

GK12 Module Teacher's Guide

How does something so BIG fit into something so SMALL?

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Abstract:

This inquiry-based module gives students the opportunity to explore ways in which chromosomes, tightly coiled and compacted bodies of DNA and protein, fit inside a cell's nucleus.

Grade Level(s): 6th-7th

Objectives:

- Understand and explore how DNA fits into the nucleus of a cell.

National Standards:

Standard A: Science as Inquiry; Abilities necessary to do scientific inquiry

Standard A: Science as Inquiry; Understandings about scientific inquiry

Standard C: Life Science; Structure and function in living systems

Standard C: Life Science; Reproduction and heredity

Standard E: Science and Technology; Understandings about science and technology

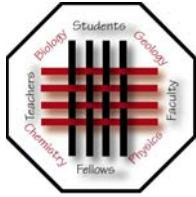
New Mexico Standards:

Strand 1, Standard 1: Scientific Thinking and Practice; Use scientific method

Strand 1, Standard 1: Scientific Thinking and Practice; Understand process of scientific investigation

Strand 2, Standard 2: Life Science; Structure and function of living things

Strand 2, Standard 2: Life Science; Heredity and evolution of species



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Materials:

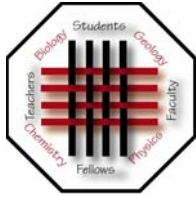
- Film canisters, one per student
- Length of dowel rod, cut to fit the film canister
- Pipe cleaners, 12 per student

Background:

One chromosome contains thousands of genes. Each gene is a segment of DNA that codes for a particular trait. This information was used to assemble tissues and organs when students were in embryonic form, but as they grow and develop, genes govern the functions of the billions of cells in our bodies. In somatic cells, humans have 46 chromosomes. If each strand of DNA were laid out from a single chromosome, it would be approximately 5cm long (Johnson 1998). Considering that each cell in our body is a microscopic unit, the sheer size of DNA is barely comprehensible. How could something that BIG fit into something so SMALL? The answer is that the DNA winds itself around chunks of proteins. When students are presented with materials to explore this process, they may try many different ways of fitting all pipe cleaners into the film canister. Based on their prior knowledge, they should come to realize that the pipe cleaners will fit tightly within the film canister if they are wound around the dowel rod. In this way, students can visualize a 'chunk' of protein (the dowel rod) and the DNA (the pipe cleaner).

References:

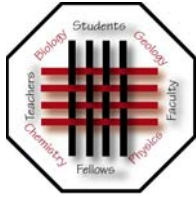
Johnson, G.B. 1998. *Biology: Visualizing Life*. Holt, Rinehart, and Winston, Inc. National Academy Press, Washington DC.



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Procedures:

Each student is given one film canister, one dowel rod and 12 pipe cleaners. Explain that the film canister represents the nucleus of the cell, the pipe cleaners represent DNA and the dowel rod represents a protein. Alternatively, students could be asked to determine what each of the materials represents. Ask students to fit all pipe cleaners and the dowel rod into the film canister but tell them they are not allowed to cut the pipe cleaners. Everything must fit into the film canister so that the lid can be closed (it will be very snug), in this way mimicking the nucleus of the cell.



GK12 Module Glossary

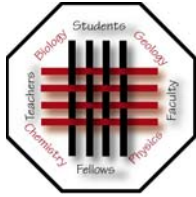
Chromosome - thread-like structures found in the nucleus that contain genes.

DNA - Deoxyribonucleic acid; the chemical inside the nucleus of a cell that carries the genetic instructions for making living organisms.

Gene - a segment of DNA that contains information on hereditary characteristics such as hair color, eye color, and height.

Nucleus - The part of the cell that contains the genetic material DNA.

Protein - A molecule made up of amino acids that are needed for the body to function properly. Proteins are the basis of body structures such as skin and hair and of substances such as enzymes, cytokines, and antibodies.



How does something so **BIG** fit into something so **SMALL**?

Materials:

- Film canisters, one per student
- Length of dowel rod, cut to fit the film canister
- Pipe cleaners, 12 per student

Procedure:

1. The film canister represents the nucleus of the cell, the pipe cleaners represent DNA and the dowel rod represents a protein.
2. Your goal is to fit all the pipe cleaners and the dowel rod into the film canister, but you are not allowed to cut the pipe cleaners. Everything must fit into the film canister so that the lid can be closed (it will be very snug), in this way mimicking the nucleus of the cell.

Conclusions:

Explain and draw a picture of how you fit the pipe cleaners and the dowel rod into the film canister: