

biology



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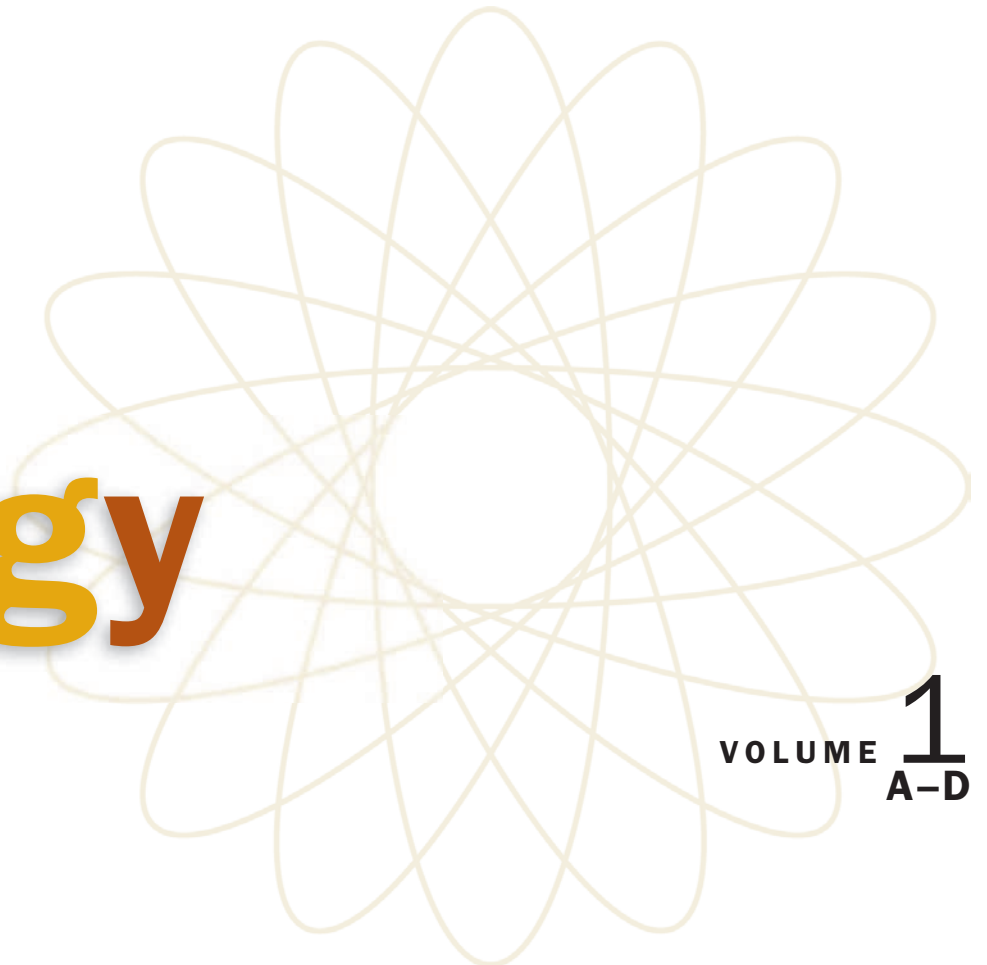
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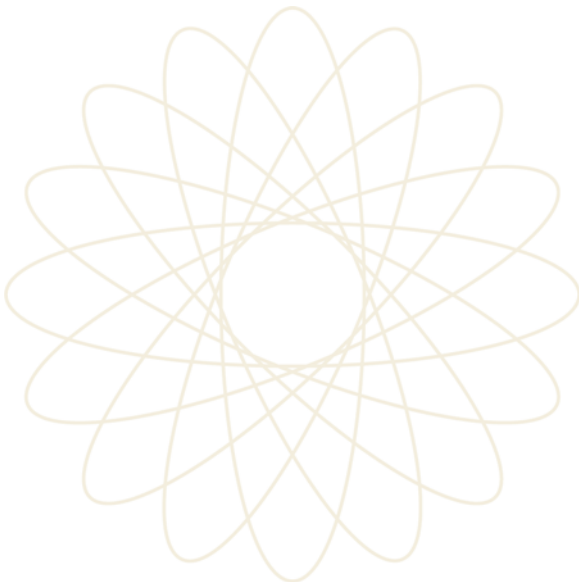
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biology



