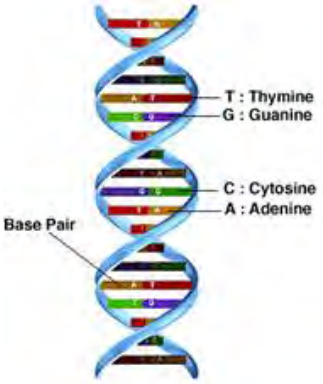
Build Whale DNA

Discover the structure of a DNA molecule and make your own model!



Materials Needed: Cornstarch building blocks (e.g. Magic Nuudles) in 4 colors*, Whale DNA Sequences sheet, white paper, scissors, sponge, water.

* If your colors are different from those on the sheet, decide which color will represent each letter. If you don't have cornstarch building blocks, adapt the activity using beads to make a bracelet (www.yourgenome.org/activities/sequence-bracelets) or make an edible version with marshmallows and licorice (teach.genetics.utah.edu/content/dna/Have-Your-DNA-and-Eat-It-Too.pdf).

Instructions:

Step 1: Choose a species from the Whale DNA Sequences sheet. For a challenge, choose a DNA sequence with missing letters (called "bases"). Fill in the missing letters, following these rules:

A (Adenine) pairs with T (Thymine)
C (Cytosine) pairs with G (Guanine)

(Example: if there is a T on the first strand, the second strand would be A. If there is a G on the first strand, the second strand would be C).

Step 2: Sort your blocks into 4 colors. Each color represents one letter (base). To read DNA sequences, scientists use a standard color code: A is **green**, T is **red**, C is **blue**, and G is **black**. If you have different colors, decide which color will represent each base.

Step 3: Make base pairs. A base pair is a letter from the first strand matched to its complementary letter on the second strand (e.g. A-T). Count how many T-A and A-T pairs there are in your DNA sequence. Use a damp sponge to wet the ends of two blocks, and stick the wet ends together. Make your A-T and T-A base pairs, then repeat this process with C-G and G-C base pairs.

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Step 4: Make the DNA strand. Read the DNA sequence from left to right.

- Start with the first base pair in your left hand.
- Take the second base pair in your right hand and dab it onto the sponge to apply water on the long side.
- To make the DNA strand twist, hold the first base pair straight up and down, and tilt the second base pair's top slightly towards you and the bottom of it slightly away from you.

- Stick the wet side of the second base pair onto the first.
- Stick the second and third base pair together in the same way.

- Repeat for every base pair until you reach the end of the strand. As your build your DNA, the strands will slowly form a double helix twisting to the right.

Step 5: Add a backbone, which holds the DNA molecule together. Cut a thin strip of white paper. Run the wet sponge along one side of the building blocks. Stick the paper strip to the wet edge. Repeat this step with the other side of your DNA molecule. Trim off any excess paper.

Hint: Use only a slightly damp sponge, as the paper can easily get too soggy.

Enjoy your whale DNA model! One gene can contain a few hundred to several million base pairs! DNA gives all the instructions for building an animal as BIG as a whale!

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Whale DNA Sequences

This DNA sequence is from the same COI amplified mitochondrial gene for each of the species of whales. The 5’ to 3’ is the way we write the direction of the DNA strand. The complementary strand runs in the opposite 3’ to 5’ direction.

Bowhead Whale DNA

5’ AGT TCT AGT CAC 3’

3’ TCA AGA TCA GTG 5’

Beluga Whale DNA

5’ AGT CTT AAT TAC 3’

3’ TCA GAA ___ ___ 5’

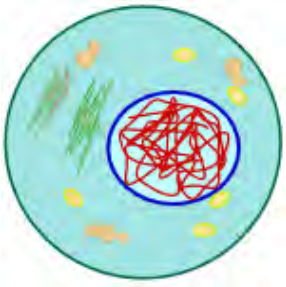
Humpback Whale DNA

5’ AGT CCT AGT CAC 3’

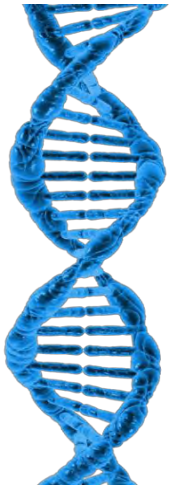
3’ ___ ___ ___ ___ 5’

What Is DNA and How BIG Is It?

DNA (short for **D**eoxyribo**n**ucleic **A**cid) is a molecule found inside every living cell on Earth. DNA contains instructions that determines how every living thing will look and function, and what traits its descendants will inherit. Each individual has a unique set of genetic instructions, called a genome.



Right: Model cell with uncondensed DNA inside the nucleus. *Image: Wikimedia Commons.*



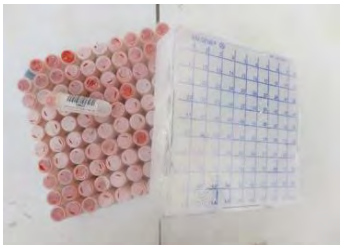
DNA is both **tiny** and **HUGE**. Each human cell contains DNA made up of 3.2 billion base pairs, coiled in such a way that they fit into a space just 0.0002 inches wide (6 microns). That's about one-tenth of the width of a hair! If we stretched out all this DNA from **one cell** it would be about 6 feet (2 m) long. If we stretched out all the DNA from **one human**, it would be about 67 billion miles long, almost the distance of 12 round trips to Neptune! Even though that is very long, other animals have much larger genomes. The marbled lungfish has about 133 billion base pairs. Imagine how far into outer space marbled lungfish DNA could stretch!

Left: DNA molecule. *Image: Pixabay.*

In 1953, James Watson, Francis Crick, and Rosalind Franklin discovered the double helix structure of DNA. After this, scientists started to learn more about genetics and how DNA passes down traits from parents to offspring. Since then, there have been major advances in the science and tools to map genomes and unlock the secrets of DNA.

Genomics (the study of genomes) helps us understand more about species' origins, evolution, ecology, and conservation. The UA Museum of the North has a large collection of DNA. Over 200,000 tissue samples from a variety of species are preserved in liquid nitrogen and ultra-cold freezers. Species in the collection include insects, birds, and mammals from the present day, as well as ancient animals. This is the largest collection of its kind of Alaskan species, and it helps researchers study DNA and make new discoveries!

Kyndall Hildebrandt working in the UAMN Ancient DNA Lab.



Frozen tissue vials.

Watch a video about UAMN Genomics Resources:
www.youtube.com/watch?v=kSLEeMK0OOw

Information from National Institute of General Medical Sciences:
www.nigms.nih.gov/education/Inside-Life-Science/Pages/genetics-by-the-numbers.aspx

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