Discover the biological molecules involved in the central dogma of molecular biology: DNA → RNA → Protein. Learn how our genes, made of DNA, encode proteins. These processes are central to life.

- Unlock the molecular structures of DNA, RNA, and proteins
- Discover essential life processes
- Learn about the magical building blocks of creation
- See these molecules come to life!

The structures of life are amazing, but simple. How these structures work together to make a living being is almost magical. There are still great mysteries to be solved.

You can build the molecules of life! To start using molecule cards and Zometool components right now, turn to page 5 (QUICK START!)

**Biochemistry Kit 1: Numbers in Life**

You can see life at the molecular level! Use your Life Molecule cards and your atoms and bonds to make the individual molecules important for life.

A polymer is a chain of the same or similar molecules. Life uses variations in polymer sequences to create tremendous diversity of form and function.

The number 1 represents you. You are unique and the only 1 of your kind. Celebrate your uniqueness!

The number 2 represents your parents. Two also represents the 2 sets of genes, or blueprints, you inherited from your 2 parents.

Your parents inherited their genes from their parents, and so on, back through countless generations. Your genes have all the instructions to make you. Each of your cells has these genes on structures called chromosomes.

Life’s plans are written in a simple code using 4 molecules of DNA, called bases. These 4 base molecules are conveniently represented by the base pairs G, C, A, and T, and they can be envisioned as the rungs of the twisted ladder that is a DNA double helix. There are millions of coding bases connected together in a single polymer. We have billions of these bases in each of our cells.

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**The Big Idea**

The “big idea” of molecular biology states that the main function of genes, which are made of DNA, is to encode proteins. The DNA code isn’t directly translated into proteins. DNA must first be transcribed into a closely related molecule called RNA. DNA is the code, RNA is the message to make the code, and protein is the final product of the code. Thus, DNA goes to RNA goes to protein.

Life is simple as 1, 2, 4, 20!

We can look at life as a connection between numbers.

1 is for you! You are a unique life-form!
2 is for your 2 parents and the 2 sets of genes they gave you.
4 is for the 4 code molecules in DNA (G, C, A, T) or RNA (G, C, A, U), DNA and RNA code for proteins.
20 is for 20 of nature’s ultimate building blocks, amino acids. These 20 building blocks, in different combinations, make all the proteins in us.

**Life’s simple code**

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**Making Life:** One atom at a time

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**Transcription**

The number 4 also represents the number of coding base molecules in RNA. RNA is patterned after your DNA, and it is made when the cell needs to express the protein encoded by a gene. This first step in gene expression is called transcription. Once the DNA is transcribed into RNA, it acts as a message to the cell to make the protein. The RNA message is very similar to the DNA it is made from, but instead of the base T, RNA uses a similar base molecule, represented by the letter U.

While DNA is made from two strings of G, C, A, and T’s and forms a twisted ladder called a double helix, RNA is usually a single strand made of G, C, A, and U’s.

You can learn more about how DNA and amino acids work at our websites: www.magdna.com or www.zometool.com

Look for the education links.
The process of turning the RNA code into a protein is called translation, because while the languages of DNA and RNA are very similar, the language of RNA has to be translated into the very different language of amino acids.

In this universal genetic code, the strings of the RNA encode strings of amino acids: a sequence of three RNA bases encodes a particular amino acid. The next three bases in the string encode the next amino acid, and so on. A three base code is called a "codon", and each amino acid has at least one specific codon. Since there are 4 possible bases at three different positions, there are 4 X 4 X 4 = 64 possible codons, which are more than enough for the 20 amino acids. There are also specific codons to signal the beginning and the end of an amino acid chain.

Proteins are extremely varied in size and function, and this variety is a function of these amazing building blocks. Amino acids are large or small, positively-charged, negatively-charged or uncharged, bent or straight, or even rings and charged rings. This incredible diversity of building blocks allows nature to come up with vast diversity in proteins, and function, and this variety is a function of these amazing building blocks. The way to build these life molecules and learn about them is through the Life Molecule Cards. There are 28 Life Molecule Cards included in each kit. You will build what you see in the picture, but remember that the picture is 2-D, and real life is 3-D! Use what you know about molecular architecture (the Molecular Modeling with Zometool handout will help) to build a 3-D molecule that looks like the molecule on the card.

The name and abbreviation(s) for the molecule are at the top of the card. An atom by atom picture of the molecule is in the middle of the card. You will build what you see in the picture, but remember that the picture is 2-D, and real life is 3-D! Use what you know about molecular architecture (the Molecular Modeling with Zometool handout will help) to build a 3-D molecule that looks like the molecule on the card.

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