**Sc 10 Biotech Project: Research Template**

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| **Source #1** |  | | |  |  | |
| Title of source: Learn Genetics | Author: | | Date of publication: | | Date accessed (by you): April 30, 2020 | |
| URL: <https://learn.genetics.utah.edu/content/epigenetics/> |  |  | | |  | |
| Copy and paste relevant information directly from source:  **Other tabs too/Include Video**  Epigenetic tags record the cell's experiences on the DNA, helping to stabilize gene expression. Each signal shuts down some genes and activates others as it nudges a cell toward its final fate. Different experiences cause the epigenetic profiles of each cell type to grow increasingly different over time.  Even in differentiated cells, signals fine-tune cell functions through changes in gene expression. A flexible epigenome allows us to adjust to changes in the world around us, and to learn from our experiences.  The epigenome changes in response to signals. Signals come from inside the cell, from neighboring cells, or from the outside world (environment).  **Early in development**, most signals come from within cells or from neighboring cells. Mom's nutrition is also important at this stage. The food she brings into her body forms the building blocks for shaping the growing fetus and its developing epigenome. Other types of signals, such as stress hormones, can also travel from mom to fetus.  **After Birth,** Social interactions, physical activity, diet and other inputs generate signals that travel from cell to cell throughout the body. As in early development, signals from within the body continue to be important for many processes, including physical growth and learning. Hormonal signals trigger big changes at puberty.  **Old age**, cells continue to listen for signals. Environmental signals trigger changes in the epigenome, allowing cells to respond dynamically to the outside world. Internal signals direct activities that are necessary for body maintenance, such as replenishing blood cells and skin, and repairing damaged tissues and organs  Once a signal reaches a cell, proteins carry information inside. Like runners in a relay race, proteins pass information to one another.  The information is ultimately passed to a gene regulatory protein that attaches to a specific sequence of letters on the DNA. |  | **Make “raw” notes in your own words (this is not a summary):**  The study of the chemical reactions and the factors that influence them  Epigenome Video:   * DNA raps around proteins call histone   + Both are covered with chemical tags * The Epigenome shapes the physical structure of the genome * Inactive genes are tightly coiled (hard to read), whereas active genes are relaxed (easily accessible) * Different sets of genes are active in different cell types, in different places in the body * Unlike the DNA code the Epigenome is flexible * The Epigenomes chemical tag react to factors in the outside world   + Diet   + Stress   Adjust specific genes in our “genomic landscape” in response to our interaction with the outside world/changing environment  “Epigenetic tags record the cells experiences on DNA”  Each signal can shut down or activate others as it proceeds to its final form.  Different experiences cause the profile of the epigenetic cells to grow different over time.  Signals from the outside world, inside or outside the cell can alter the cells function through gene expression.  Nutrition from the mother is important in the early development stage. Food is the building blocks for shaping the fetus and development of the epigenome. Stress hormones are also factoring to the development.  Social interaction, physical activity, diet and other interaction between the human and the environment.  “Hormonal signs trigger big changes at puberty.”  At old age, your cells continue to listen for signals Internally, signals direct actions that are essential for body maintenance. Replenishing blood cells, skin, damaged tissue, and organs. | | | |  |

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| **Source #2** |  |  | | |  | |
| Title of source: Live Science | Author:  Epigenetics Definitions and Examples | | Date of publication: June 24, 2013 | Date accessed (by you): April 30, 2020 | | |
| URL: <https://www.livescience.com/37703-epigenetics.html> |  |  | | |  | |
| Copy and paste relevant information directly from source:  Epigenetic changes alter the physical [structure of DNA](https://www.livescience.com/37247-dna.html). One example of an epigenetic change is DNA methylation — the addition of a methyl group, or a "chemical cap," to part of the DNA molecule, which prevents certain genes from being expressed.  Another example is histone modification. Histones are proteins that DNA wraps around. (Without histones, DNA would be too long to fit inside cells.) If histones squeeze DNA tightly, the DNA cannot be "read" by the cell. Modifications that relax the histones can make the DNA accessible to proteins that "read" genes.  Epigenetics is the reason why a skin cell looks different from a brain cell or a muscle cell. All three cells contain the same DNA, but their genes are expressed differently (turned "on" or "off"), which creates the different cell types.  **Epigenetic inheritance**  It may be possible to pass down [epigenetic changes](https://www.livescience.com/34937-epigenetic-changes-linked-obesity-100915.html) to future generations if the changes occur in sperm or egg cells. Most epigenetic changes that occur in sperm and egg cells get erased when the two combine to form a fertilized egg, in [a process called "reprogramming."](http://learn.genetics.utah.edu/content/epigenetics/inheritance) . If this is true, things like the food a person eats before they conceive could affect their future child. However, this has not been proven in people.  **Epigenetics and cancer**  Scientists now think [epigenetics can play a role in the development of some cancers](http://www.pbs.org/wgbh/nova/body/epigenetic-therapy.html). For instance, an epigenetic change that silences a tumor suppressor gene — such as a gene that keeps the growth of the cell in check — could lead to uncontrolled cellular growth. Another example might be an epigenetic change that "turns off" genes that help repair damaged DNA, leading to an increase in DNA damage, which in turn, increases cancer risk. |  | **Make “raw” notes in your own words (this is not a summary):**    Change to the physical of DNA  DNA methylation – additional group (is a chemical cap) prevents certain genes to be expressed  Histone modification – proteins that DNA wraps around (without DNA is too long to fit inside of cells) Histones make DNA coil tightly or relax in order for DNA to be read or not read.  “Epigenetics is the reason why a skin cell looks different from a brain cell or a muscle cell”   * They have the same DNA but are expressed differently (on/off)   **Has not been proven**  It may be possible to pass down epigenetic traits  Epigenetic change from an egg and sperm get erased when the form a fertilized egg.  Things like how e person eat will affect their future unborn child.  Epigenetics could play a role in the development of cancer  “epigenetic change that silences a tumor suppressor gene — such as a gene that keeps the growth of the cell in check — could lead to uncontrolled cellular growth.”  “epigenetic change that "turns off" genes that help repair damaged DNA, leading to an increase in DNA damage, which in turn, increases cancer risk.” | | | |  |

