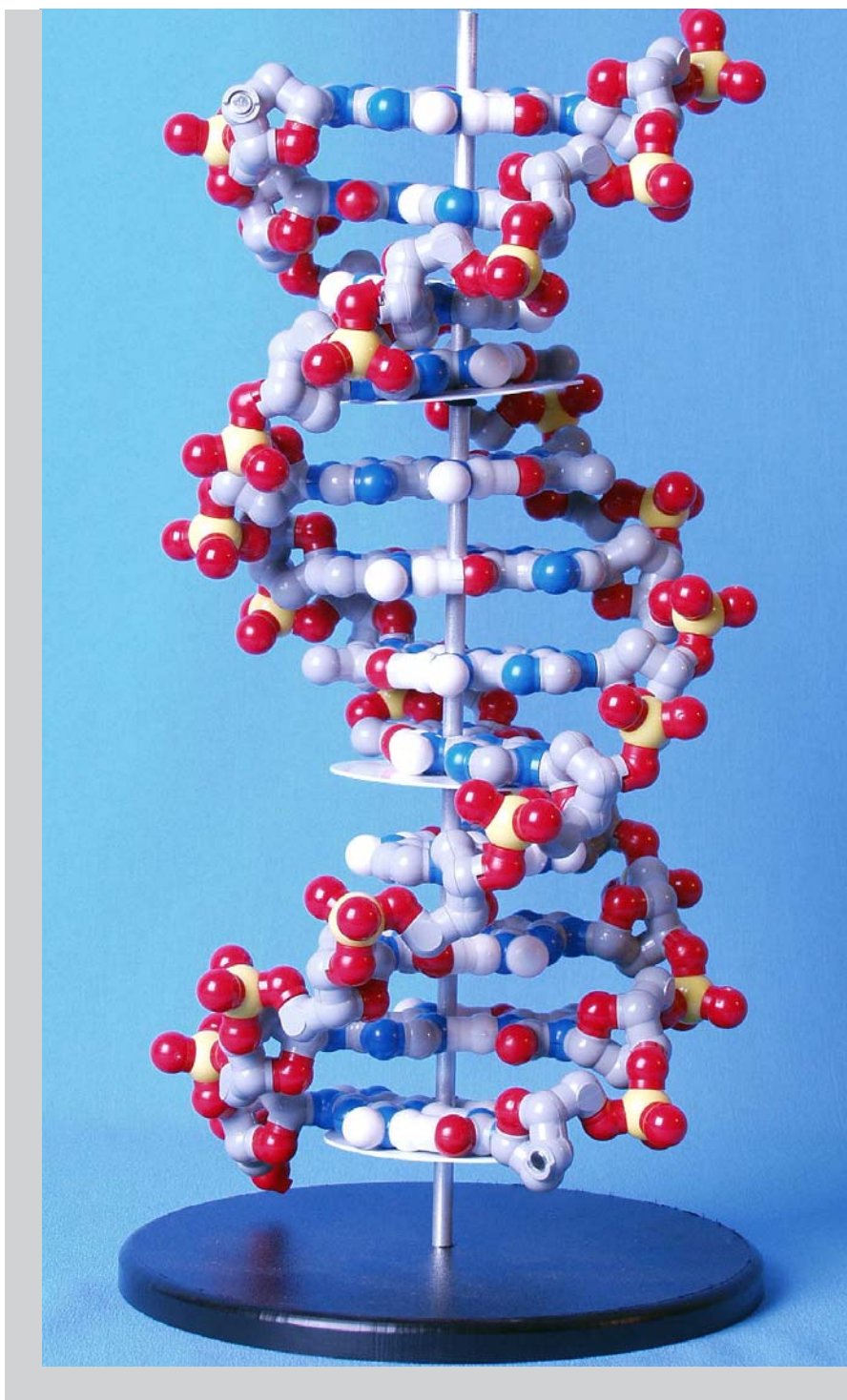


Introduction to The DNA Discovery Kit®



Dear Friends and Colleagues,

The DNA Discovery Kit® is the result of the creativity, hard work and tenacity of many talented people.

Before recognizing those who contributed specifically to the DNA Discovery Kit®, it is important to acknowledge Tom Bray, Dean of the Milwaukee School of Engineering (MSOE) Applied Research and Grants Department, who quickly saw the value of physical molecular models and who made it possible to establish the CBM at MSOE. In addition, a grant from the NIH National Center for Research Resources made it possible to hold the *Genes, Schemes and Molecular Machines* (GSMM) course and launch our research on educational models.

