Using Podcasts as a Supplemental Learning Tool for Genetics

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Table of Contents

Introduction

Genetics is a fascinating topic of biology. It is taught at many different stages of education, from the first mention of DNA in elementary school to the most advanced courses a graduate student can take. It is a subject that is full of complex ideas and processes. There are many different ways to teach genetics. Lecture, discussion, group work, and lab are just several examples. It is a very intriguing course on its own. However, giving any topic an extra layer or another way to make it more applicable to life instantly and more obviously reveals the importance of learning the material.. A great resource to add another component to a lecture or activity is a podcast. Having a platform where real scientists or doctors discuss what the student is learning about in class gives more meaning to that subject. In this teaching resource, four different podcasts will be broken down with lesson plans for how they could be implemented in the classroom. The textbook, *Genetics: A Conceptual Approach* (Pierce *et. al*, 7th edition) will be used to link podcasts to specific chapters and sections from the text. Reading something in a textbook or hearing a professor lecture about the material is one thing, but listening to someone in the real world describe how that material is significant to people makes all the difference. Past research has shown that providing relevance to the content students learn is the most important factor to gaining students' attention (Kember *et. al*). Giving context to the subject, past the course material, allows students to relate the concept to their own lives and apply it to areas that they consider to be significant. Studies have shown that students are highly receptive to podcasts, either to teach lecture material or provide current news about the topics being taught. Students specifically enjoyed podcasts created by their professors as a different platform for lecturing (Aguiar). Having the basis of students being receptive to podcasts opens the door for implementing podcasts not centered around a lecture into learning.

genetics unzipped: *The Natural Lottery*

S4.24 (28:38 minutes) Link to podcast

Main Topics

- ➢ Genetics through a Social Lens
- ➢ Nature vs. Nurture
- ➢ Genes Impacting Intelligence, Education, and Income
- ➢ Misuse of Research to Misinform Others

Summary

Dr. Kat Arney chats with Paige Harden, a professor of Psychology at the University of Texas at Austin, about how variation in our genes could impact our chances in life. Professor Harden argues that variation in our DNA can lead to differences in personalities and health, which in turn impact opportunities for academic and economic success. It is clear that genes influence more than just a person's physical traits, but studying their full effect on humans is difficult. It is hard to draw a line between what genes correlate with and what they cause when it comes to a person's psychology and personality. In looking at the influence of genetics, the question of Nature vs. Nurture makes things murkier. Professor Harden states that people should be less concerned with arguing for one over the other and more concerned with looking at how nurture interacts with nature. Genes do play a role in personality, income, and education but it is less clear-cut than looking at the role of genes in biological diseases. There are many more factors that can contribute to and influence each other. Even in doing research into the role of genetics, there is a risk that that research could be used to attack certain groups of people. Professor Harden recognizes that knowledge is power and it can be used for good or for bad. The best way to include all groups of people in genetics research is to not generalize statistics about one population to every group of people. Over the counter

genomic services (common genetics kits) have the habit of generalizing results to larger populations despite the results only coming from a small sample of people who have access to the tests. In finding these correlations between variation in genes and social aspects of life, it is hard to decide how to use this information and how to account for the impact variation can have on peoples' lives. Professor Harden believes that genetic variation is similar to the concept of luck in life. Luck can not be changed in peoples' lives but actions can be taken to minimize the effects of a lack of luck or non-advantageous genetic variation.

Significance and Implementation in the Classroom

This podcast would be a great introduction to a genetics course. Many students go into the course wondering why they are required to take it or why, maybe even if genetics matters. This podcast gives genetics meaning outside of the world of science. As students are being introduced to the basic concepts of a gene, this podcast gives them a reason to care about the information that goes beyond science. It is a very thought-provoking podcast that gives a social context to why genetics is important and how our genes influence more than just our biological characteristics.