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| **Source #3** |  | |  |  | |
| Title of source:   Epigenetic Therapy | Author:  Jean-Pierre Issa | | Date of publication:  October 15, 2007 | Date accessed (by you):  May 1st 2020 | |
| URL:  <https://www.pbs.org/wgbh/nova/article/epigenetic-therapy/> |  | |  |  | |
| Copy and paste relevant information directly from source:  For decades, scientists and doctors assumed that cancer was caused by damage to some critical stretch of DNA within one's genome. But recently, a more complex picture has emerged, one that shows that some cancers are caused by epigenetic changes—tiny chemical tags that accumulate over time and can turn genes on or off.  It turns out that there are two kinds of modifications that can affect DNA. One is a biochemical modification that attaches straight to DNA itself, the most understood of which right now is DNA methylation. The other key event is the fact that DNA is wrapped around a series of proteins called histones. If these proteins hug the DNA very tightly, then it is hidden from view for the cell. A gene that is hidden cannot be utilized. It is the same as having a dead gene or a mutated gene. These are the kinds of things that can regulate gene expression and also become abnormal in cancer.  Up until recently the idea was that cancer is a disease of genetic changes. The genes themselves, their structures, become abnormal. Over the past few years we have come to realize that there might be more than one way to skin the cat—that there might be changes other than genetic changes that would account for the bizarre behavior of cancer cells. And these relate to epigenetics.  If one has a genetic basis in mind, then one is simply asking, "What causes genetic damage?" Cigarette smoking causes genetic damage. Certain types of environmental exposures and radiation cause genetic damage, and that's how they cause cancer.  tissue damage, inflammation, and the need for stem cells to repair that injury. Every time a stem cell has to repair injury, it is aging a little more. So a person who has been exposed to a lot of things that injure tissues is a person who is older than a person who has never been exposed to things that injure tissues. |  | **Make “raw” notes in your own words (this is not a summary):**   Because epigenetic is the study of how the DNA turn on and off genes, cells are able to retract or expose certain genes in order to repair the cell.  DNA methylation is a modification that attaches directly to the DNA  Histones are proteins that DNA wraps around tightly or loosely depending on what traits need to be turned on or off. If it is very tightly wrapped, that gene will be hidden not able to be utilized. It acts the same as a dead or mutated gene. ‘These are the kinds of things that can regulate gene expression and also become abnormal in cancer.”  Genetic damage is based on external choices made like smoking and radiation exposures, but Epigenetic damage is caused internally by how the cell chooses to turn on and off specific genes.  Individuals who are aging are more susceptible to getting epigenetic cancer because every time a stem cell repairs an injury it becomes weaker/older. | | |  |

