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Enrich

The Genetic Code

James Watson and Francis Crick are credited with discovering the structure of DNA. Read the passage below. Then use a separate sheet of paper to answer the questions that follow.

Paving the Way for Watson and Crick

Many people mistakenly think that James Watson and Francis Crick discovered DNA. In fact, the pair identified the *structure* of DNA. A great deal of work by earlier scientists helped paved the way for their groundbreaking discovery.

In the 1920s, Frederick Griffith was credited with discovering a process that he termed the "transforming principle." Griffith, who was working on a vaccine to prevent infection in the Spanish flu outbreak following World War I, showed that genetic information from dead bacteria could be transferred to living bacteria with the living bacteria expressing the new genetic information.

But scientists still had yet to identify the source of this genetic information. Most thought that genetic material was contained in cell protein, an idea that persisted for many years. It was not until 1944 when Oswald Theodore Avery and his colleagues Colin MacLeod and Maclyn McCarty, continuing the work done by Griffith, identified the DNA molecule as the source of genetic information. Eight years later, experiments conducted by Alfred Hershey and Martha Chase clearly confirmed that DNA was indeed the source of genetic material.

In the early 1950s, Maurice Wilkins, working with Raymond Gosling, began to explore using X-rays to photograph DNA. Not long after, Rosalind Franklin refined Wilkins' pioneering techniques and produced startling new images of DNA. Franklin's X-ray photographs came to play an important role in the formation of Watson and Crick's hypothesis about the helical structure of DNA. Early in 1953, the two scientists completed their model and revealed that DNA is a double-helix of two strands, each with a carbon-phosphate backbone and pairs of nucleotides arranged like rungs on a ladder. Their findings were published in *Nature* on April 25, 1953, and ushered in the field of modern genetics.

In 1962, Watson, Crick, and Wilkins were awarded the Nobel Prize in Medicine for their pioneering work on the structure of DNA. Franklin, who died in 1958, was not eligible to be nominated for the award because rules state that it cannot be given posthumously.

1. What did Avery and his colleagues discover? What was the significance of this discovery?
2. How does this passage demonstrate the idea that a single scientific discovery is often the result of research and contributions by earlier scientists?
3. Why do you think other scientists who made important discoveries in the field of genetics are not as familiar as Watson and Crick?

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

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How Cells Make Proteins

Read the passage and study the table below it. Then, on a separate sheet of paper, use the table to answer the questions that follow.

The Genetic Code

The genetic code is made up of groups of three nitrogen bases in the messenger RNA. Each three-base group, called a **codon,** codes for one amino acid. The table below shows the genetic code. To find the amino acid that is coded for by the codon UGG in messenger RNA, look in the row of the first base in the codon—U. Then move to the box that is specified by the second base in the codon—G. Finally, look down the list of amino acids in the box until you find the one in row "G." the third base in the codon. You should find that UGG is the codon for tryptophan.

Transfer RNA matches up with the messenger RNA at the ribosome to deliver the correct amino acid to the growing protein chain. Transfer RNA has a three-base code called an **anticodon** that matches up with the codon in the messenger RNA.

1. If the DNA sequence of a gene were TACTTACCGAGCTAGACT, then what is the sequence of the messenger RNA?
2. Use the genetic code to identify the sequence of amino acids encoded by the messenger RNA that you identified in Question 1.
3. What are the sequences of the anticodons for the transfer RNA molecules that carry each of the amino acids in the protein sequence that you identified in Question 2?

The Genetic Code (messenger RNA)

First Base in Codon	Second Base in Codon: A	Second Base in Codon: G	Second Base in Codon: U	Second Base in Codon: C	Third Base in Codon
A	Lysine Lysine Asparagine Asparagine	Arginine Arginine Serine Serine	Isoleucine Methionine Isoleucine Isoleucine	Threonine Threonine Threonine Threonine	A G U C
G	Glutamic acid Glutamic acid Aspartic acid Aspartic acid	Glycine Glycine Glycine Glycine	Valine Valine Valine Valine	Alanine Alanine Alanine Alanine	A G U C
U	"Stop" codon "Stop" codon Tyrosine Tyrosine	"Stop" codon Tryptophan Cysteine Cysteine	Leucine Leucine Phenylanaline Phenylanaline	Serine Serine Serine Serine	A G U C
C	Glutamine Glutamine Histidine Histidine	Arginine Arginine Arginine Arginine	Leucine Leucine Leucine Leucine	Proline Proline Proline Proline	A G U C

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Mutations

Cancer is a leading cause of death in the United States. Cancer death rates by age and sex in the United States for 1985, 1995, and 2005 are given in the table below. Study the table. Then use a separate sheet of paper to answer the questions that follow.

Deaths From Cancer

Death Rates From Cancer, United States, 1985, 1995, and 2005

	Females			Males		
Age at Death (years)	**1985**	**1995**	**2005**	**1985**	**1995**	**2005**
under 20	3	3	2	4	3	3
20–49	45	38	32	42	34	28
50–64	305	280	229	405	355	287
65–74	649	687	614	1,125	1,091	911
75 and older	1,026	1,136	1,093	2,011	2,107	1,826
Note: The death rate is the number of deaths for that sex and age group per 100,000 people of that sex and age group in the United States population.						

1. In which groups of males were there declines in cancer death rates between 1985 and 1995?
2. In which group of females was there an increase in cancer death rates between 1985 and 2005?
3. Which sex had higher death rates from cancer at all ages over 50 years of age in all three years shown in the table?
4. Which age group of females had higher death rates from cancer than males?
5. What percent of males aged 75 and older died from cancer in 1995? What percent of females aged 75 and older died from cancer in 1995?