

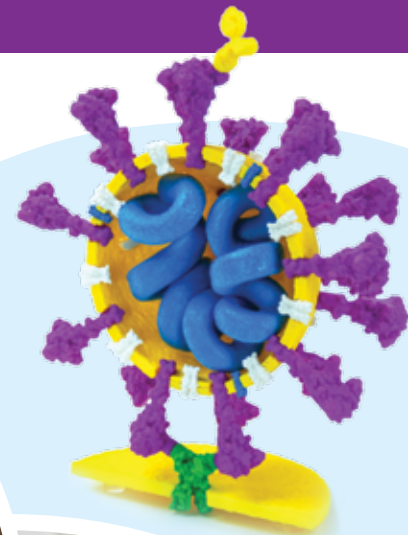
# Models Give Words Meaning

Explore  
patterns

Make  
predictions

Revise  
explanations

Grapple with  
complex biology  
concepts



## 2022 CATALOG

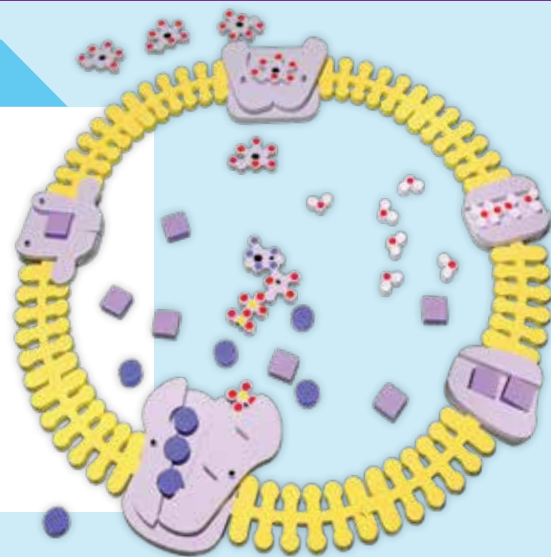
## Phospholipid & Membrane Transport Kit<sup>®</sup>

Let your students discover the spontaneous formation of membranes for themselves, using this kit featuring the amphipathic structure of phospholipids, with their hydrophilic heads and hydrophobic tails. Your students will explore the chemical structure of a phospholipid and then construct a phospholipid monolayer, micelle and bilayer, leading to an understanding of the plasma membrane structure. Additional components of this kit allow students to construct lipid bilayers and consider the role of transport proteins in moving ions and small molecules across membranes.

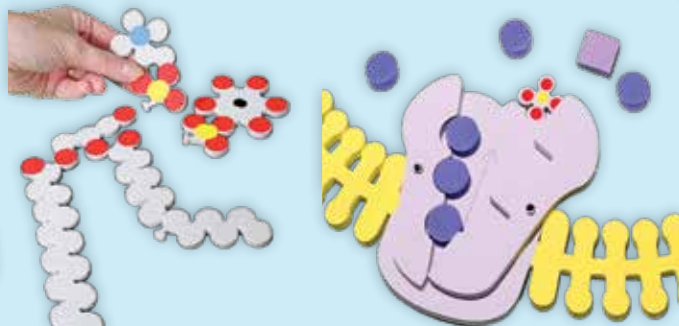
**Lessons and activities are available online at**  
[3dmoleculardesigns.com](https://www.3dmoleculardesigns.com)

**1-Group Set \$50 (PMTK-01)**  
**3-Group Set \$138 (PMTK-03)**

Also see Water Kit<sup>®</sup> (page 3).



Phospholipid Structure



Phosphorylated Na<sup>+</sup>/K<sup>+</sup> Pump

**⚠ WARNING: CHOKING HAZARD**  
**CAUTION:** Science Education Product  
**⚠ WARNING: CALIFORNIA PROP 65**  
Please see bottom of page 17 for details.

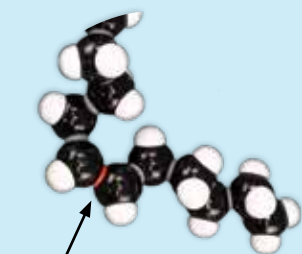
## Phospholipid Modeling Set

These Molymod<sup>®</sup> phospholipid models enable your students to explore the amphipathic structure of phospholipids, the most abundant lipids in membranes. The set contains all of the atoms and bonds needed to construct five phospholipids and compare and contrast the chemical make-up of their hydrophilic heads and hydrophobic tails. The phospholipid models can be used separately or with the Phospholipid & Membrane Transport Kit<sup>®</sup>.

**Phospholipid Modeling Set \$275 (PLMS-01)** • **Phosphatidylcholine \$65 (PLMS-A)**  
**Phosphatidylserine \$63 (PLMS-B)** • **Phosphatidylinositol \$68 (PLMS-C)**  
**Phosphatidylethanolamine \$61 (PLMS-D)** • **Sphingomyelin \$67 (PLMS-E)**

*Not eligible for discounts*

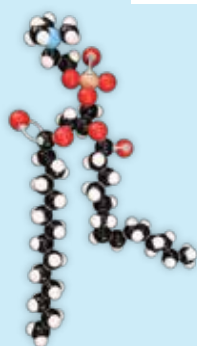
Also see Water Kit<sup>®</sup> (page 3) and Phospholipid & Membrane Transport Kit<sup>®</sup> (above).



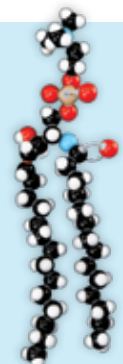
Indicates  
Double Bond



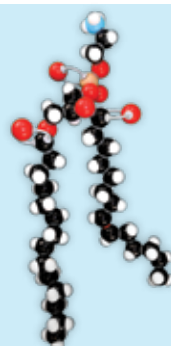
Phosphatidylinositol



Phosphatidylcholine



Sphingomyelin



Phosphatidylethanolamine



Phosphatidylserine

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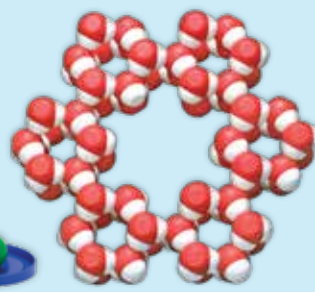
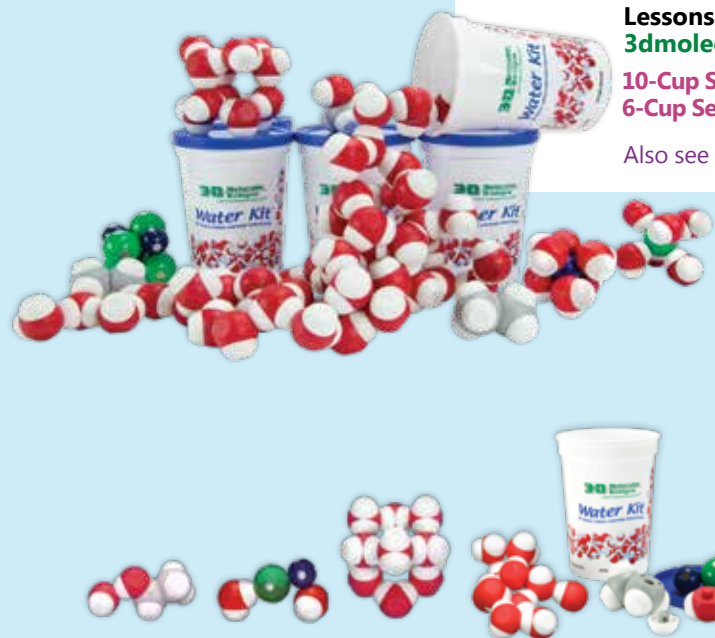
## Water Kit<sup>®</sup>

While playing with these appealing magnetic water molecules your students will understand concepts that are often difficult to learn. They will explore hydrogen bonding, make ice, dissolve salt, evaporate water, explore transpiration, create ethanol and much more. Each Water Kit<sup>®</sup> cup includes pieces for 12 water molecules, 1 sodium, 1 chloride, 1 ethane and 1 hydroxyl group. All atoms are correctly magnetized to reflect their positive or negative charges.

**Lessons and activities are available online at**  
**3dmoleculardesigns.com**

**10-Cup Set \$580 (WK-10)** • **8-Cup Set \$472 (WK-08)**  
**6-Cup Set \$360 (WK-06)** • **1-Cup \$62 (WK-01)**

Also see Phospholipid & Membrane Transport Kit<sup>®</sup> (page 2).



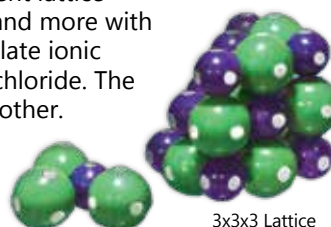
**Use the Water Kit and NaCl together!**

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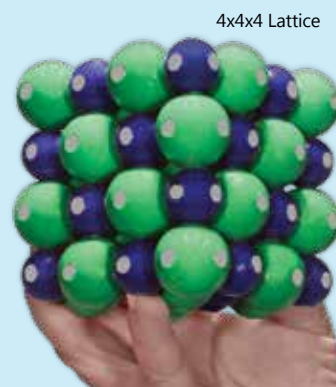
## NaCl Lattice<sup>®</sup>

Your students will discover the cubic nature of salt crystals, efficient lattice packing, high melting temperature, brittleness, cleavage planes and more with these models. Each ion model has 6 embedded magnets to simulate ionic bonding. The 4x4x4 lattice contains 64 ions - 32 sodium and 32 chloride. The 3x3x3 lattice contains 27 ions - 13 of 1 type of ion and 14 of the other. (Water molecules are not included.)

**4x4x4 Lattice \$316 (NACL-04)**  
**3x3x3 Lattice \$150 (NACL-03)**



3x3x3 Lattice



4x4x4 Lattice



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## 2022 CATALOG

## Enzymes In Action Kit<sup>®</sup>

Take your students beyond the simple lock-and-key concept of enzyme action with this dynamic, multifunctional kit. Color-coded foam pieces represent enzymes, a variety of substrates and inhibitors. Your students will use this kit to discover the specificity of substrate binding, how enzymes catalyze either catabolic or anabolic reactions and the effect of various inhibitors on enzyme action.