VOLUME **1**
A-D

Richard Robinson, Editor in Chief



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Preface

The scope of biology is so vast it can be dizzying. Upwards of 50 million species of living things exist on Earth. Within each species, the number of creatures can range from the alarming (only a handful of Yangtze River dolphins exist), to the worrisome (our own species numbers six billion and counting), to the astonishing (five hundred quadrillion individual wheat plants emerge and die every year). But numbers alone can't tell the tale, because life at every level is a process and a pattern, from the development of a single creature to the evolution of a whole species, and from the expression of a single gene to the nutrient cycling of an entire ecosystem. The human body contains about fifty trillion cells, every one of which draws on its store of thirty thousand genes to make the pattern of proteins that control it and make it unique. Within the human brain, one hundred billion neurons make one hundred trillion connections, which combine to make the pattern of thoughts, memories, and feelings that make each of us unique.

Central Ideas and Vital Details

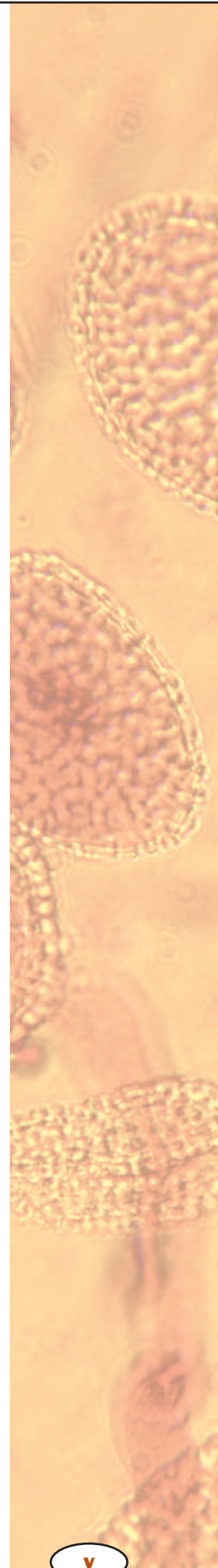
How can a single book, or even a four-volume encyclopedia, encompass so vast a subject? It can't. And in producing *Biology*, we didn't try to cover every topic from Aardvark to *Zyzyva*. Instead, in our 432 entries we present as broad an introduction as possible to the many facets of biology, while concentrating in depth on a smaller number of central ideas and phenomena that are at the heart of all biological processes.

One of our major themes is molecular genetics, which in the last two decades has taken center stage in biology, along with its offspring, biotechnology. In these volumes, students will find detailed and accessible descriptions of the many aspects of these growing disciplines, from genes and chromosomes to cloning and the Human Genome Project. Genes exert their effects through proteins in cells, and we discuss both individual cell processes and the rapidly growing understanding of control mechanisms. Throughout, our emphasis is on clear explanation of the underlying principles, so that students can prepare to understand phenomena that may yet remain undiscovered.

Understanding of human physiology is central to medicine and health, and in *Biology*, we discuss almost every aspect of the human system, including bones, brains, and behavior. We devote special attention to several health issues especially important to students, including smoking, alcohol, and sexually transmitted diseases. Comparative animal physiology and plant physiology are also featured.

★ Explore further in DNA, Nucleus, and Clone

★ Explore further in Development, Immune Response, and Smoking and Health





★Explore further in
Eubacteria, Conifers, and
Conservation

★Explore further in
Grasslands, Population
Dynamics, and Sexual
Selection

The world's biodiversity is being revealed even as it is increasingly threatened, and we survey both of these crucial aspects within our pages. Animal and plant diversity is discussed in many separate entries, and major entries are provided on archaea, eubacteria, fungi, and protists. Up-to-date classification systems are used throughout. We examine the major environmental challenges facing the world today, including global climate change, extinction, desertification, and the growing human population.

“The ecological theater and the evolutionary play” was how one notable biologist described the vital connection between these two major areas in biology. This interplay is explored in entries that range from physiological ecology to human evolution, and in environments from the Arctic tundra to the depths of the oceans. Finally, we examine the history of biology through major entries and capsule biographies, and we look at careers in biology at every level in every field.

