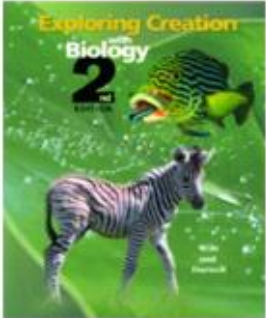

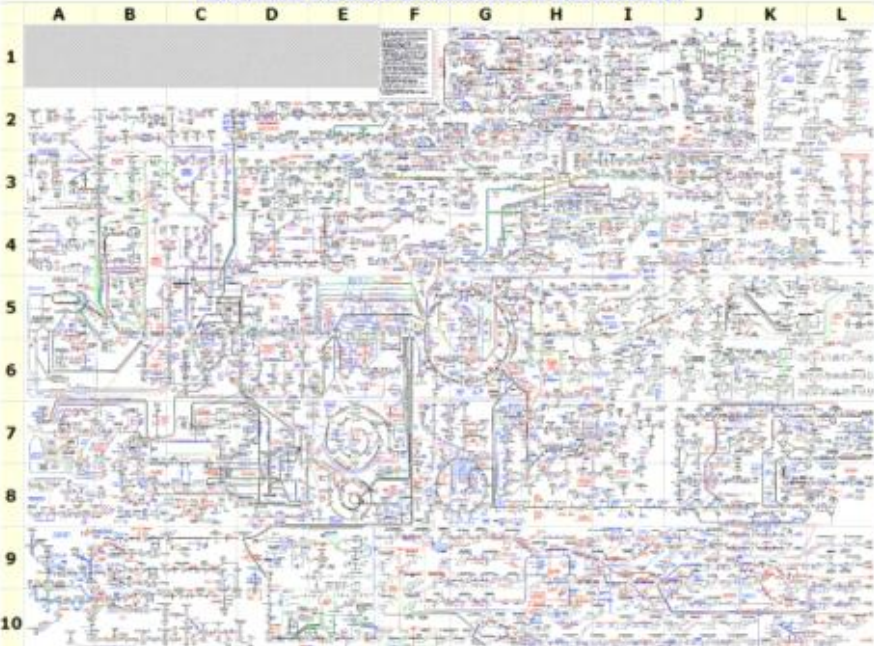


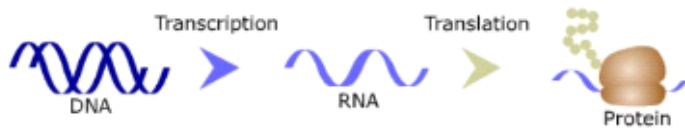
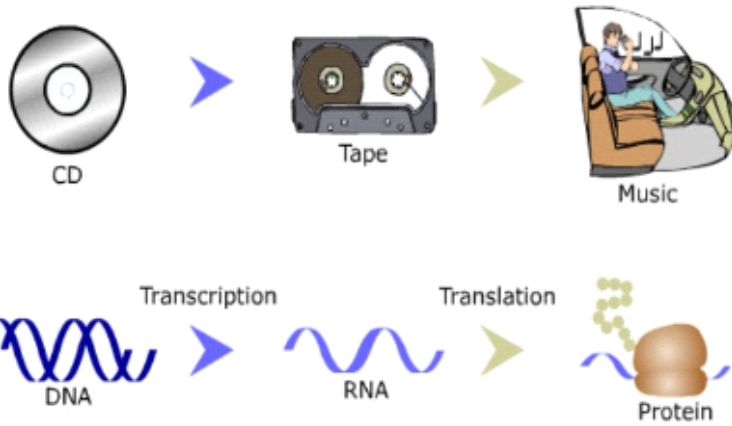
# M06 L5 Protein Synthesis

Thursday, March 05, 2009  
11:30 AM

VoiceThread	<a href="http://voicethread.com/share/240486/">http://voicethread.com/share/240486/</a>
Cmap	<a href="http://cmapspublic2.ihmc.us/servlet/SBReadResourceServlet?rid=1163952498890_1337583305_33562&amp;partName=actualhtmltext">http://cmapspublic2.ihmc.us/servlet/SBReadResourceServlet?rid=1163952498890_1337583305_33562&amp;partName=actualhtmltext</a>