Each Enzymes In Action Kit<sup>®</sup> 1-group set contains 10 foam pieces (2 gray, 2 green, 2 orange, 1 red, 1 tan, 1 purple and 1 blue) and 1 sheet of stickers.

Teacher notes and student handouts are available online at [3dmoleculardesigns.com](https://3dmoleculardesigns.com)

**12-Group Set \$144** (EAK-12) • **6-Group Set \$78** (EAK-06) • **3-Group Set \$42** (EAK-03)

Also see Substrate Specificity Kit<sup>®</sup> (below).



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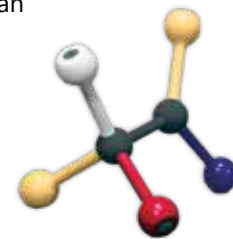
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Please see bottom of page 17 for details.



## Substrate Specificity Kit<sup>®</sup>

Help your students achieve that "aha moment" with this simple but elegant kit that demonstrates the highly-specific interaction between a substrate and an enzyme. With the Substrate Specificity Kit<sup>®</sup> students:

- Use color-coded functional groups to construct a substrate and examine its chemical properties.
- Use a mini toober to engineer an enzyme active site specific to the substrate constructed.
- Explore different types of specificity including stereochemical specificity and absolute specificity.
- Discover how subtle changes in enzyme structure can potentially have a significant impact on substrate binding in the active site.



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**⚠ WARNING: SMALL MAGNETS**

**CAUTION:** Science Education Product

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Please see bottom of page 17 for details.

Lessons and activities are available online at [3dmoleculardesigns.com](https://3dmoleculardesigns.com)

**Substrate Specificity Kit \$58** (SSK-01)

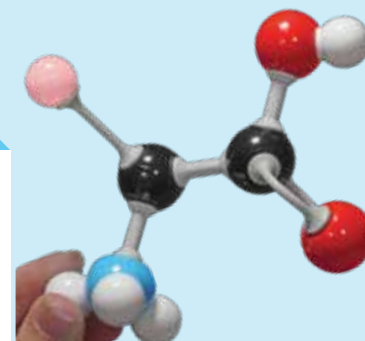
Also see Enzymes in Action Kit<sup>®</sup> (above).

## Amino Acid Building Block Models

These Amino Acid Building Block Models from Molymod<sup>®</sup> enable your students to explore the basic structure of amino acids — the building blocks of proteins. The kit contains all of the atoms and bonds needed to construct 2 models of a generic amino acid. Side chains are represented by the green spheres. The 2 amino acids can be joined by a peptide bond to make a dipeptide — splitting out a water molecule. Activities for using the models are available online.

**Amino Acid Building Block Models \$16.50** (AABB) *Not eligible for discounts*

Also see Amino Acid Starter Kit<sup>®</sup> (page 5).



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## Amino Acid Starter Kit®

*"I can never again teach protein structure without toobers—they make it much easier for students to SEE protein folding!"*

Your students will explore the primary, secondary and tertiary structure of proteins with this captivating kit. They will learn the chemical properties and atomic structure of the 20 amino acid side chains through the kit's dual coloring scheme. Understanding protein structure begins with this unique combination of atomic and chemical properties. With the kit's engaging, hands-on activities your students will gain a basic knowledge of protein folding before discovering the importance of secondary structure and active sites.

Each 1-group set includes 1 chemical properties circle, 1 amino acid side chain chart, 22 amino acids and clips, 1 1-meter mini toober and 6 hydrogen bond connectors.

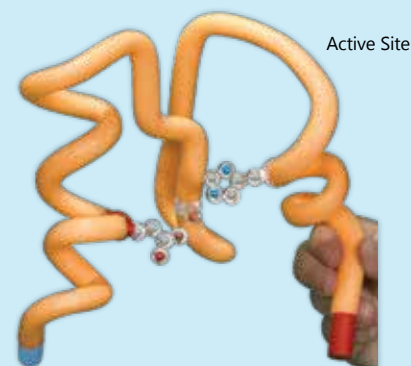
**Teacher notes, student handouts and interactive Jmol visualization tools are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)**

Project Lead the Way® selected the Amino Acid Starter Kit® for its BioMedical Sciences™ Program.

**6-Group Set \$438 (AASK-06)** • **5-Group Set \$375 (AASK-05)**  
**3-Group Set \$231 (AASK-03)** • **1-Group Set \$79 (AASK-01)**

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Please see bottom of page 17 for details.



To increase your students' understanding of proteins, see the  $\beta$ -Globin Folding Kit® and Map of the Human  $\beta$ -Globin Gene® (page 7), Insulin mRNA to Protein Kit® (page 6), David Goodsell Cellular Landscapes (page 18-19), Amino Acid Starter Kit Poster® (below) and Genetic Codon Posters® (page 8).

## Amino Acid Starter Kit Poster®

The Amino Acid Starter Kit Poster® allows students to connect the chemical structure of each amino acid side chain as it is commonly represented in textbooks. The poster features the same dual color scheme as the Amino Acid Starter Kit®. Each atom of the side chain is color-coded according to atom type and each base is color-coded to reflect the overall chemical property of the side chain.

**Amino Acid Starter Kit Poster® (24" x 29") \$32 (AASKP)**

Also see Amino Acid Starter Kit® (above) and Genetic Codon Posters® (page 8).

**Amino Acid Side Chain Chart®**

Name	Amino Acid Side Chain	Name	Amino Acid Side Chain	Name	Amino Acid Side Chain	Name	Amino Acid Side Chain
Alanine		Glutamine		Valine		Threonine	
Arginine		Glutamic Acid		Asparagine		Threonine	
Asparagine		Aspartic Acid		Asparagine		Threonine	
Aspartic Acid		Asparagine		Asparagine		Threonine	
Asparagine		Asparagine		Asparagine		Threonine	
Asparagine		Asparagine		Asparagine		Threonine	
Asparagine		Asparagine		Asparagine		Threonine	
Asparagine		Asparagine		Asparagine		Threonine	
Asparagine		Asparagine		Asparagine		Threonine	

**Atom Color Key**

**Amino Acid Property Key**

## 2022 CATALOG

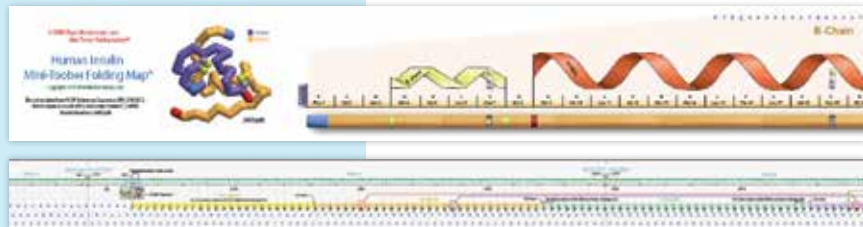


## Insulin mRNA to Protein Kit<sup>®</sup>

The Insulin mRNA to Protein Kit<sup>®</sup> helps your students understand that the specific sequence of amino acids in a protein is encoded by the specific sequence of nucleotides in the corresponding gene. After using the bioinformatics map to search for the nucleotide sequence that encodes the amino acid sequence of insulin, your students will fold a physical model of the 3-D structure of the insulin protein, using mini toobers (1 for the A-chain and 1 for the B-chain) and a folding map.

Each 1-group set includes student mRNA map, student folding map, 2 mini toobers, side chains, plastic clips, support posts, endcaps and an assortment of parts to mark and connect the chains.

**Teacher notes, student handouts and interactive Jmol visualization tools are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)**



**6-Group Set \$336 (INSFK-06)**

**3-Group Set \$189 (INSFK-03)**

**1-Group Set \$72 (INSFK-01)**

It's best if your students first use the Amino Acid Starter Kit<sup>®</sup> (page 5) before using the Insulin mRNA to Protein Kit<sup>®</sup>. Also see Insulin Model and Insulin Poster<sup>®</sup> (below),  $\beta$ -Globin Folding Kit<sup>®</sup> (page 7) and Genetic Codon Posters<sup>®</sup> (page 8).

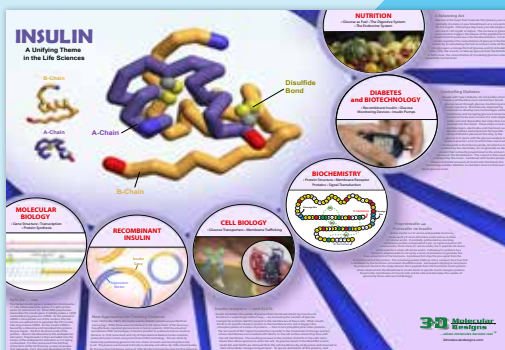
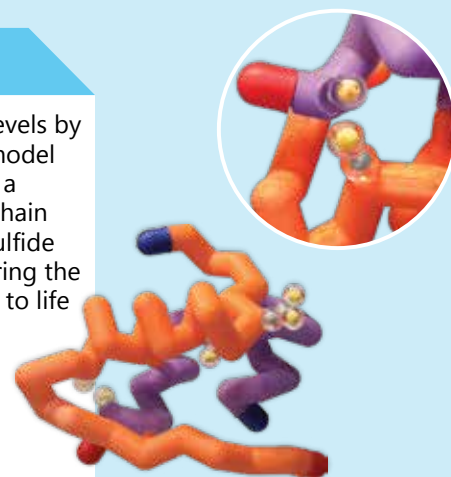
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## Insulin Model

The hormone insulin is an important regulatory protein that helps control blood sugar levels by signaling cells to take up glucose circulating in the blood. Our alpha carbon backbone model of insulin – now printed in more durable plastic – features a 51-amino acid peptide with a longer B chain (orange) composed of an alpha helix and a beta strand, and a shorter A chain (purple) consisting of two alpha helices. The two chains are linked together by three disulfide bonds formed between the three pairs of cysteine side chains displayed in the model. Bring the basic principles of primary, secondary, tertiary and quaternary levels of protein structure to life in your classroom by exploring the structure of the insulin model.

