



DARIUS GOES WEST

THE ROLL OF HIS LIFE

**Darius Goes West “Know About It”
LESSON PLAN**
Subject: BIOLOGY
Age range: 6th - 12th grade
Created by: Benjamin Seckler, M.D.

How Did Darius Get Duchenne Muscular Dystrophy, and Will There Ever Be a Cure?

OVERVIEW

After seeing the film *Darius Goes West*, students will learn what causes Duchenne Muscular Dystrophy. Through this lesson plan, they will be exposed to the concepts of DNA, chromosomes, genes, proteins, and genetic mutations. They will learn about several promising therapeutic approaches. This lesson plan is divided into three parts and designed to be spread out over 2-4 days, depending on students' grade level, prior knowledge, and aptitude.

LESSON OBJECTIVES

Students will:

- 1) Create a model of DNA using edible materials
- 2) Learn how proteins are created
- 3) Engage in interactive activity that demonstrates how mutations occur
- 4) Demonstrate their understanding of what causes Duchenne Muscular Dystrophy in a format of their choice
- 5) Explore several therapeutic approaches

PART ONE: WHAT IS DNA?

INSTRUCTIONAL PLAN

- From the many variations available on the internet, choose a set of directions for how to make an “edible DNA model.” The clearest directions I found were provided by the University of Utah Genetic Science Learning Center at:
http://learn.genetics.utah.edu/units/basics/print-and-go/eat_DNA.cfm
Visit this webpage to review the background information and print the student instructions sheet. NOTE: To access this lesson plan you must first register (for free) by entering your e-mail and creating a password.
- Print a separate list of “materials needed” for each student. Tip: Vary the order on each list so when it is time to collect materials, the whole class doesn't converge on the toothpicks at once!
- On a back table, set up enough materials for each student to collect what (s)he needs
- Copy the worksheet “Find Out Your DNA Alias,” which can be found at:
http://www.nature.ca/genome/05/051/0511/0511_m205_e.cfm

- Preview the glossary of terms (see Resources at end of this lesson plan) compiled by the Canadian Museum of Nature at:
http://www.nature.ca/genome/02/022_e.cfm
Choose which definitions you will assign for homework each night.

MATERIALS/PREPARATION

- Make copies of instructions for how to make the DNA model for your students.
- Make copies of “materials needed” for your students.
- Collect ingredients for the model (exact ingredients will depend on which variation of this activity you choose, but will include licorice, colored marshmallows, toothpicks, etc.)
- Make copies of the worksheet “Find Out Your DNA Alias” for your students, which can be found at http://www.nature.ca/genome/05/051/0511/0511_m205_e.cfm
- Be sure each student has two sheets of paper and a pen.

LEARNING ACTIVITIES AND DISCUSSIONS

1) Brainstorm and Discussion: What causes Duchenne Muscular Dystrophy?

After viewing the film *Darius Goes West*, write this question on the board: ***How do you think Darius “got” Duchenne Muscular Dystrophy?*** Allow 1-2 minutes of quiet time for students to jot down ideas, then open the floor for sharing. Encourage students to share their ideas, even if they are unsure of their knowledge. If comments are not forthcoming, prompt students with guiding questions such as:

- Do you know anyone (real or fictional) with a disease that seems similar?
- Do you think DMD could be contagious?
- Do you think he was born with it?
- Do you remember who else is mentioned/shown in the film who also had DMD?

While students are sharing their ideas, conduct informal assessment of their knowledge.

2) Introduction to DNA

Explain that DMD is caused by a **genetic mutation**. A genetic mutation happens when something goes wrong with a code that exists inside everyone’s body. The code resides in something called DNA. Give students 2-3 minutes to jot down anything they know – or think they know – about DNA, such as what the acronym stands for, where DNA exists in the body, what it is made of, what it looks like, anything! Students do not have to put their names on the paper, but collect the papers so you can get a sense of their prior knowledge.

While you read through the anonymous notes, have students collect the materials they will need. When students are seated with their materials, build on their prior knowledge to give a brief explanation of DNA. Validate all observations students have submitted by assuring them that in order to develop understanding of a concept, it is just as important to confront misconceptions as it is to build on what they already know.

Explain that:

- DNA stands for deoxyribonucleic acid.
- DNA contains the instructions in a gene that tell the cell how to make a specific protein.
- Our body makes lots of different proteins. Proteins are made up of something called amino acids.

- The DNA code has four letters: A, T, C, and G. They stand for the chemicals adenine, thymine, cytosine, and guanine.
- Each gene's code combines the four chemicals in various ways to spell out 3-letter "words." These 3-letter combinations specify which amino acid is needed at every step in making a protein.

3) Activity

Pass out the student instruction sheet for how to make the DNA model. If you are using the University of Utah version of this activity, the sheet is entitled, "Have Your DNA and Eat It Too." Have each student create the DNA model using the materials at his/her desk.

4) Summary and Conclusion

Lead a discussion of how the models help students understand what DNA is. Encourage students to show their models and point out what seems clear and what is still confusing about the concept of DNA.

HOMEWORK

Have students complete the useful (and fun) pen/paper activity designed by the Canadian Museum of Nature, "Find Out Your DNA Alias." Download instructions at:

http://www.nature.ca/genome/05/051/0511/0511_m205_e.cfm

PART TWO: GENES, PROTEINS, AND MUTATIONS

1) Review

If you assigned vocabulary words for homework, give a quiz on the definitions.+ Before the quiz begins, ask students if they have questions about the words and their meanings.