Organization of the Material

To aid students and teachers in exploring this vast territory, *Biology* includes individual volume indexes as well as a cumulative index at the end of Volume 4. We also provide a glossary of more than 550 terms with definitions both in the page margin and collected at the end of each volume. Each entry contains suggestions for further reading. A topical index provides a guide to entries by subject, and useful references are provided as frontmatter, including a geologic time scale and tables of metric conversions.

Acknowledgments and Thanks

A work of this scope would be impossible without the dedication and hard work of many people. Our contributors are biologists who have devoted their careers to understanding the living world, and have now devoted many hours to explaining it carefully and clearly enough for a beginning audience. H el ene Potter of Macmillan Library Reference charted a challenging and inspiring course in launching this encyclopedia, and Linda Hubbard, Michelle Harper, Diane Sawinski, and Christine Slovey of the Gale Group provided a sure hand on the tiller during rough weather. Ricki Lewis offered invaluable editorial review when it mattered most.

The editorial advisors for this project have given their time and expertise unstintingly, often far beyond the call of duty. As will be clear from the list of authors, several of them are also gifted and generous authors. They have my deep gratitude for all their work on this encyclopedia. Sadly, Tom Frost, an aquatic ecologist of national stature, did not live to see the completion of this work. His loss was a blow to this project, and even more so to the world of ecology. But he has left his mark on *Biology*, and we dedicate this work to him.

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For Your Reference

The following section provides information that is applicable to a number of articles in this reference work. Included are a metric measurement and conversion table, geologic timescale, diagrams of an animal cell and a plant cell, illustration of the structure of DNA nucleotides, detail of DNA nucleotides pairing up across the double helix, and a comparison of the molecular structure of DNA and RNA.

METRIC MEASUREMENT

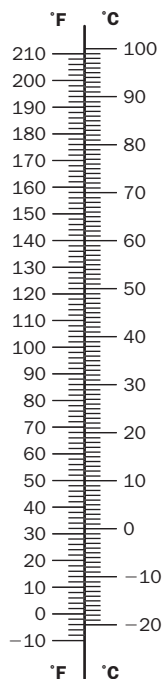
Definitions

Kilo = 1000
 Hecto = 100
 Deka = 10
 Deci = 0.10 (1/10)
 Centi = 0.01 (1/100)
 Milli = 0.001 (1/1000)
 Micro = 0.000001 (1/1,000,000)
 Nano = 0.000000001 (1/1,000,000,000)

Conversions

To convert	Into	Multiply by
Acres	Hectares	0.4047
Centimeters	Inches	0.3937
Feet	Meters	0.3048
Gallons	Liters	3.7853
Grams	Ounces	0.0353
Grams	Pounds	0.0022
Hectares	Acres	2.4710
Inches	Centimeters	2.5400
Kilograms	Pounds	2.2046
Kilometers	Miles	0.6214
Liters	Gallons]	0.2642
Meters	Feet	3.2808
Miles	Kilometers	1.6093
Ounces	Grams	28.3495
Pounds	Kilograms	0.4536
Pounds	Grams	453.59