**5" Plastic Model \$65 (INSPM)**

This model can be used as an accurate smaller scale template when using the Insulin mRNA to Protein Kit<sup>®</sup> (above). It can break if abused.



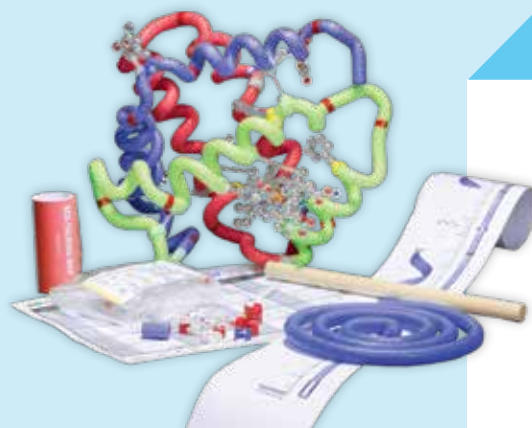
## Insulin Poster<sup>®</sup>

By using the insulin protein as a starting point, teachers can weave together a broad range of biology topics including the flow of genetic information, biochemistry and protein structure, cellular organelles, anatomy, physiology and cell biology of glucose homeostasis, energy metabolism, the endocrine and digestive systems, recombinant DNA technologies and new approaches to monitor blood glucose levels and control diabetes.

**Insulin Poster \$29 (INSP)**

Also see Insulin mRNA to Protein Kit<sup>®</sup> (above).





## Beta-Globin Folding Kit®

Proteins become real in your students' hands as they fold 3 mini toober beta-globin fragments and discover the primary, secondary and tertiary structure in this model. Maps guide your students in folding the mini toobers into beta-globin's 3-D shape. Use the folded mini toober model of beta-globin to discuss protein structure, the important role of hemoglobin in oxygen transport and the lasting effects of a single amino acid mutation on a protein. The kit includes mini toobers, folding map guides, amino acid side chains, heme group, iron atom, oxygen atoms and an assortment of parts to mark and connect the fragments. The folding kit can be used successfully by 6 to 9 students working in 3 teams.

Lessons and activities are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)

Folding Kit \$212 (BGFK)

It's best if your students first use the Amino Acid Starter Kit® (page 5) before using the Beta-Globin Folding Kit®. Also see Map of the Human Beta-Globin Gene® (below).

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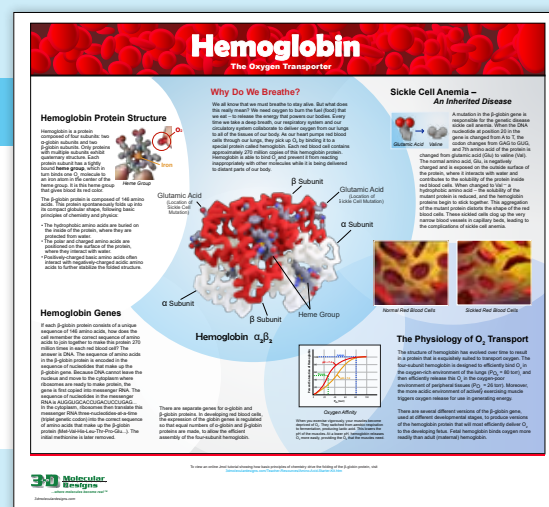
**WARNING: CALIFORNIA PROP 65**

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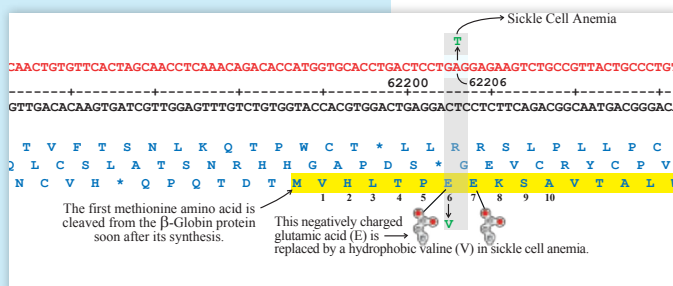
## Hemoglobin Poster®

From exploring the question "Why do we breathe?," to illustrating the structure of hemoglobin, the cause of sickle cell anemia and the physiology of oxygen transport, our colorful Hemoglobin Poster® will spark new inquiry among your students. Best used as a companion guide for Beta-Globin Folding Kit® and Map of the Human Beta-Globin Gene®. The poster can also stand alone to help facilitate meaningful discussions about hemoglobin.

Hemoglobin Poster® (21" x 22") \$29 (HGP)



## Map of the Human Beta-Globin Gene®



Don't just tell your students about triplet codons, reading frames or introns and exons. Let them discover these eukaryotic gene features as they explore the Map of the Human Beta-Globin Gene®. Starting with the protein sequence, students work backward to discover the beta-globin gene. Student maps can be used by individuals or small groups and are available in sets of 1, 3 or 12. One teacher's map comes with every combo. The teacher's map features highlighted reading frames and mutation sites. All maps are laminated.

Teacher notes, instructions and student handouts are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)

1 Student and 1 Teacher Map Combo \$60 (BGGM-01S-01T)

3 Student and 1 Teacher Map Combo \$95 (BGGM-03S-01T)

12 Student and 1 Teacher Map Combo \$248 (BGGM-12S-01T)

## 2022 CATALOG

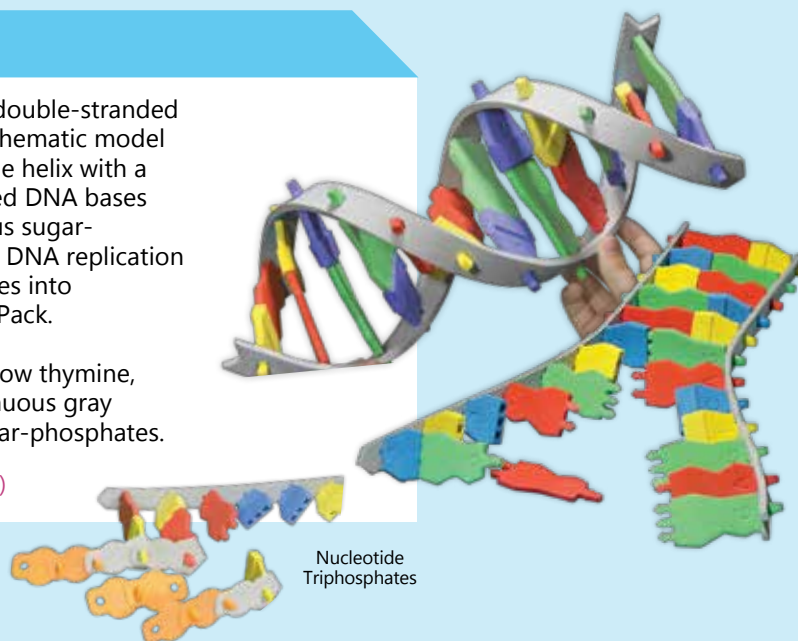
### DNA Starter Kit®

Engage your students with this interactive, foam model of double-stranded DNA and single-stranded RNA. The DNA Starter Kit® is a schematic model that transforms from the familiar ladder shape to the double helix with a twist. Your students can explore the structure of color-coded DNA bases showing purines and pyrimidines connected to a continuous sugar-phosphate backbone. Then they can explore the process of DNA replication and RNA transcription. Turn the nucleotide monophosphates into nucleotide triphosphates with the Triphosphate Expansion Pack.

Each 1-group set includes 51 bases (12 red adenine, 12 yellow thymine, 12 blue cytosine, 12 green guanine, 3 white uracil), 4 continuous gray backbones, 24 gray sugar-phosphates and 12 lavender sugar-phosphates.

**2-Group Set \$100 (DNASK-02) • 1-Group Set \$54 (DNASK-01)**

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Nucleotide Triphosphates

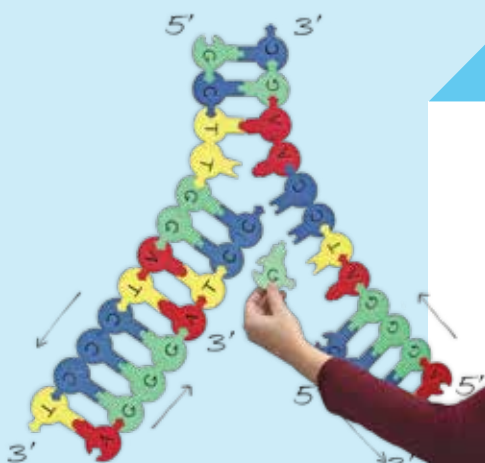
### Demo DNA Nucleotides®

Using these large-scale, color-coded foam nucleotides, you can teach the complementary A-T and C-G base pairs and the antiparallel nature of double-stranded DNA. Move on to the flow of genetic information as you teach the basic processes of semiconservative DNA replication and mRNA transcription. You can then stretch your students by introducing PCR (polymerase chain reaction) and the Sanger DNA sequencing method — and much more. One set contains 80 nucleotides: 20 As, 20 Ts, 20 Cs and 20 Gs.

**Demo DNA Nucleotides® \$54 (DDNS-01)**

Also see *Dynamic DNA Kit®* (page 11), *Flow of Genetic Information Kit®* (page 10), *DNA Starter Kit®* (above), and *Tour of a Human Cell®* (page 18).

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### Genetic Codon Posters®

The Genetic Codon Chart® and Genetic Codon Circle® can be used with 3DMD's popular Amino Acid Starter Kit®, β-Globin Folding Kit® and Insulin mRNA to Protein Kit® — which introduce your students to a standard color scheme: hydrophobic amino acids are yellow, polar amino acids are white, acidic amino acids are red, basic amino acids are blue and cysteines are green. Students can easily build a seamless connection between the triplet codon in mRNA and the chemical property of the amino acid it encodes.