Application to *Genetics: A Conceptual Approach*:

- ➢ Chapter 1: Introduction to Genetics
    - Section 1.1: Genetics Is Important to Us Individually, to Society, and to the Study of Biology

Additional Resources

Professor Paige Harden's Book:
The Genetic Lottery: Why DNA Matters for Social Equality

Patient Stories with Grey Genetics: *Slowing Down with Mitochondrial Myopathy*

Episode 56 (27:47 minutes) Link to podcast

Main Topics

- ➢ Mitochondrial Disease
- ➢ Homoplasmic Mutations
- ➢ Genetic Diseases
- ➢ Genetic Counseling
- ➢ Inheritance Patterns of Disease

Summary

Karen Fieri is a woman who was diagnosed with mitochondrial myopathy which was caused by a homoplasmic variant in mitochondrial DNA. Karen compares living with the disease to “running [her] entire body on an old double A battery”. Mitochondrial myopathy is a multi-system disease that affects all of her organs since mitochondria synthesize ATP for all of the cells in her body. Mitochondrial myopathy is very difficult to diagnose and has a range of symptoms that are not always visible to others. Karen had been having strange symptoms throughout her life but did not fully become aware that something was wrong until her 30s. It was when she became too fatigued to chew her food and walk up the stairs that she knew something more serious was going on. Fortunately, her doctor was able to key into her symptoms and realized that something was wrong with her metabolism. She saw many different doctors who all had differing opinions. Eventually, she ended up seeing a neurologist who specializes in mitochondria and helped determine a diagnosis. She briefly saw a genetic

counselor to discuss the inheritance pattern of the disease. Since Karen's mutation is homoplasmic, it is present in all of her mitochondrial DNA which she passes on as the mother. Her children ages 15 and 13 have started to show signs of the disease that Karen experienced at that age. Her daughter is waiting on results from her first genetic testing and her son's genetic testing appointment is scheduled. There is a lot of stress and worry for Karen to not know if her children will be permanently affected by this disease. The question of her daughter being able to carry children and potentially passing this disease onto them is also a major concern. Karen's mother has no symptoms although her mother's aunt and some other family members have had strange symptoms that could indicate who she inherited the disease from. Karen wanted to remind everyone that it is okay to feel scared or upset because the disease is scary, but to not dwell on negative thoughts. When she feels overwhelmed, she likes to just slow down and be with her family as she bravely fights through life with mitochondrial myopathy.

Significance and Implementation in the Classroom

In teaching about inheritance, pedigrees or mitochondrial disease, this podcast gives a very human side to those subjects. Getting to hear from someone who is affected by a genetic disease makes that topic more surreal. Being reminded that these diseases are not just paragraphs in a textbook and that they affect real people makes learning about them more meaningful. Also, this gives an opportunity to focus on non-chromosomal inheritance patterns. Most pedigree analysis activities focus on autosomal or sex-linked traits.

Application to *Genetics: A Conceptual Approach*:

- Chapter 3: Basic Principles of Heredity
    - Section 3.1: Gregor Mendel Discovered the Basic Principles of Heredity

- ➢ Chapter 6: Pedigree Analysis, Applications, and Genetic Testing
  - Section 6.2: Geneticists Often Use Pedigrees to Study the Inheritance of Characteristics in Humans
  - Section 6.4: Genetic Counseling and Genetic Testing Provide Information to Those Concerned about Genetic Diseases and Traits
- ➢ Chapter 18: Gene Mutations and DNA Repair
  - Section 18.1: Mutations Are Inherited Alterations in the DNA Sequence