The idea for a DNA model that would be both accurate and easy to assemble grew out of the GSMM course, taught by Mike Patrick and myself. Gunnar Vikberg, then an MSOE student, designed the early prototypes that we called the DNA Construction Kit®. Gunnar is now a graduate of MSOE and an employee of the CBM.

Many of the features you find in the DNA Discovery Kit® were suggested by high school teachers, who used the DNA prototypes when attending the GSMM course. In addition, these teachers wanted models for their classrooms that would be similar to those developed in the course, but ones that would be durable and affordable.

Mike and I had earlier created 3D Molecular Designs (3DMD), a private, independent business, to continue the research and development of the CBM's most promising ideas, and to make custom models for researchers. With this prompting from teachers, we began to explore the feasibility of producing molecular models for science educators and their students.

A Small Business Innovative Research award from the NIH-National Center for Research Resources to 3DMD made it possible for 3DMD to begin research and development of the DNA model.

3DMD engaged Vito Gervasi and his research assistants at the MSOE Applied Research and Grants Department to conduct the technology research and provide designs for molds. The DNA Discovery Kit® could not have happened without Vito's efforts.

Tom Niemiec, of Imperial Tool and Plastics, created the final designs and production molds. (Imperial Tool and Plastics also produces and assembles the DNA nucleotides for 3DMD.)

Mike Patrick, Phil Kroner and I, all contributed to various aspects of the documentation that accompanies the Kit. The documents on the CD and website are greatly enhanced by Sean Ryan's photos and Mark Hoelzer's graphics.

Heather Ryan stepped in whenever and wherever needed to keep the project moving forward. Heather began as a consultant to 3DMD and is now an employee.

Finally, the success of the DNA project is largely due to tireless efforts of Diane Herman, whose contributions to all aspects of the development of the DNA Discovery Kit® are too numerous to mention.

While this briefly summarizes the development of the DNA Discovery Kit® and some of those who were involved, it doesn't begin to describe the challenges we faced or all of those who were involved. And it doesn't come close to capturing the hard work, creativity and commitment it took to overcome those challenges.

I appreciate all of the efforts of those named above and those who haven't been named, but who helped make the DNA Discovery Kit® a reality. Thank you.

Sincerely,

Tim Herman
3D Molecular Designs

Introduction to the DNA Discovery Kit®

Hands-On Highlights

As science educators, we know the fascinating story of how two young scientists identified the structure of DNA without devising or conducting a single DNA experiment, themselves.

The significance of the discovery of DNA's double helical structure is undisputed. But the story of James Watson and Francis Crick's quest to be first to identify the structure of DNA is also a compelling example of *real science*.

By using the *Discovery Approach* with The DNA Discovery Kit® your students can encounter science as a dynamic, creative process.



Armed with the bases, deoxyribose groups and phosphate groups, and the same facts Watson and Crick had in 1953, your students will be able to discover the structure of DNA for themselves. In doing so, they will construct an understanding of DNA that will allow them to build on their knowledge as they encounter more sophisticated topics. They will also understand how this structure is ideally suited to encode information that can be faithfully replicated.

Your students will view science as a dynamic process as they begin assembling *The DNA Discovery Kit Puzzle*®. The Puzzle takes them to 1869, when Johann Friedrich Miescher purified a crude preparation of DNA from white

blood cells (that he named *nuclein*) and demonstrated that while *nuclein* was not a protein, it contained phosphorous, carbon, oxygen, nitrogen and hydrogen.

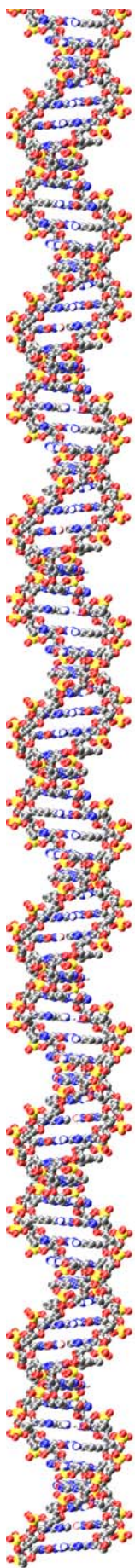
As they move to each new milestone in the Puzzle, your students will literally see that science is a multi-step process, in which scientists have sought to gain a better understanding of our natural world. In the case of DNA, it involved several generations of scientists, who contributed bits and pieces to the puzzle that ultimately was solved by Watson and Crick.



Brief summaries of the supporting materials included on the CD are on the next page.

Please send your feedback on the DNA Discovery Kit, its supporting activities and materials and/or activities and materials to Diane Herman at dianeherman3dmd@wi.rr.com or Tim Herman at herman@msoe.edu. Thank you!