**Genetic Codon Chart® (24" x 30") \$32 each (GCCA)**

**Genetic Codon Circle® (30" x 24") \$32 each (GCCB)**

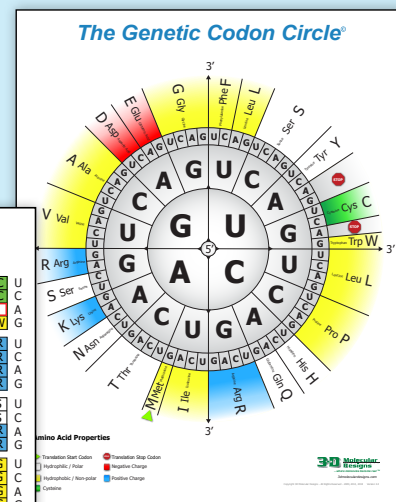
Best when used with the Amino Acid Starter Kit® and Amino Acid Starter Kit Poster® (Page 5), β-Globin Folding Kit® and Map of the Human β-Globin Gene (page 7), Insulin mRNA to Protein Kit® (page 6) and Flow of Genetic Information Kit® (page 10).

**The Genetic Codon Chart®**

	U	C	A	G
U	UUU → Phe F UUC → Phe F UUA → Leu L UUG → Leu L	UCU → Ser S UCC → Ser S UCA → Ser S UCG → Ser S	UAU → Tyr Y UAC → Tyr Y UAA → Stop UAG → Stop	UGU → Cys C UGC → Cys C UGA → Stop UGG → Trp W
C	CUU → Leu L CUC → Leu L CUA → Leu L CUG → Leu L	CCU → Pro P CCC → Pro P CCA → Pro P CCG → Pro P	CAU → His H CAC → His H CAA → Gln Q CAG → Gln Q	CGU → Arg R CGC → Arg R CGA → Arg R CGG → Arg R
A	AUU → Ile I AUC → Ile I AUA → Ile I AUG → Met M	ACU → Thr T ACC → Thr T ACA → Thr T ACG → Thr T	AAU → Asn N AAC → Asn N AAA → Lys K AAG → Lys K	AGU → Ser S AGC → Ser S AGA → Arg R AGG → Arg R
G	GUU → Val V GUC → Val V GUA → Val V GUG → Val V	GCU → Ala A GCC → Ala A GCA → Ala A GCG → Ala A	GAA → Asp D GAG → Asp D GAA → Glu E GAG → Glu E	GGU → Gly G GGC → Gly G GGA → Gly G GGG → Gly G

**Amino Acid Properties**

- Translation Start Codon
- Hydrophobic / Non-polar
- Hydrophilic / Polar
- Translation Stop Codon
- Negative Charge
- Positive Charge
- Cysteine



The Genetic Codon Circle®

The Genetic Codon Chart®





## Chromosome Connections Kit<sup>®</sup>

### DNA ~ Cell Division ~ Inheritance

Help your students make the connection between chromosomes at the microscopic scale and chromosomes at the molecular scale! The Chromosomes Connections Kit<sup>®</sup> will enhance your classroom exploration of the cell cycle, cell division and genetics. Students can manipulate the colorful foam pieces in the kit to:

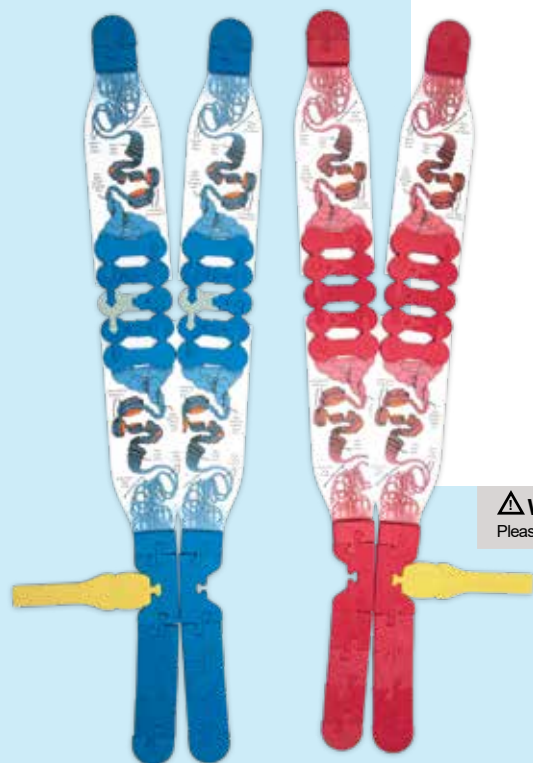
- Model chromosome structure and anatomy.
- Construct Punnett squares to connect inheritance of traits to chromosomes at the molecular level.
- Compare and contrast mitosis and meiosis.
- Model mechanisms that contribute to genetic variation.
- Model chromosomal aberrations such as nondisjunctions, translocations, inversions, deletions and duplications.
- And much more!

**1-Group Set \$70 (CHK-01) • 2-Group Set \$132 (CHK-02)**

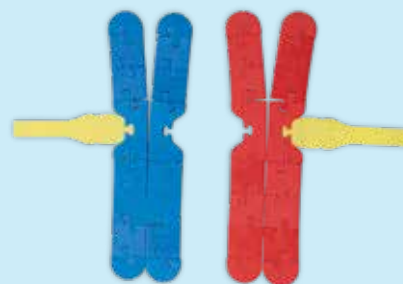
Also see Flow of Genetic Information Kit<sup>®</sup> (page 10).

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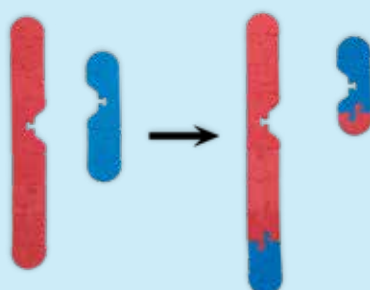
**CAUTION: Science Education Product**



Molecular scale



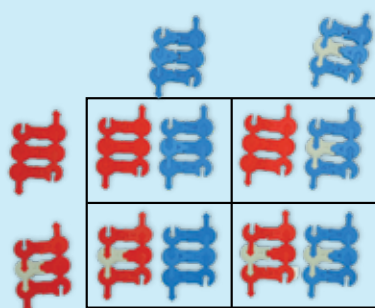
Microscopic scale



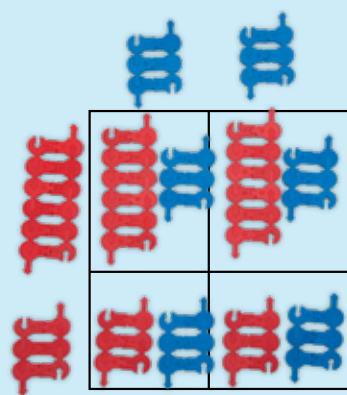
Translocation



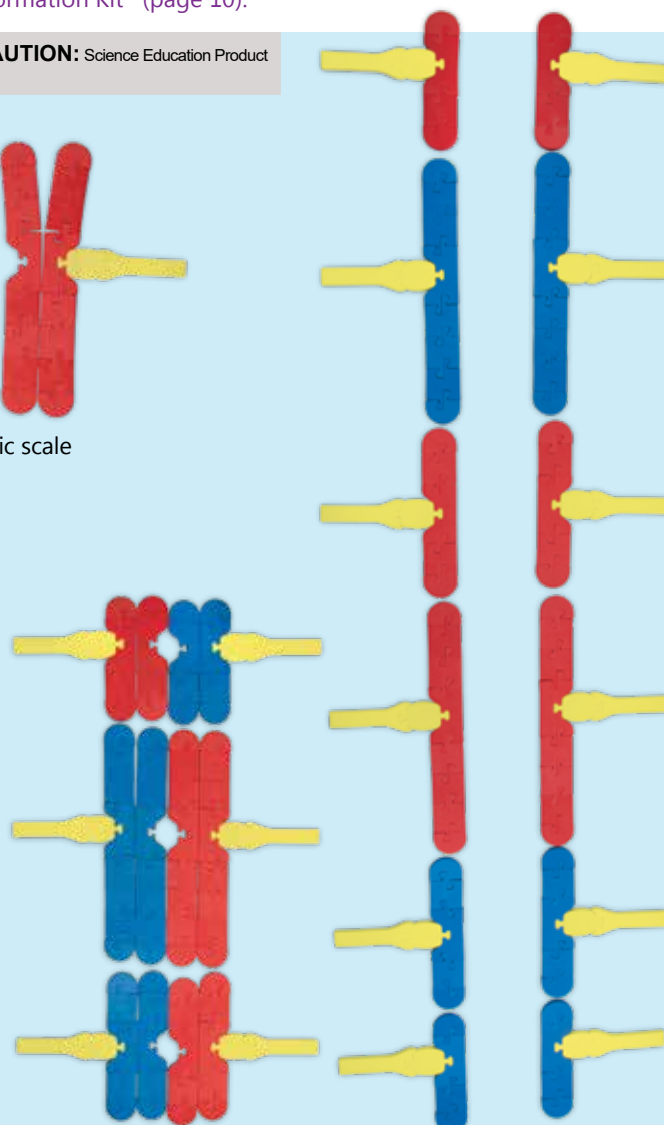
Crossing over



Dominant inheritance



Recessive inheritance



Meiosis

Mitosis

## 2022 CATALOG

### Flow of Genetic Information Kit®

Don't be surprised if one of your students blurts "Now I get it!" while using our Flow of Genetic Information Kit®! Manipulating the kit's color-coded foam nucleotides and placemats, students model:

- Replication of the leading and lagging strands of DNA.
- Transcription as they copy one strand of DNA into mRNA using an RNA polymerase.
- Translation/protein synthesis as they decode the mRNA into protein on the ribosome placemat.
- Your students can then explore the folding of the protein into its final 3D shape using our popular Amino Acid Starter Kit® (page 5).