Temperature Conversion

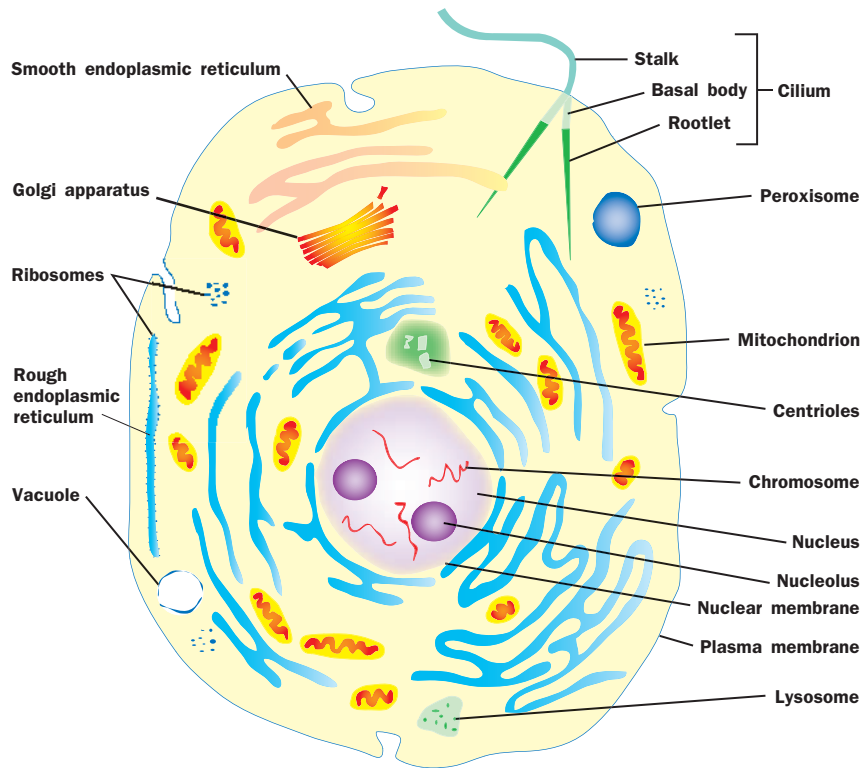


100°C = water boils
 0°C = water freezes

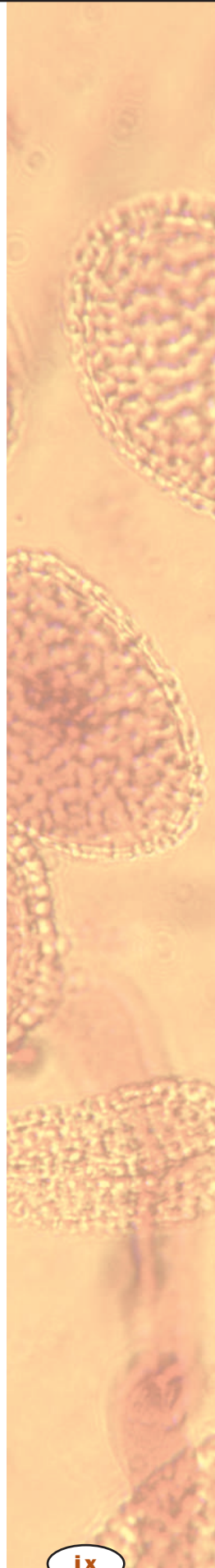
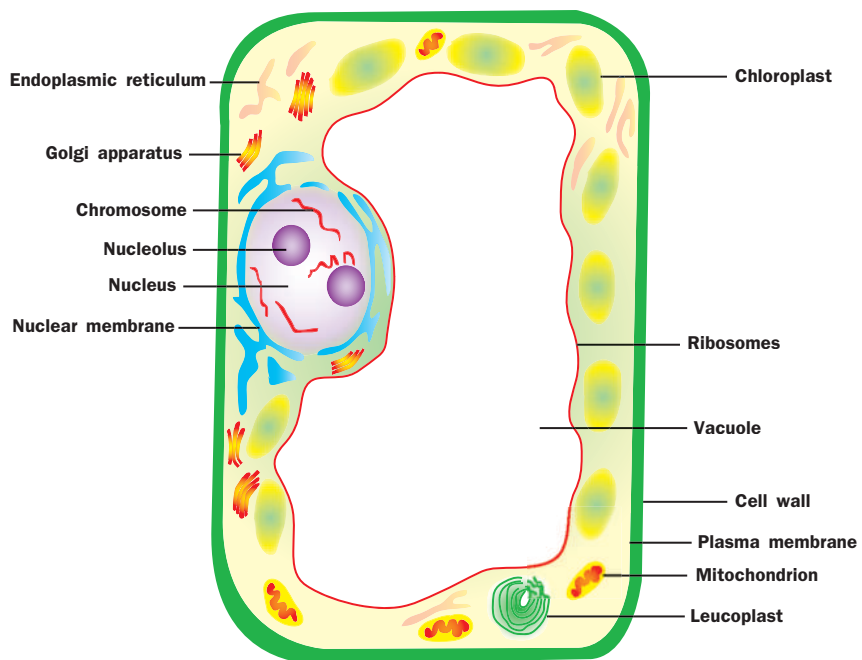
GEOLOGIC TIMESCALE

