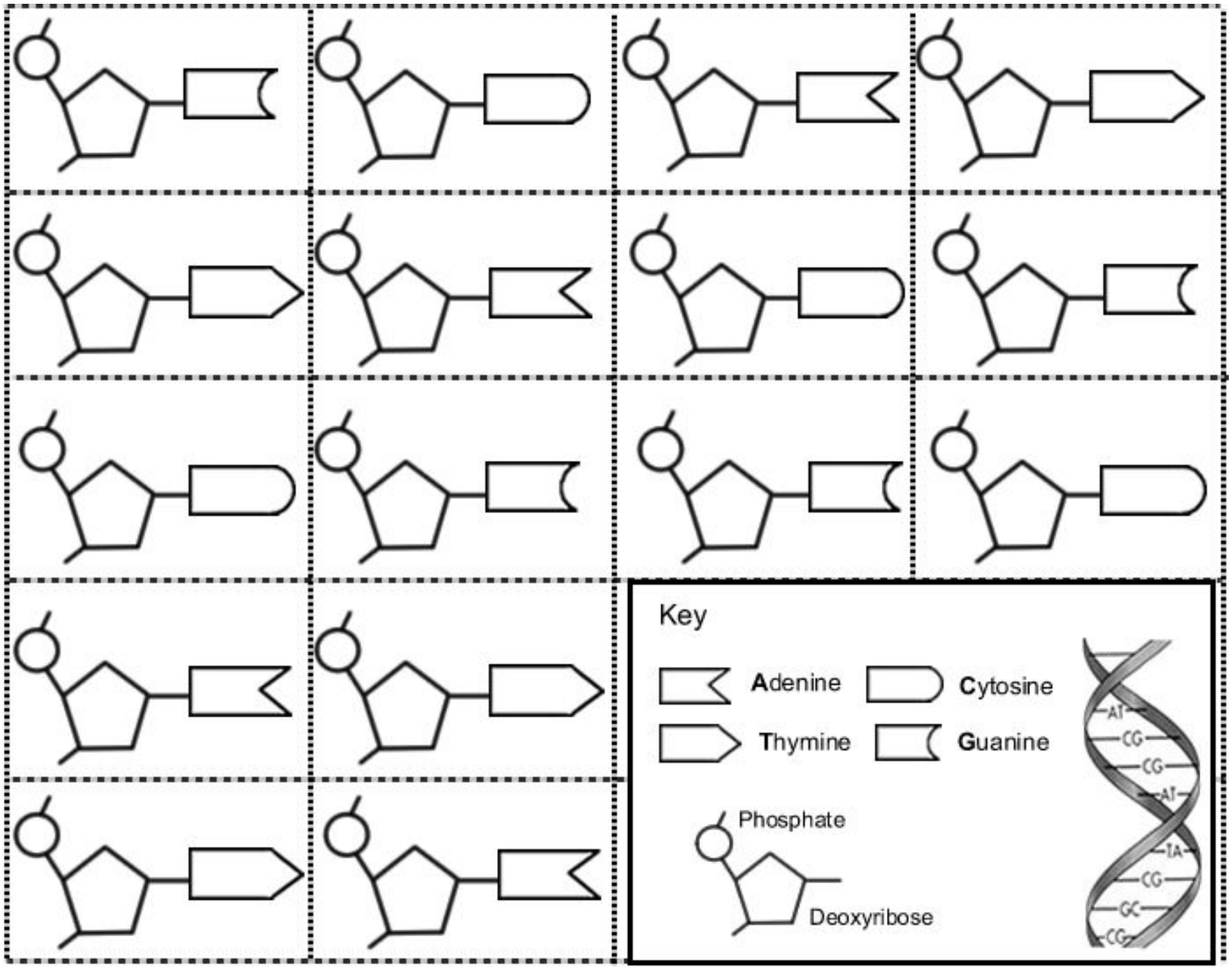
***if you don't have these exact colors, choose other colors and color over the names. If you only have a pencil or pen, then shade things in a particular pattern (i.e. thymine = stripes, adenine = dots, etc)**

Questions:

1. Describe the base-pair rule, which bases go together according to your model? (Adenine pairs with..)

2. What three things make up a nucleotide?

3. What does anti-parallel mean?



Lesson 10: 2 Week Assessment of Learning - One Pager

In this activity, you will be creating a one-pager to show all that you've learned about genetics, how we get our traits, and why it's possible that the two twins (at the beginning of the learning) can have the same parents but look so different. A few examples of one-pagers on a different topic can be found at the bottom (note, one doesn't have a border - yours should)

Examples of what your one-pager can be titled include
"How traits are inherited" or "Why the twins look so different" or "What I learned about genetics"

Your one pager should include

- ❑ A relevant border around the page (something related to the topic)
- ❑ At least 5 Illustrations or representations (of vocabulary or concepts learned, maybe from some of the vocabulary below!)
- ❑ Vocabulary words must appear somewhere on the page - it can be in drawings or it can be in your answers to the questions.
  - ❑ Alleles
  - ❑ Traits
  - ❑ chromosomes
  - ❑ Genes
  - ❑ Dominant
  - ❑ Recessive
  - ❑ Heterozygous
  - ❑ Homozygous
  - ❑ probability/chance
  - ❑ DNA
- ❑ An answer to the questions in 1 - 2 sentences somewhere on the page:
  - ❑ Why do the twins look different
  - ❑ How do we get our traits
  - ❑ Are our traits determined by the environment, our genetics, or both?
- ❑ One thing you learned about *your own traits* during these 2 weeks.
- ❑ 2 questions you still have about this topic.
- ❑ This SHOULD BE colored or shaded. Be artsy :)

This can be created on the back of this sheet or on another piece of paper.