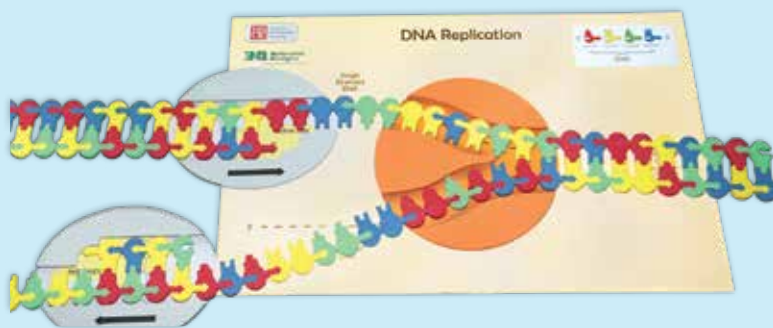
Lessons and activities are available online at [3dmoleculardesigns.com](https://3dmoleculardesigns.com)

**1-Group Set \$130** (FGIK-01)  
**3-Group Set \$375** (FGIK-03)  
**6-Group Set \$720** (FGIK-06)

**Additional DNA & RNA Nucleotide Set \$26** (FGIK-ANS)  
**Side Chain Expansion Pack \$29** (FGIK-SCEP)  
**tRNA Expansion Pack \$20** (FGIK-TEP)

**⚠ WARNING: CHOKING HAZARD**  
**CAUTION: Science Education Product**  
**⚠ WARNING: CALIFORNIA PROP 65**  
Please see bottom of page 17 for details.

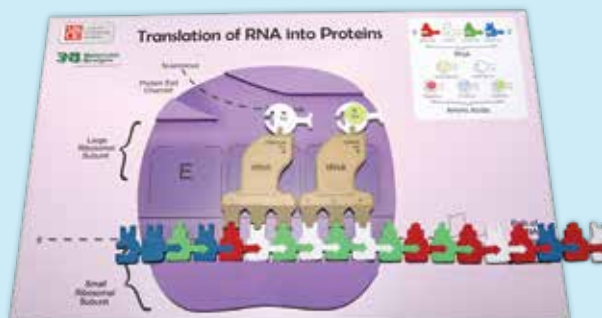
Replication: DNA Polymerase Catalyzes the Synthesis of New DNA



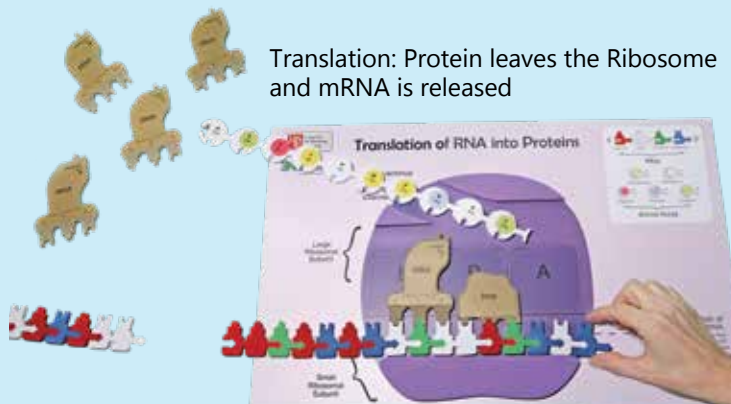
Transcription: mRNA is Synthesized



Translation: mRNA sequence determines the Amino Acid sequence built



Translation: Protein leaves the Ribosome and mRNA is released



Also see *Dynamic DNA Kit®* (page 11), *DNA Starter Kit®* (page 8), and *Tour of a Human Cell®* (page 18).





## Dynamic DNA Kit<sup>®</sup>

*"I can use it with multiple levels to reveal higher knowledge concepts."*

Introducing our new *Dynamic DNA Kit<sup>®</sup>* – a next generation teaching tool that will help your students better understand how the genetic information in DNA is revealed and used. *Dynamic DNA* includes the best features of our popular DNA Discovery Kit<sup>®</sup>: It's accurate and easy to put together. Students can assemble the nucleotides, feel the hydrogen bonding of the A-T and G-C base pairs and discover the double helical structure of DNA. But now – thanks to patented design innovations – they can also twist and unwind the double helix to model DNA replication and RNA transcription!

Field-tested by teachers, the 12 Base Pair Set includes 6 A-T and 6 G-C base pairs, 5' hydrogen and 3' oxygen parts, oxygen atoms to model RNA, removable carbons for uracil, ATP, TTP, GTP and CTP models, and display stand.

**Lessons and activities are available online at**  
**3dmoleculardesigns.com**

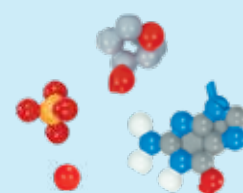
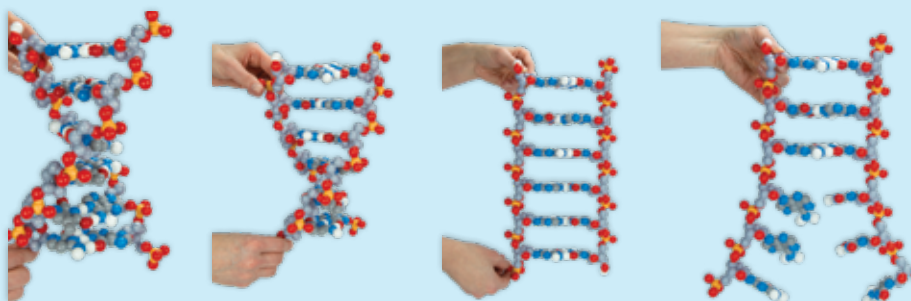
Project Lead the Way<sup>®</sup> selected the *Dynamic DNA Kit<sup>®</sup>* for its BioMedical Sciences™ Program.

**12 Base Pairs \$298 (DDNA-12) • 6 Base Pairs \$156 (DDNA-06)**  
**2 Base Pairs \$58 (DDNA-02) • 6 Sets of 12 Base Pairs \$1,500 (6DDNA-12)**

Also see Modeling Mini Toobers (page 14), Flow of Genetic Information Kit<sup>®</sup> (page 10), and Tour of a Human Cell<sup>®</sup> (page 18).

*"This will hook a kid!"*

Experience the dynamic flexibility of DNA with a better kit at a lower price!

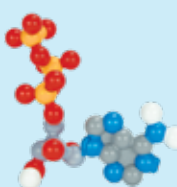
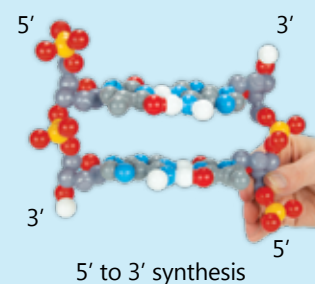


Assemble the nucleotide's nitrogen base, sugar and phosphate group

DNA replication

Major and minor grooves

*"This is literally the diagram from the textbook that students can manipulate!"*



Adenosine triphosphate

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**⚠ WARNING: SMALL MAGNETS**  
**CAUTION: Science Education Product**  
**⚠ WARNING: CALIFORNIA PROP 65**  
Please see bottom of page 17 for details.

## Biotechnology Kit<sup>®</sup>

### PCR – Sanger Sequencing – Restriction Enzymes

Help your students achieve a better understanding of multiple biotechnology concepts including diagnostics, forensics, and bacterial transformation with a single hands-on modeling kit! Using the color-coded foam nucleotides in the Biotechnology Kit<sup>®</sup> and teacher-developed activities, students:

- Model polymerase chain reaction and how flanking primers result in the exponential amplification of a short product.
- Model the Sanger DNA sequencing method using chain-terminating fluorescent dideoxy nucleotide analogs.
- Model DNA cloning using restriction endonucleases to cut DNA at specific sequences.
- And more!

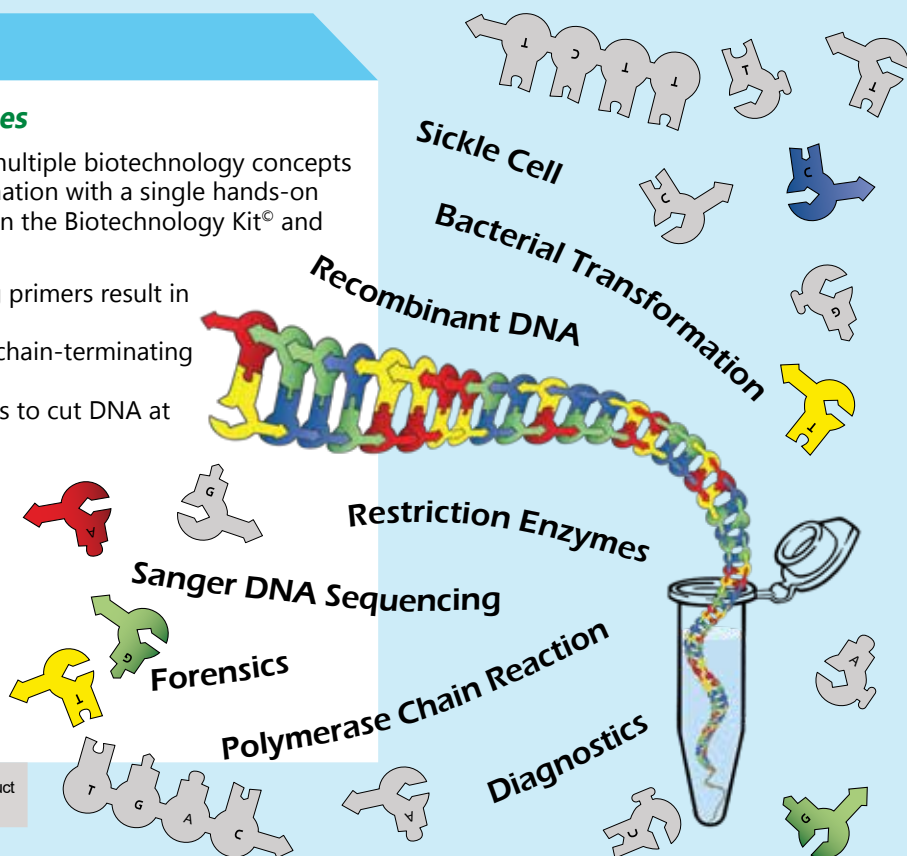
Lessons and activities are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)

**1-Group Set \$109 (BTK-01)**

Also see Flow of Genetic Information Kit<sup>®</sup> (page 10), Dynamic DNA Kit<sup>®</sup> (page 11),  $\beta$ -Globin Folding Kit<sup>®</sup> (page 7), and Map of the Human  $\beta$ -Globin Gene<sup>®</sup> (page 7).