2) Brainstorm and Discussion

Ask students what the connection is between DNA and Darius's disease. Allow time for testing of hypotheses.

3) Introduction to Genes and Proteins

Write the terms genes, proteins, and mutation on the board. Explain that to understand the connection between DNA and muscular dystrophy, we have to understand these terms. Give a mini-lesson on the three terms. The Canadian Museum of Nature has an excellent website with useful background information. See http://www.nature.ca/genome/index_e.cfm

4) Activity

Break into pairs. Have each pair come up with a definition for one of the three terms. Make sure each pair writes down the definition. Come together as a class. On overhead projector, show the definitions from the Canadian Museum of Nature glossary. Compare the students' definitions to the glossary. Through comparing and contrasting the definitions, refine understanding of the terms.

Extension activity: If you have access to computers in the classroom, have students play “mighty mutation maker,” a game that illustrates how genetic mutations occur.
http://www.nature.ca/genome/04/0413_e.cfm#010

5) Summary and Conclusion/Connection to *Darius Goes West*

Explain that one of the proteins our body needs is called **dystrophin**. Darius, like all boys with DMD, does not produce dystrophin. This protein is necessary for muscle strength and function. Without dystrophin, muscle cells cannot thrive. Boys with DMD appear fine for the first few years of life. They are usually diagnosed from 3-5 years

PART THREE: PROGRESS TOWARD A CURE

1) Review

If you assigned vocabulary words for homework, give a quiz on the definitions. Before the quiz begins, ask students if they have questions about the words and their meanings. Last question on quiz: Explain what causes Duchenne Muscular Dystrophy.

2) Brainstorm and Discussion

Now that you know the cause of DMD, what might scientists do to fix it? Write all ideas on the board. If students are “stumped,” remind them that boys with DMD do not produce a protein called dystrophin. This should prompt students to think of ideas such as:

- “Create dystrophin and inject it into boys with DMD.”
- “Get dystrophin from someone else and inject it into the boy with DMD.”
- “Try to get the body to produce dystrophin.”
- “Replace the defective gene with a good gene.”

How about: “Get the body to double up production of another protein that is similar to dystrophin?” If no one suggests this idea, remind students that the body has many proteins and that perhaps some are similar to dystrophin.

3) Activity

From the list the students have generated, circle the suggestions that are actually being investigated by scientists. Relabel the suggestions with their scientific names. Potential therapies for DMD include:

1. Gene replacement therapy
2. Stem cell therapy
3. Gene modification therapy (exon skipping)
4. Upregulate utrophin (similar to dystrophin)

NOTE: Other approaches exist, but for the sake of avoiding extremely complicated material, I recommend sticking to these. See www.charleystfund.org/research for more information on the latest research toward a cure.

Have each student choose one approach that could become a treatment or cure for DMD. Learn more about it using any of the following websites:

www.charleysfund.org
www.mdausa.org
www.parentprojectmd.org
www.cureduchenne.org

If you do not have internet access in the classroom, print out information on each approach in advance so the students can work from the printed material. Have each student write a 3-paragraph news article describing the potential therapy. The article should include:

- ✓ Briefly explain the disease and what causes it.
- ✓ Explain the potential therapy and how scientists hope it will work.
- ✓ What hurdles do scientists face using this approach?
- ✓ Where is the research being done?

Activities for Overall Assessment

Have students consider these scenarios:

1. Your cousin, who lives in another state, is coming to visit you for a few days. Your best friend at home has DMD. Write a letter to your cousin to let him know what to expect. Be sure to include how DMD affects your friend, and what causes it.
2. Your 8-year-old brother has DMD. He is worried that his peers think he is “weird” or “sick.” Create a picture book about your brother and DMD that you will read to the class. Your book should be at least 6 pages long.

RESOURCES

Glossary of Terms

The Canadian Museum of Nature has compiled a terrific glossary of terms related to the study of genes. See http://www.nature.ca/genome/02/022_e.cfm

As part of this unit, consider assigning words that are related to the material covered. Have students look up the definitions using the on-line glossary and memorize the meanings of the words. Some of the words have a “talking glossary,” which is fun for students to listen to. The words you choose will depend on students’ prior knowledge. Some suggestions:

amino acid
cell
chromosome
DNA

*Duchenne Muscular Dystrophy: one of nine types of muscular dystrophy, this disease is caused by a lack of dystrophin. First described by a French doctor named Dr. Guillaume Duchenne in the 1860s.

*dystrophin: A protein necessary for muscle strength and function. Boys with Duchenne muscular dystrophy do not produce this essential protein

gene
gene therapy
genome

nucleotide base
nucleus
protein
trait
mutation

* definition provided because the term is not included in the Canadian Museum of Nature glossary

ABOUT THE AUTHOR

Benjamin Seckler, MD, is the president and co-founder of Charley's Fund, a non-profit foundation that supports research for a cure for Duchenne Muscular Dystrophy. Dr. Seckler received his BS from Harvard College and his MD from the Mount Sinai School of Medicine. He completed his residency training at Mass General Hospital, and is now a radiologist in private practice in New York's Hudson River Valley. Dr. Seckler has three children; his six-year-old son Charley has DMD.