Teaching with the DNA Discovery Kit®

Brief Descriptions of CD Documents

You will find that the supporting materials included on the CD included with your DNA Discovery Kit® (and on our website) provide a variety of ideas and approaches for teaching the structure of DNA with the DNA Discovery Kit®.

We hope you will be able to review all of the documents and select the documents or a combination of elements from each of the documents that will work best for you and your students.

The Discovery Approach and *The Guided Discovery Approach* feature on hands-on, thought-provoking ways to use the nucleotide models to help your students understand the structure of DNA. Both also include detailed photos of ways to use models.

The Discovery Approach is the least structured, allowing your students maximum freedom in exploring the model pieces and enabling them to construct their own understanding of DNA. It also creates a setting that encourages spontaneous questions, discussion and further exploration.

The Guided Discovery Approach is more structured, allowing you to control the sequence in which your students explore DNA. It also provides more details and background information.

For your convenience, most of the supporting materials developed for these two approaches are included in both documents. These include the *Student Handout*, *Three Frequently Asked Questions* and templates that can be printed on transparency film for overhead use.

The *Student Handout* provides background information on James Watson and Francis Crick's discovery of the structure of DNA. It summarizes what was known about DNA in 1953 and challenges your students to apply what was known to the model pieces in their hands and to make DNA nucleotides that will form into a double helix.

Three Frequently Asked Questions answers the most common questions teachers and students have had about the models when field testing the DNA Discovery Kit.

The *Student Handout* and *Three Frequently Asked Questions* are also available as separate documents to make printing easier.

The subfolder on the CD that contains the above documents is named **DNA Activities Folder** and it resides within the **DNA Activities and & Teacher Notes Folder**, which also includes:

The **Watson & Crick Papers Folder** contains copies of the two Watson and Crick's papers that were published in *Nature* in April and May of 1953.

The **DNA Puzzle Folder** includes instructions on how to use the DNA Discovery Kit Puzzle with detailed photos. It provides directions and templates for creating your own Discovery Puzzle.

The **DNA Resource Information Folder** contains the document, *Teacher Notes and Background Information & Supplementary Material for Teaching DNA*. It provides a wealth of background information on DNA, some activity ideas, and supplementary materials. This document was reviewed several times by numerous teachers who provided valuable insights and suggestions. The folder also contains a *Student Worksheet* and *Student Answersheet*.

The file in the **DNA Website Folder** lists websites that provide resources for examining and teaching DNA from a variety of perspectives.

The remaining folder on the CD is the **Contents and Introduction Folder**. It contains this Introduction and the *DNA Contents & Assembly Directions* document.

Teaching with the DNA Discovery Kit®

Contents of CD

Contents & Introduction Folder

DNA Discovery Kit® Introduction
DNA Contents & Assembly Directions

DNA Activities & Teacher Notes Folder

DNA Activities Folder

The Discovery Approach
The Guided Discovery Approach
Student Handout
Three Frequently Asked Questions

DNA Puzzle Folder

DNA Discovery Kit® Puzzle
DNA Discovery Puzzle Template
DNA Discovery Puzzle Directions
Create Your Own Discovery Puzzle
PDF Template

Watson & Crick Papers Folder

Watson & Crick – April 1953
Watson & Crick – May 1953
Annotated Version of
Watson & Crick Paper

DNA Resource Information Folder

Read Me First
DNA Background – Teacher Notes
Student Worksheet
Student Answersheet

DNA Websites Folder

Additional DNA Resources

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DNA — The Information Molecule

After examining DNA from the structural perspective, you may want your students to look at DNA from the information perspective.

3D Molecular Designs has created an inexpensive, innovative way for your students to appreciate how much information genes contain, how it's packaged and how it's transcribed in cells to make proteins.

The **3DMD Paper Bioinformatics Activity — Map of the β -Globin Gene** contains the entire DNA sequence of the β -Globin Gene and three of its reading frames. Your students are given the β -Globin protein amino acid sequence and challenged to find the sequence on the map, encountering exons and introns as they do so. Through this hands-on activity, your students gain a greater understanding of DNA as an information molecule, which also makes the structure-function aspects of DNA more meaningful.

The Paper Bioinformatics activity also introduces your students to the field Bioinformatics and the advances that have been made possible due to molecular scientists' ability to analyze and engineer DNA.

(Exons are highlighted on the Teachers Map, which also includes mutation sites and other information.)

For more information, please visit New Products on our website, www.3dmoleculardesigns.com