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| **Source #4** |  | |  |  | |
| Title of source: Cancer Quest | Author: | | Date of publication: | Date accessed (by you): April 2nd, 2020 | |
| URL:  <https://www.cancerquest.org/cancer-biology/cancer-epigenetics> |  | |  |  | |
| Copy and paste relevant information directly from source:  Abnormal epigenetic modifications in regions of DNA outside of genes can also lead to cancer.  The environment and human behavior are main causes. Poor diet, lack of exercise, drugs, exposure to environmental chemicals or radiation – these all have the potential to cause epimutations which can lead to cancer. Smoking cigarettes, for example, has been shown to affect DNA methylation patterns across multiple organ systems.  Genetics is a major factor in determining someone’s risk of developing cancer. People with certain genetic mutations carry a relatively high risk of developing cancer during their lifetimes and these mutations can often be passed on to offspring.  Cancer cells often have a different epigenome, or epigenetic profile, than normal cells. A cancer cell’s epigenetic profile is typically characterized by decreased methylation across much of the genome (global DNA hypomethylation).  The main preventable causes of epimutations linked to cancer are environment exposures and behavior. Elimination or reduction of exposure to carcinogenic chemicals such as those found in tobacco products would likely reduce epimutations and related cancers. Other chemicals and drugs have also been found to cause epimutations, notably alcohol, which causes both DNA methylation and histone modification. A diet high in cruciferous vegetables, such as broccoli, cabbage, cauliflower, and kale, has been linked to a lower risk of developing prostate cancer.  Epigenetic treatments or “epi-drugs” refer to drugs that reverse abnormal epigenetic modifications in cancer cells. |  | **Make “raw” notes in your own words (this is not a summary):**    Epigenetics can cause or can treat cancer.  Environmental modifications and human behavior are main cause to how the DNA strands get altered.  Other factors such as poor diet and unhealthy living can also affect the chance of getting cancer.  Also, genetics can determine higher or lower chances of cancers. People who carry genetic mutations have a higher chance of getting cancer.  Cancer cells have a different epigenome/profile then a normal body cell.  To prevent getting cancer, reduce contact with drugs and exposer to negative environment behaviors.    “Epigenetic treatments or ‘epi-drugs’ refer to drugs that reverse abnormal epigenetic modifications in cancer cells.” | | |  |

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| **Source #5** |  | |  |  | | |
| Title of source: What is Biotechnology? | Author:  Unknown | | Date of publication: | Date accessed (by you):  May 3RD 2020 | | |
| URL: <https://www.whatisbiotechnology.org/index.php/science/summary/epigenetics/> |  | |  |  | | |
| Copy and paste relevant information directly from source:  Epigenetics is the study of heritable changes in gene expression (active versus inactive genes) that do not involve changes to the underlying DNA sequence — a change in phenotype without a change in genotype — which in turn affects how cells read the genes  What began as broad research focused on combining genetics and developmental biology by well-respected scientists including [**Conrad H. Waddington**](https://en.wikipedia.org/wiki/C._H._Waddington) and Ernst Hadorn during the mid-twentieth century has evolved into the field we currently refer to as epigenetics. The term epigenetics, which was coined by Waddington in 1942, was derived from the Greek word “epigenesis” which originally described the influence of genetic processes on development. … this led to elucidation of the molecular basis of Conrad Waddington’s observations in which environmental stress caused genetic assimilation of certain phenotypic characteristics in Drosophila fruit flies.  Currently, [**DNA methylation**](https://www.whatisepigenetics.com/dna-methylation/) is one of the most broadly studied and well-characterized epigenetic modifications dating back to studies done by Griffith and Mahler in 1969  studies have shown that children born during the period of the Dutch famine from 1944-1945 have increased rates of coronary heart disease and obesity after maternal exposure to famine during early pregnancy compared to those not exposed to famine  Studies performed by Feinberg and Vogelstein in 1983, using primary human tumor tissues, found that genes of colorectal cancer cells were substantially hypomethylated compared with normal tissues.  Epigenetic changes are also linked to several disorders that result in intellectual disabilities |  | **Make “raw” notes in your own words (this is not a summary):**  While people began studying how genetic bonded, Scientists Conrad H. Waddington and Ernst Hadorn evolve it to what is now called epigenetics (mid 20th century)    1942, epigenetics comes from a Greek word “epigenesis” which originally described the influence of genetic processes on development.  This led to the discovery of the “molecular basis” of Conrad Waddington’s observations where environmental stress caused genetic adaptation of specific phenotypic characteristics in Drosophila fruit flies.  “Cancer was the first human disease to be linked to epigenetics. “  Feinberg and Vogelstein, using mostly human tumor tissues, found the genes of colorectal cancer were significantly hypomethylated compared to normal tissues.  “An accumulation of genetic and epigenetic errors can transform a normal cell into an invasive or metastatic tumor cell.”  Epigenetic changes can be used as biomarkers for the molecular diagnosis of early cancer.  Epigenetic changes are also linked to several disorders that result in intellectual disabilities  “For example, the imprint disorders Prader-Willi syndrome and Angelman syndrome, display an abnormal phenotype as a result of the absence of the paternal or maternal copy of a gene, respectively.”  In addition to epigenetic alterations, specific mutations affecting components of the epigenetic pathway have been identified that are responsible for several syndromes | | |  |

Extra Cites:

<https://youtu.be/KYHBbEKap0A>

<https://www.the-scientist.com/lab-tools/high-throughput-epigenetics-analyses-30163>

<https://cancerdiscovery.aacrjournals.org/content/3/7/713>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5075137/>

<https://blogs.biomedcentral.com/on-biology/2016/09/08/future-epigenetic-drugs/>

<https://www.sciencedirect.com/science/article/pii/B9780128110607000218>