**⚠ WARNING: CHOKING HAZARD**  
Please see bottom of page 17 for details.

**CAUTION: Science Education Product**



## Field Test Opportunity

### Extend Your Students' Learning with Augmented Reality

Your students can engage with our unique activities that extend their learning with our 3D models! Your feedback will help us shape the design and usability of our augmented reality program. To learn more, [contactus@3dmoleculardesigns.com](mailto:contactus@3dmoleculardesigns.com).







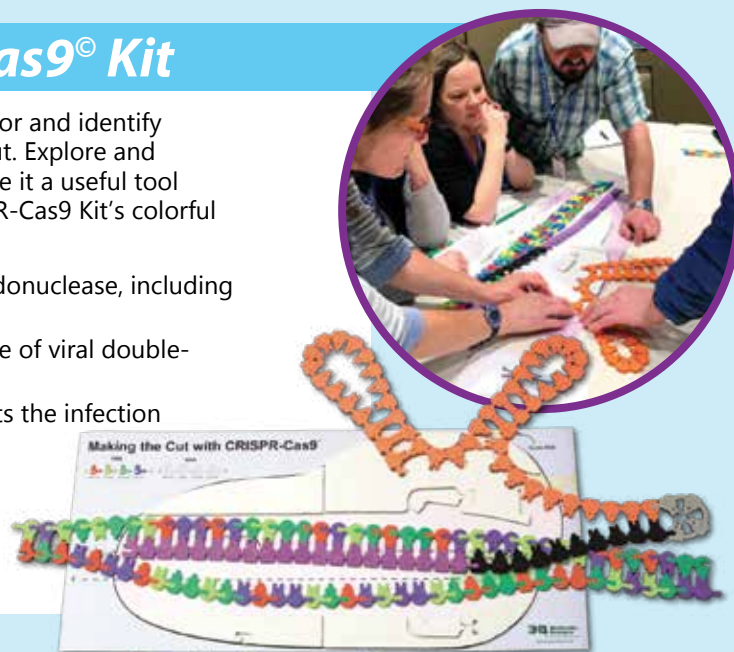
## Making the Cut with CRISPR-Cas9<sup>®</sup> Kit

Model how the Cas9 protein is programmed with RNA to search for and identify specific sequences of DNA before making the double-stranded cut. Explore and discuss how Cas9 is being engineered with new features that make it a useful tool for editing the human genome. Using Making the Cut with CRISPR-Cas9 Kit's colorful foam pieces and placemat your students can:

- Build a schematic model of the CRISPR-Cas9 RNA-guided endonuclease, including the viral double-stranded DNA and dual guide RNA.
- Understand how the Cas9 protein binds to a specific sequence of viral double-stranded DNA at a PAM site — and cuts it.
- Demonstrate how that cut destroys viral genome and prevents the infection of bacteria.
- And much more!

**1-Group Set \$88 (MCC-01)**  
**2-Group Set \$162 (MCC-02)**

**⚠ WARNING: CHOKING HAZARD**  
**CAUTION:** Science Education Product  
**⚠ WARNING: CALIFORNIA PROP 65**  
Please see bottom of page 17 for details.



## CRISPR Adaptive Immunity Kit<sup>®</sup>

Discover how bacteria remember past viral infections and activate their CRISPR systems to search for and destroy the remembered virus' DNA — preventing infection. This introduction to CRISPR biology will prepare your students to use Making the Cut with CRISPR-Cas9 and understand how the Cas9 protein works. With the CRISPR Adaptive Immunity Kit's engaging foam pieces, your students can:

- Build the bacteria's CRISPR array, including Cas9, tracr, spacer and repeat nucleotides.
- Detect the presence of viral double-stranded DNA.
- Integrate a fragment of viral genome into the bacteria's CRISPR array.
- Express the CRISPR array as Cas9 proteins with guide RNAs.

**1-Group Set \$70 (CAIK-01)**  
**2-Group Set \$132 (CAIK-02)**

**⚠ WARNING: CHOKING HAZARD**  
**CAUTION:** Science Education Product  
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Please see bottom of page 17 for details.

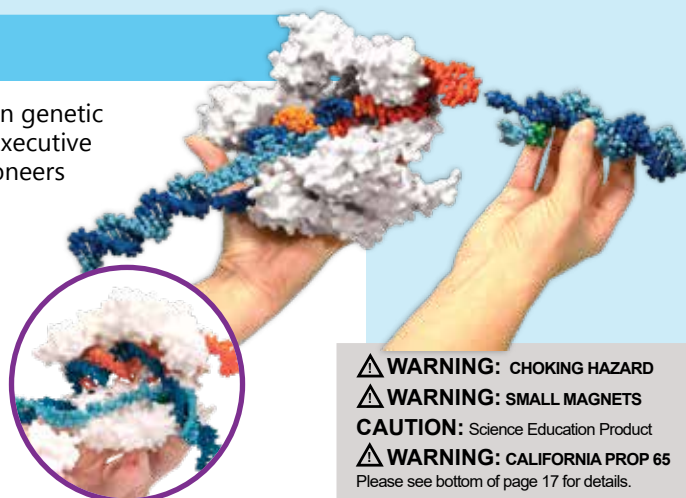
**Teacher tip:**  
Put magnets  
on the back to  
utilize whiteboards!  
\*MAGNETS ARE NOT INCLUDED.



## CRISPR-Cas9 Models

Give your students a hands-on exploration of the next generation in genetic engineering! Jennifer Doudna, PhD, Professor at UC-Berkeley and Executive Director of the Innovative Genomics Initiative (IGI), is one of the pioneers of the CRISPR-Cas9 technique, which allows researchers to make specific changes to the genetic code of cells and organisms. 3D Molecular Designs designed and built the model for Dr. Doudna with Jacob Corn, PhD, Scientific Director of the IGI. The front segment detaches from the model, allowing students a closer look at the guide RNA and two strands of DNA inside.

**5" Nylon Model \$498 (NCC9M-5)**  
**11" Nylon Model \$1,450 (NCC9M-11)**  
Not eligible for discounts



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**⚠ WARNING: SMALL MAGNETS**  
**CAUTION:** Science Education Product  
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## 2022 CATALOG

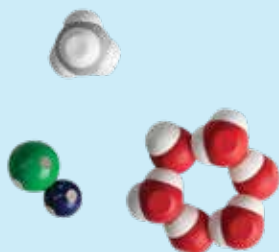
### Student Modeling Packs

Now students can now explore the molecular world with their own individual modeling pack. Even with virtual environments, students are far more engaged and abstract concepts become better understood through hands-on learning. Teachers have also found these kits are great for in-person classwork too. Available kits shown below.

**Student Modeling Pack Collection Set of all 6 \$79 (SMPC)**

**⚠ WARNING: CHOKING HAZARD** **CAUTION:** Science Education Product **⚠ WARNING: CALIFORNIA PROPOSITION 65**  
Please see bottom of page 17 for details.

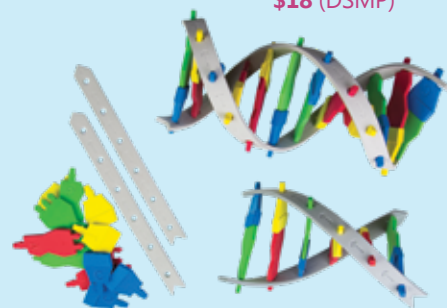
**Water Student Modeling Pack**  
**\$50 (WSMP)**



**Nucleotide Student Modeling Pack**  
**\$18 (NSMP)**



**Double Helix Student Modeling Pack**  
**\$18 (DSMP)**



**Membrane Student Modeling Pack**  
**\$12 (MSMP)**



**Chromosome Student Modeling Pack**  
**\$17 (CSMP)**



**Protein Student Modeling Pack**  
**\$20 (PSMP)**



### Modeling Mini Toobers



**⚠ WARNING: CHOKING HAZARD**  
**CAUTION:** Science Education Product  
Please see bottom of page 17 for details.

Versatile mini toobers provide hands-on learning experiences in many science disciplines. Biology and chemistry students can model DNA or create protein structures while following the principles of chemistry. Physics students can explore sound and other waves. The flexible foam mini toobers have a soft wire core and are 1-meter long. One red and one blue end cap is included with each mini toober. Use end caps to designate N terminus and C terminus in protein-folding or 3' and 5' ends in DNA model. **Push Pins Are Not Included.** 3DMD's protein folding activity is available online.

**1 Toober \$14 (MTBR-01)**

Also see Amino Acid Starter Kit<sup>®</sup> (page 5) and Dynamic DNA Kit<sup>®</sup> (page 11).





## Synapse Construction Kit<sup>®</sup>

Engage your classroom with hands-on modeling of neuronal communication! Students can use the colorful foam pieces in our Synapse Construction Kit<sup>®</sup> to:

- Discover how the resting potential of a neuron is established.
- Demonstrate the propagation of an action potential down an axon.
- Simulate the action of the sodium-potassium pump in resetting the resting potential.
- Explore the effects of neurotransmitters acetylcholine, dopamine and GABA on a post synaptic neuron.
- Model cholinergic, dopaminergic and GABAergic synapses.
- Compare and contrast metabotropic and ionotropic receptors.
- Analyze the impact of various substances such as nicotine, cocaine, sarin gas and propofol on neuronal signaling.