ERA	PERIOD	EPOCH	STARTED (millions of years ago)	
Cenozoic: 66.4 millions of years ago–present time	Quaternary	Holocene	0.01	
		Pleistocene	1.6	
	Tertiary	Neogene	Pliocene	5.3
			Miocene	23.7
		Paleogene	Oligocene	36.6
			Eocene	57.8
			Paleocene	66.4
Mesozoic: 245–66.4 millions of years ago	Cretaceous	Late	97.5	
		Early	144	
	Jurassic	Late	163	
		Middle	187	
		Early	208	
	Triassic	Late	230	
		Middle	240	
		Early	245	
	Paleozoic: 570–245 millions of years ago	Permian	Late	258
Early			286	
Carboniferous		Pennsylvanian	Late	320
		Mississippian	Early	360
Devonian		Late	374	
		Middle	387	
		Early	408	
Silurian		Late	421	
		Early	438	
Ordovician		Late	458	
		Middle	478	
		Early	505	
Cambrian		Late	523	
		Middle	540	
	Early	570		
Precambrian time: 4500–570 millions of years ago			4500	

A TYPICAL ANIMAL CELL

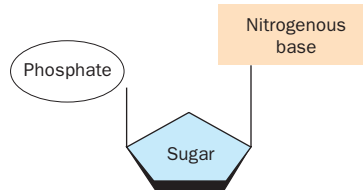


A TYPICAL PLANT CELL



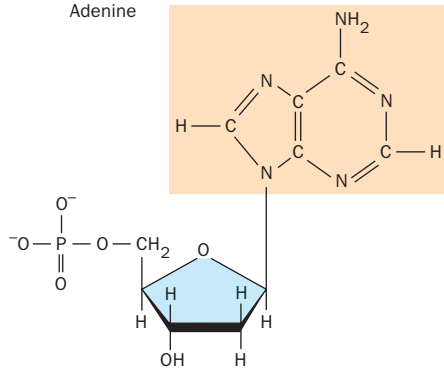
STRUCTURE OF DNA NUCLEOTIDES

Components of a nucleotide



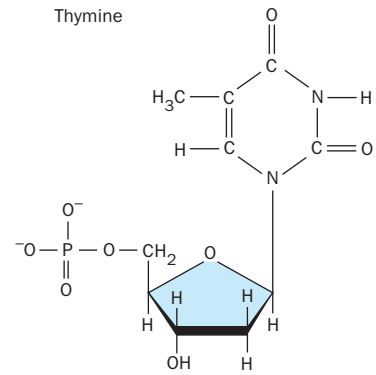