Additional Resources

Karen's Instagram: @karenfieri

Learn more about Mitochondrial Myopathy: mitoaction.org

The Naked Scientists: *Breeding a better cow*

14 June 2015 (09:20 minutes) Link to podcast

Part one of five in this episode

Main Topics

- ➢ Selective Breeding
- ➢ Genetic Markers

Summary

Dr. Kat Arney chats with Professor Jennie Pryce from La Trobe University in Australia about the process and genetics behind breeding cows. Jennie Prcye explained that breeders look for high milk production, disease resistance, and feed efficiency. In terms of feed efficiency, cows are producing more milk than they did in the past although they do not weigh anymore now than they did back then. This has been achieved through selection. With genomic selection technology, genetic markers on a cow or bull that they are interested in can be combined with data on feed efficiency. Patterns between efficient cows and specific genetic markers can then be examined. Those patterns can then be used to predict feed efficiency in animals that do not have a measure of that by looking at their DNA. Jennie explains that genetic markers can be generalized to bull populations and multiple generations because there are a lot of relationships between dairy cattle populations. Jennie also touched on the negative effects of selective breeding on dairy cattle. She mentioned that overtime, as breeders were selecting for high production yields, fertility

began to decrease. To correct this, breeders had to begin looking at several different criteria, not just production, when breeding the cows. Kat asked Jennie if she sees genome editing being used with cows anytime in the future to improve the accuracy of breeding. Jennie said that she did not think gene editing had a strong place in dairy farming and that the tools they have now with looking at the genetic markers should be focused on and improved.

Significance and Implementation in the Classroom

This podcast is a bit unique and at first, it can seem strange to use this in a classroom. However, it provides real-world context to the role that humans play in shaping the genomes of the animals we domesticate. Learning about how cows produce almost twice the amount of milk they did in the early 1900s and how fertility drastically decreased in cows at one point because of selection is eye-opening. Understanding that genomic variation is influenced by a lot of factors, including human beings, is important to knowing why genetics matters.

Application to *Genetics: A Conceptual Approach*:

- Chapter 19: Molecular Genetic Analysis and Biotechnology
  - Section 19.4: Molecular Techniques Can Be Used to Find Genes of Interest

Radiolab: You Are What Your Grandpa Eats

11/19/12 (15:11 minutes) Link to podcast

Second of three parts in Radiolab's Inheritance podcast

Main Topics

- ➢ Epigenetics
- ➢ Inheritance

Summary

Jad Abumrad and Robert Krulwich discussed questions about inheritance and how much a person can pass down to future generations. They focused on a small Swedish town called Överkalix where data can be found about people from a very long time ago. The records contain a lot of information about every person that lived in the town, when they died and how they died. They also have a lot of records on crops and livestock from the farmers. A researcher named Olov Bygren used the records to follow families throughout generations during the many cycles of famine and feast and determine if that had an impact on future generations. He wanted to examine the effects of starvation on many generations. Olov found that boys between the ages of 9 and 12 who lived with limited food resources had healthier kids and grandkids. The grandchildren were 25% less likely to develop heart disease if the grandfather “starved” between the ages of 9 and 12. The grandchildren also had a lower risk of diabetes and approximately 30 year longer life expectancies. The years of 9-12 are slow for physical growth in boys, but sperm develop during this time period. The DNA of someone that experienced starvation at that

critical time point is marked and carried onto the next generation through the sperm. Adversely, boys who had ample food supply during the ages 9-12 had grandchildren with 400% greater risk of diabetes and a higher incidence of heart attacks. Thus, the environment can have a large impact on a person's gene expression and phenotype.

Significance and Implementation in the Classroom

This podcast brings up a very interesting example of epigenetics and inheritance. The idea that the amount of food a grandfather eats can impact the health of his grandchildren is proof of the power of gene expression that can reverberate through generations. This podcast provides a real example of how changes in DNA can be brought about by slight changes in the environment and then can be passed onto generations if the changes are present in gametes. It makes the idea of inheritance more interesting when you think about how your decisions and life could impact the life of your grandchildren.

Application to *Genetics: A Conceptual Approach*:

- Chapter 21: Epigenetics
  - Section 21.1: What Is Epigenetics?
  - Section 21.4: Epigenetic Alterations Bring about Changes in Behavior, Reproduction, and Metabolism

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