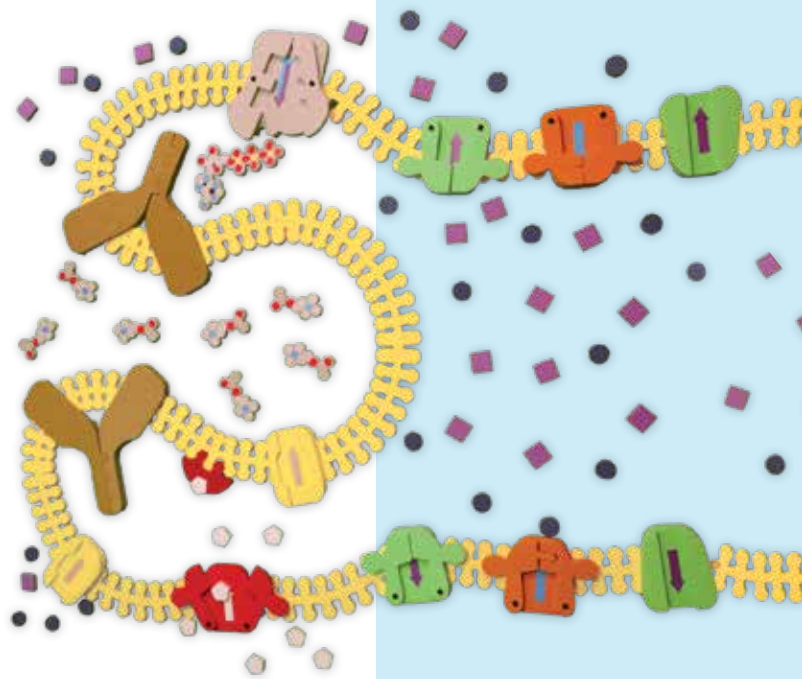
**Assembly instructions, lessons and activities are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)**

**1-Group Set \$142 (SCK-01)**

**3-Group Set \$420 (SCK-03)**

**6-Group Set \$798 (SCK-06)**

Also see Phospholipid & Membrane Transport Kit<sup>®</sup> (page 2) and Neuron Modeling Kit<sup>®</sup> (below).



**⚠ WARNING: CHOKING HAZARD** **CAUTION:** Science Education Product **⚠ WARNING: CALIFORNIA PROPOSITION 65**  
Please see bottom of page 17 for details.

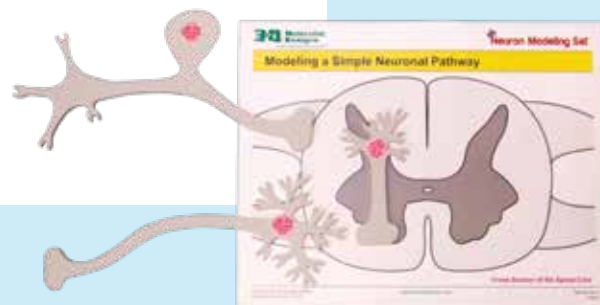
## Neuron Modeling Kit<sup>®</sup>

Captivate your classroom and explore multiple concepts with our large and small foam neuron models! Students can use the Neuron Modeling Kit<sup>®</sup> to:

- Construct a model and identify parts of a multipolar neuron.
- Distinguish between multipolar neurons, bipolar neurons, unipolar neurons and interneurons, and determine their location and function in the human body.
- Use myelin sheath pieces to show differences between two types of neuroglia in the central and peripheral nervous systems.
- Construct simple and complex neural pathways and examine the effect on neuronal firing at excitatory and inhibitory synapses.

**Lessons and activities are available online at [3dmoleculardesigns.com](http://3dmoleculardesigns.com)**

**Neuron Modeling Kit<sup>®</sup> \$58 (NMK-01)**



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## 2022 CATALOG

## Coronavirus Models

Help your students visualize and better understand the SARS CoV-2 coronavirus with our new 3D printed plastic model – available in 3 sizes and 2 color schemes! The surface of the virus membrane is shown in gray or yellow. The spike protein is shown in red or magenta. Magnets embedded in 2 spike proteins at the bottom of the virus allow it to dock with the host cell base, binding to an ACE2 receptor (green on both models). The antibody (yellow) also has a magnet, allowing you to model how an antibody finds and attaches to the receptor-binding domain of the spike protein, preventing it from binding to the ACE2 receptor. Mini toober RNA viral genome is provided. Use with our FREE Science of Coronaviruses Series!

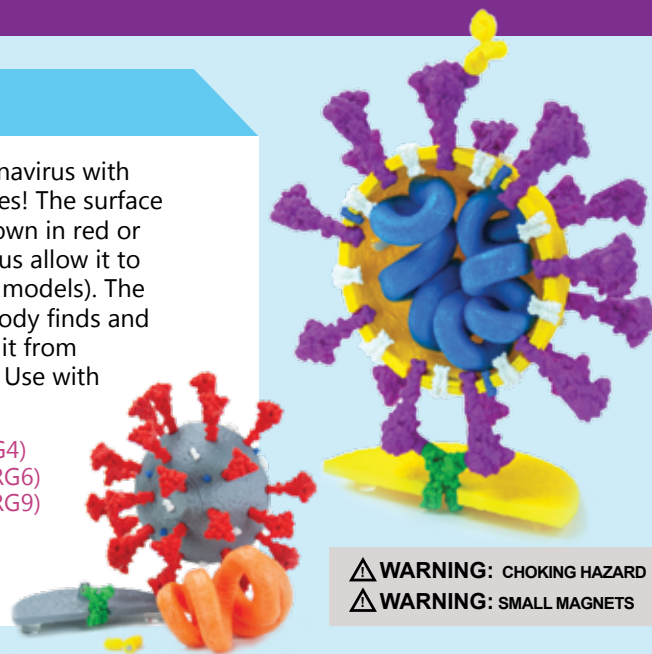
**4" Red & Gray \$99** (CVPM-RG4)  
**6" Red & Gray \$299** (CVPM-RG6)  
**9" Red & Gray \$699** (CVPM-RG9)

**4" Yellow & Magenta \$99** (CVPM-RG4)  
**6" Yellow & Magenta \$299** (CVPM-RG6)  
**9" Yellow & Magenta \$699** (CVPM-RG9)

**Classroom Set: 1 Medium (6") & 6 Small (4") Models**

**Red/Gray \$799** (CVPM-1RG6-6RG4)

**Yellow/Magenta \$799** (CVPM-1MY6-6MY4)



**⚠ WARNING: CHOKING HAZARD**

**⚠ WARNING: SMALL MAGNETS**

## Antibody and Antigen Models

Incorporate the concepts of protein structure and function while teaching the immune system using our antibody model – now printed in more durable plastic. Antibodies are composed of 12 repeating immunoglobulin folds. Our model highlights the four polypeptides – two yellow heavy chains and two red light chains – that join to form the iconic Y shaped molecule. Students will model how an antibody binds to two antigens (purple globular structures) found on an influenza virus protein.

Enhance your students' conceptual understanding of immunity and infection with multiple models. Use the Antibody and Antigen Models to actively simulate the antibody binding and specificity illustrated in the Flu Fight: Immunity & Infection Panorama® (page 19).

**1 8.5" Plastic Antibody and 2 3.5" Antigen Models \$80** (ANTPM)

**Flu Fight: Immunity & Infection Panorama® 23" x 66" and 6-Antibody and 12-Antigen Models Combo \$456** (DGFFP-01-ANTPM-06)

**⚠ WARNING: SMALL MAGNETS**  
Please see bottom of page 17 for details.

**CAUTION: Science Education Product**

**⚠ WARNING: CALIFORNIA PROPOSITION 65**

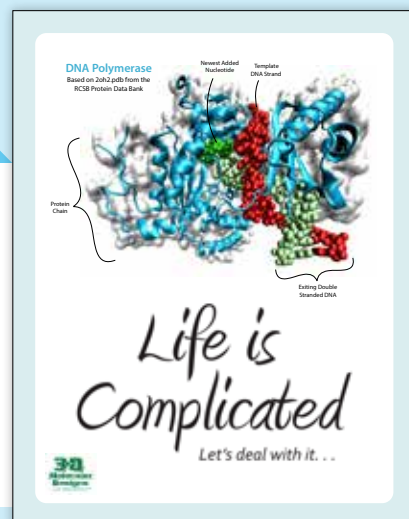
Flu Fight: Immunity  
& Infection Panorama®

## Life Is Complicated Poster®

**Life is complicated. Let's deal with it!** This poster of DNA polymerase, the enzyme that creates DNA molecules by assembling nucleotides in an order determined by DNA is based on file 2oh2.pdb from the RSCB Protein Data Bank. The poster features the polymerase protein in surface (white and gray) and ribbon formats (blue). It shows the incoming nucleotide (dark green), the template DNA strand (red) and exiting double stranded DNA (red and light green).

**Life Is Complicated Poster® (24" x 18") \$29** (LCP20)

Also see Chromosome Connections Kit® (page 9).







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### Model Upgrade!

The following plaster and mini models are unavailable while we redesign them for 3D printing in a larger size and more durable plastic material. Best of all we believe we will be able to offer them at a lower price! The first ones will be ready in January 2023. Watch 3DMD's newsletter, social media, or website for details.

Acetylcholinesterase Active Site Cube, Alpha Helix & Beta Sheet Models, Aquaporin Channel,  $\beta$ -Globin Models, Green Fluorescent Protein, Hemagglutinin, Hemoglobin, Influenza Virus Capsules, Molecules of Life Collection, Nucleosome, Potassium Channel, Potassium Channel with Scorpion Toxin, Ribosome Models, Sodium Channel, Transfer RNA, and Zinc Finger Models.

3D Molecular Designs utilizes magnets in many products to help students understand inter- and intra- molecular forces in the molecular world. In compliance with the Consumer Product Safety Improvement Act of 2008 – and California Proposition 65 – 3D Molecular Designs adds these warnings to our products and encourages the safe use of our products in classrooms and other science education settings. Our kits and models are science education products, not toys. Please contact us if you have any questions or concerns.

#### **⚠WARNING: SMALL MAGNETS**

This product contains small magnets. Swallowed magnets can stick together across intestines causing serious infections and death. Seek immediate medical attention if magnets are swallowed or inhaled.

#### **⚠WARNING: CHOKING HAZARD**

This product contains small parts and should be kept out of the reach of children under the age of 3, because the parts or their pieces may present a choking hazard to small children.

#### **CAUTION:**

This is a science education product, not a toy. It is not intended for children under 8 years old.

