EPIGENETICS – IS IT ONLY ABOUT THE DNA?

As an organism grows and develops, carefully orchestrated chemical reactions activate and deactivate parts of the genome at strategic times and in specific locations. Epigenetics is the study of these chemical reactions and the factors that influence them.

Go to: http://learn.genetics.utah.edu/content/epigenetics/ The following questions begin with the title of the section of the module you will be working with. Answer the following questions as you work through the module.

THE EPIGENOME AT A GLANCE

1. What is the epigenome?

2. How is this different from your genome?

GENE CONTROL

1. Describe the following characteristics when a gene is **active**:

    a. Is the gene tightly or loosely wound around histones?

    b. Are there many or few methyl molecules attached to the gene?

    c. Are there many or few acetyl molecules attached to the genes associated histones?

    d. Are there many or few mRNA transcripts?

2. Describe the following characteristics when a gene is **inactive**:

    a. Is the gene tightly or loosely wound around histones?

    b. Are there many or few methyl molecules attached to the gene?

    c. Are there many or few acetyl molecules attached to the genes associated histones?

    d. Are there many or few mRNA transcripts?

3. How does epigenetics apply to cancer cells?

4. How could this information be used in cancer treatments?

THE EPIGENOME LEARNS FROM ITS EXPERIENCES

1. True or False. Cell signals play a role in shaping gene expression only during development.

2. What molecule is primarily responsible for carrying cell signals to DNA?

3. What are the two functions of gene regulatory proteins?

4. Are epigenetic tags passed to daughter cells?

EPIGENETICS & INHERITANCE

1. What can be passed on to offspring besides just the DNA code?

2. How does “reprogramming” work?

3. How does this apply to epigenetics?

4. Describe two examples of epigenetic inheritance. Include one human and one non-human example.

5. How can epigenetics affect evolution?

INSIGHTS FROM IDENTICAL TWINS

1. Often, the physical characteristics of genetically identical twins become increasingly different as they age, even at the molecular level. Explain why this is so. (use the terms "environment" and "epigenome")

2. Name 3-4 environmental factors that influence the epigenome.

3. What is an imprinted gene?

4. With the environment affecting the epigenome so much, how do scientists' study how the environment and genes interact?

LICK YOUR RATS

1. Explain how a high-nurturing mother rat shapes her pup's epigenome, and what that pup's response to stress will be.

2. In rats, does licking by the mother activate, or deactivate her pup's GR gene?

3. Explain how cortisol and the GR protein work together in the brain to relax a rat pup. You may draw a diagram.

4. The rat nurturing example shows us how parental behavior can shape the behavior of their offspring on a biochemical level. Relate this to humans and think about the personal and social implications. Record your thoughts.
5.

NUTRITION & THE EPIGENOME

1. Explain how the food we eat affects gene expression.

2. How can the diets of parents (include BOTH parents!) affect their offspring's epigenome?

3. How can the diets of parents affect their grandchild's' (F2 generation) epigenome?

4. How does the field of epigenetics reopen the nature vs nurture debate as it relates to IQ and intelligence?

5. How does the field of epigenetics inform the disparity between health food and fast food stores in affluent and poverty-stricken neighborhoods?

EPIGENETICS & THE HUMAN BRAIN

1. Describe at least 2 connections between epigenetics and human behaviour.

2. Are there any social implications we need to be aware of as we learn more and more about what affects human behaviour? If so, what kinds?

Complete the following Venn Diagram comparing methylation to acetylation. Make sure you include at least 5 points in each column.

	Methylation	**Both**	**Acetylation**
1.			
2.			
3.			
4.			
5.			

Additional Resources:

- https://www.dnalc.org/view/17012--Histone-Methylation.html
- https://depts.washington.edu/ceeh/downloads/FF_Epigenetics.pdf
- http://www.atdbio.com/content/56/Epigenetics