Purine-containing nucleotides

Adenine

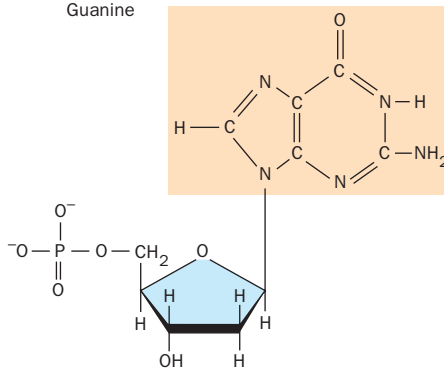


Pyrimidine-containing nucleotides

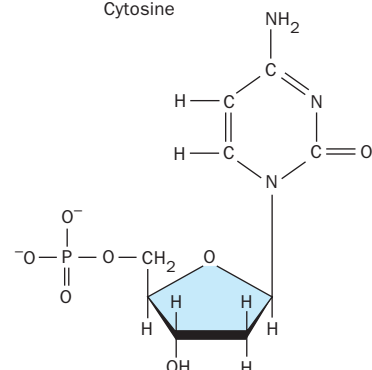
Thymine



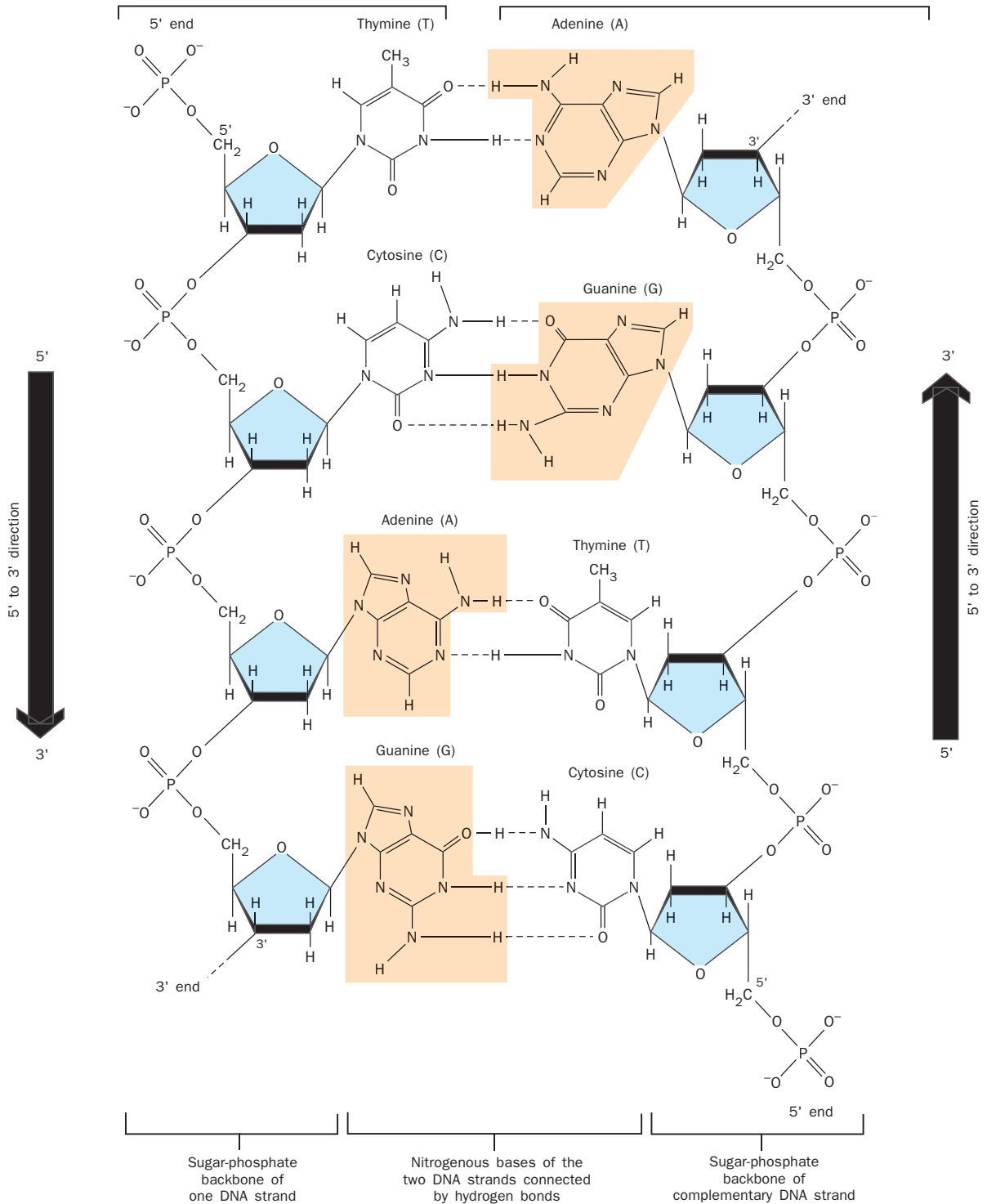
Guanine



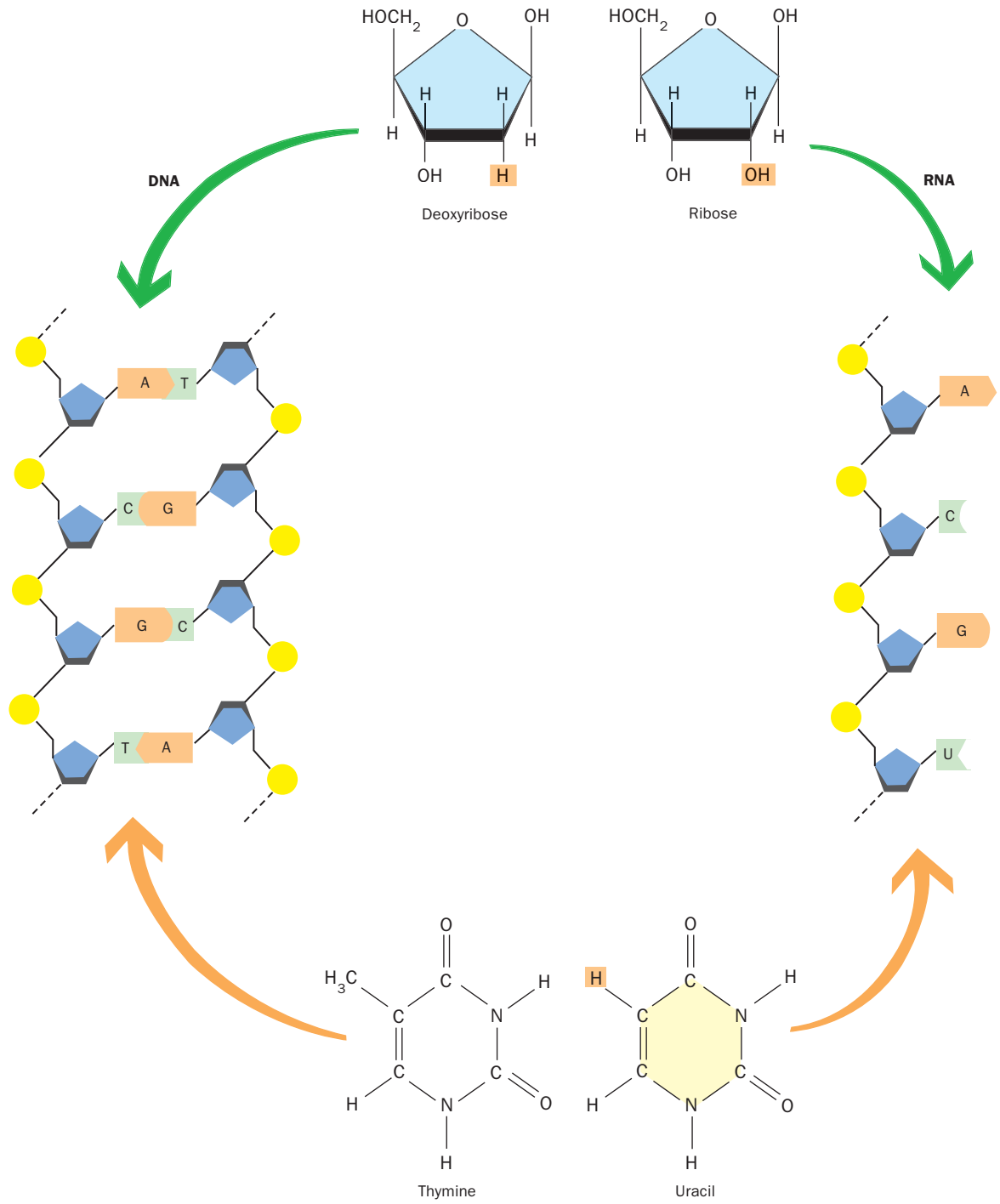
Cytosine



DNA NUCLEOTIDES PAIR UP ACROSS THE DOUBLE HELIX



COMPARISON OF DNA AND RNA



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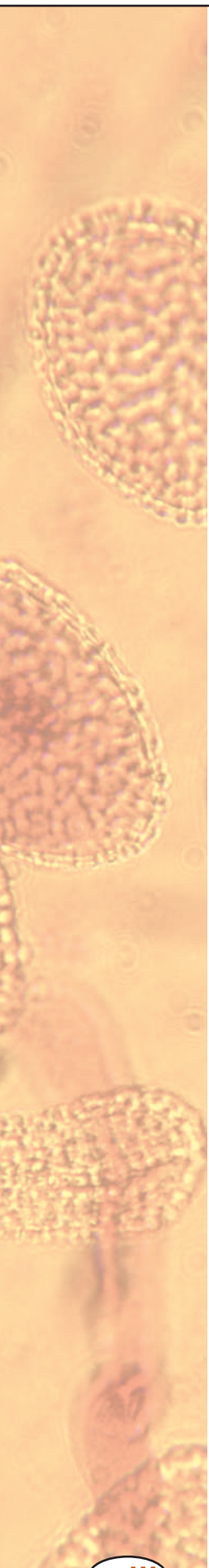


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