#### **⚠WARNING: CALIFORNIA PROPOSITION 65**

This product contains or may contain chemicals known to the State of California to cause cancer and/or birth defects or other reproductive harm. For more information visit [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

## 2022 CATALOG

## David Goodsell Cellular Landscapes

David Goodsell, PhD, scientist, author and artist of all things small, creates cellular landscapes that accurately illustrate the size, shape and distribution of proteins in their natural environment of the cell. These unique images connect the molecular world, inferred by X-ray crystallography and NMR spectroscopy, with the cellular world, observed by light and electron microscopy.

These laminated prints of Goodsell's stunning water color paintings illustrate biology in a dimension not seen in other instructional tools. Adjacent text identifies the structures and explains their functions. Whether teaching the flow of genetic information, the many jobs of proteins, energy metabolism or the immunology of a flu shot, these landscapes may be the missing piece in your current collection of instructional tools.

### Tour of a Human Cell<sup>®</sup>



*"The complexity of a cell is so very visible!"*

*"So many topics can be addressed using the grand panorama – I can't imagine teaching cell biology without it!"*

The Tour of a Human Cell Panorama<sup>®</sup> will take your students from the nucleus to the outer cell membrane. In the nucleus, DNA is wrapped around histones forming nucleosomes. RNA polymerase unwraps the DNA and makes mRNA which is delivered through nuclear pore complexes to ribosomes where antibody proteins are made and delivered into the endoplasmic reticulum. Vesicles carry the protein through the Golgi and kinesin motor proteins pull the antibodies to the cell membrane — a wonderful example of the immunology of your flu shot.

**Teacher resources including a student activity sheet are available with purchase of the panorama.**

With our new combo you can give your students a more intimate and interactive experience as you lead them in an exploration of the complexity of cell structure and function. You'll find yourself referring back to the landscape multiple times throughout the school year! The combo includes 1 Grand Panorama (approx. 11 feet long) and 6 Panoramas (approx. 6 feet long).

**Tour of a Human Cell Grand Panorama<sup>®</sup> 23" x 11' \$156 (DGTHC-GP)**

**Tour of a Human Cell Panorama<sup>®</sup> 11" x 70" \$77 (DGTHC-P)**

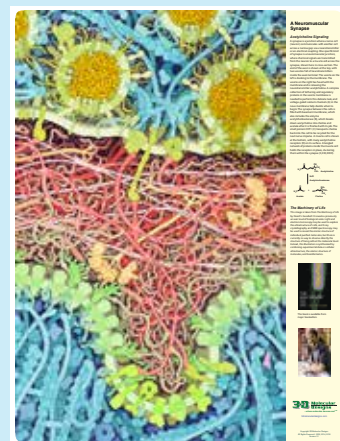
**1-Grand Panorama and 6-Panoramas Combo \$449 (DGTHC-01GP-06P)**

### Neuromuscular Synapse Poster<sup>®</sup>

The Neuromuscular Synapse Poster<sup>®</sup> (right) illustrates the molecular interactions found at a neuromuscular synapse — where vesicles filled with the neurotransmitter, acetylcholine, are fusing with the membrane of the pre-synaptic neuron. Following vesicle fusion, the acetylcholine diffuses across the synaptic space to bind to acetylcholine receptors found in the membrane of the muscle cell. Acetylcholinesterase is entangled in the synaptic space, where it breaks down the neurotransmitter, ending neuronal signaling.

**Neuromuscular Synapse Poster<sup>®</sup> 23" x 30" \$36 (DGNSP)**

Also see the *Dynamic DNA Kit<sup>®</sup>* (page 11), *DNA Starter Kit<sup>®</sup>* (page 8).



Neuromuscular Synapse Poster<sup>®</sup>



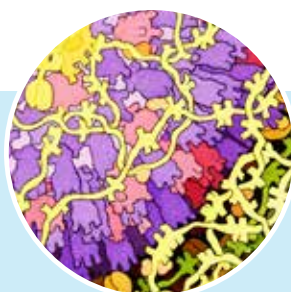


## Flu Fight: Immunity & Infection Panorama<sup>®</sup>

What molecular mechanisms protect our bodies from influenza virus infection? What events transpire when those defenses fail and infection occurs? Explore these questions and more with our Flu Fight: Immunity and Infection Panorama<sup>®</sup> created by scientist, author and artist David Goodsell, PhD.

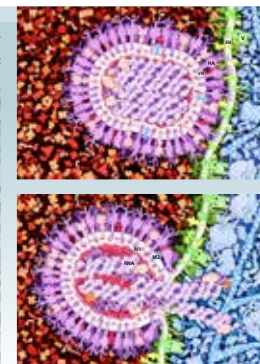
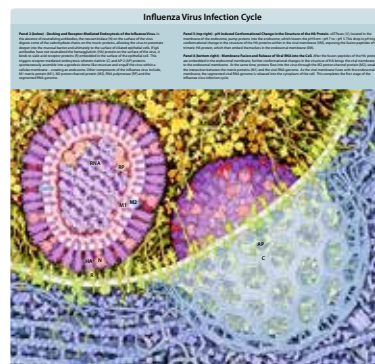
Influenza is a persistent health phenomenon that infects up to 10% (740 million) of the human population each year. These cellular, watercolor landscapes will take your students from infection of the ciliated epithelial cells that line the upper respiratory tract, through virus neutralization by antibodies in the mucosal barrier. Influenza – in the absence of antibodies – breaches the barrier and binds in the cell membrane before fusing with the endosomal membrane and finally releasing segmented viral RNA genome into the cytoplasm. Illustrate your discussions about infectious disease and immunity with this beautiful, accurate panorama that identifies key proteins and other molecular structures and explains their functions!

See our Antibody and Antigen Models on page 16! Enhance your students' conceptual understanding of immunity and infection with multiple models. Use the Antibody and Antigen Models to actively simulate the antibody binding and specificity illustrated in the Flu Fight Panorama<sup>®</sup>. Also see Tour of a Human Cell<sup>®</sup> on the previous page.



**Flu Fight: Immunity & Infection Panorama<sup>®</sup> 23" x 66" \$86 (DGFFP)**  
**Flu Fight: Immunity & Infection Panorama<sup>®</sup> 23" x 66" and 6-Antibody and 12-Antigen Models Combo \$456 (DGFFP-01-ANTPM-06)**

### Flu Fight: Immunity & Infection



## Mitochondria and E. coli Posters



Mitochondria Poster<sup>®</sup>

In the Mitochondria Poster<sup>®</sup> (left) your students will see the large protein complexes of the electron transport chain which create the electrochemical gradient that powers ATP synthase to build ATP. ATP is then transported out of the mitochondrion by the adenine nucleotide translocator and diffuses through the channels in the VDAC protein in the outer membrane.

The *E. coli* Poster<sup>®</sup> (right) illustrates the inside of an *E. coli* cell — magnified 1 million times. The molecular complexity of this bacterial cell is emphasized in this image which features a large flagellum and the motor proteins that power its rotation and a variety of transmembrane proteins that function in transporting molecules into and out of the cell. Also shown are the ribosomes and associated proteins that support bacterial protein synthesis and the DNA, along with the DNA and RNA polymerases that function in replication and transcription.



*E. coli* Poster<sup>®</sup>

**Mitochondria Poster<sup>®</sup> 23" x 30" \$36 (DGMP) • *E. coli* Poster<sup>®</sup> 23" x 30" \$36 (DGECP)**

Also see Tour of a Human Cell<sup>®</sup> (page 18), and Dynamic DNA Kit<sup>®</sup> (page 11).

# SUMMER COURSES

## Modeling the Molecular World

Join us – the first and only team to put protein models in the hands of students! – for a week of modeling. You'll:

- Hear powerful molecular stories, told by master storyteller, Tim Herman, PhD.
- Learn tips and techniques from experienced teachers who have fostered student modeling, discovery and inquiry in their classrooms.
- Become part of a community of outstanding educators utilizing 3DMD's kits and models in a variety of courses.
- Learn how to incorporate modeling with NGSS and/or your existing curriculum.
- Leave with an introductory set of innovative materials, including a Water Kit®, Amino Acid Starter Kit®, Dynamic DNA Kit®, a cellular landscape by David Goodsell and more.

Following participation in this Modeling the Molecular World course, you'll be eligible to participate in 3DMD's advanced courses, Model Teacher Program, and research project advisory groups!

Applications open Nov. 1, 2022

Watch [3dmoleculardesigns.com](https://3dmoleculardesigns.com) for details

**Session 1: June 26-30, 2023**

**Session 2: July 17-21, 2023**

## 3D Printing for the Biosciences Classroom

Wondering how to incorporate 3D printing in your classroom? This course is for you! You will:

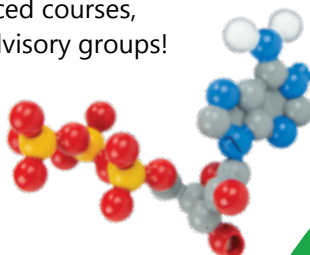
- Learn Jmol, a free molecular visualization program, for designing physical models of proteins that can be 3D printed.
- Return to your students with a physical model and validated 3D print files.
- Feel confident exploring software and choosing instructional materials on designing for 3D printing.
- Receive a digital notebook of resources.

3D Printing Course is open to current and past participants of Center for BioMolecular Modeling (CBM) summer courses. The CBM merged with its close partner organization, 3D Molecular Designs, LLC, October 1, 2022.

Applications open Nov. 1, 2022

Watch [3dmoleculardesigns.com](https://3dmoleculardesigns.com) for details

**One-Day Short Course: July 1 or 22,  
following Modeling the Molecular World**



*Don't miss out on these unique and impactful courses for science educators!*

*Courses are held at 3D Molecular Designs in downtown Milwaukee and within blocks of the Lake Michigan lakefront and Milwaukee museums.*

*You'll become part of a community of educators who are committed to making the molecular world come alive for learners!*

*For details on courses, housing, professional learning credits and fees, please see:*

**[3dmoleculardesigns.com](https://3dmoleculardesigns.com)**