Slides	Notes
 <p><b>Module 06: The Cell</b></p> <ul style="list-style-type: none"><li>Lecture 1: Cell Function</li><li>Lecture 2: Cellular Structure</li><li>Lecture 3: Cellular Transport System</li><li>Lecture 4: How Cells Produce Energy</li><li> Lecture 5: Protein Synthesis</li><li>Lab Day</li><li>Interactive Practice</li></ul>	
<p><a href="http://www.expasy.org/cgi-bin/show_thumbnails.pl">http://www.expasy.org/cgi-bin/show_thumbnails.pl</a></p> 	<p><a href="http://www.expasy.org/cgi-bin/show_thumbnails.pl">http://www.expasy.org/cgi-bin/show_thumbnails.pl</a> shows the metabolism of the cell. Most of the activities have to work in unison with other pathways for things to work properly. Cells are not simple blobs of chemicals and simple organelles.</p>

## The Central Dogma of Biology



## The Central Dogma of Biology

👉 Transcription  
Translation  
Protein Folding

Point out the chart at the top too

## The Human Genome Project



DNA in the human genome is arranged in 24 chromosomes.

The human genome has 3-billion pairs of bases

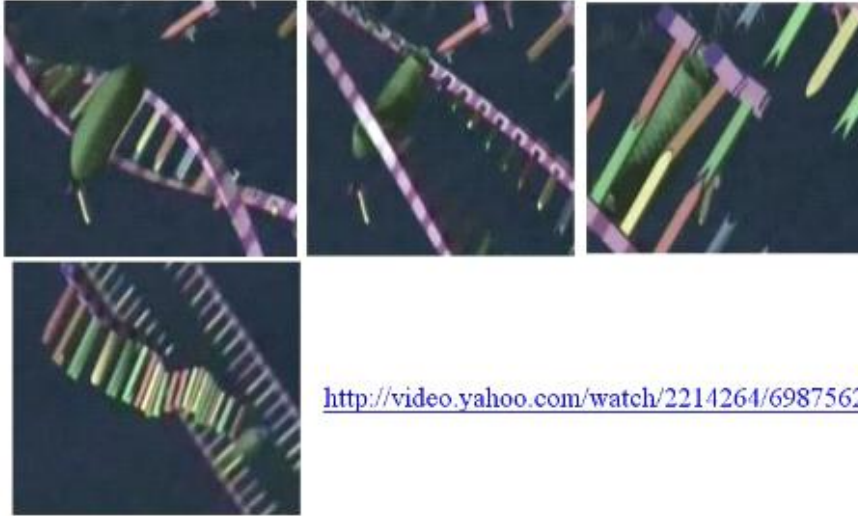
A bacterium has about 600,000 pairs of bases

Each of your cells contain about 2 meters of DNA.

1990: The project officially began (expected to take 15 years)

2003: The human genome was complete (ahead of schedule)

# DNA to mRNA



<http://video.yahoo.com/watch/2214264/6987562>

<http://video.yahoo.com/watch/2214264/6987562>

A normally matches with T, but it will be U (uracil) in the mRNA because mRNA don't have Ts

Adenine with T

Cystosine with Guanine

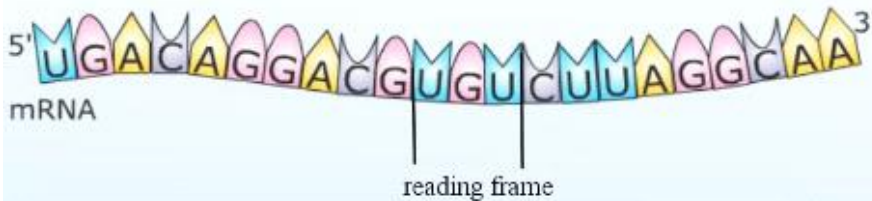
nucleotides

		Second position				Third position (3' end)
		U	C	A	G	
First position (5' end)	U	UUU Phe UUC UUA UUG Leu	UCU UCC Ser UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U A G
	C	CUU CUC Leu CUA CUG	CCU CCC Pro CCA CCG	CAU His CAC CAA Gln CAG	CGU Arg CGC CGA CGG	U A G
	A	AUU Ile AUC AUA Met AUG Start	ACU Thr ACC ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U A G
	G	GUU Val GUC GUA GUG	GCU Ala GCC GCA GCG	GAU Asp GAC GAA Glu GAG	CGU Gly GGC GGA GGG	U A G

start codons

stop codons

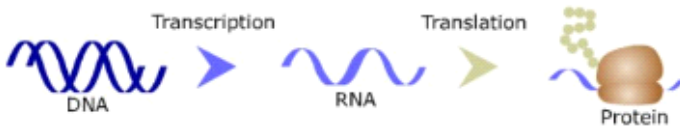
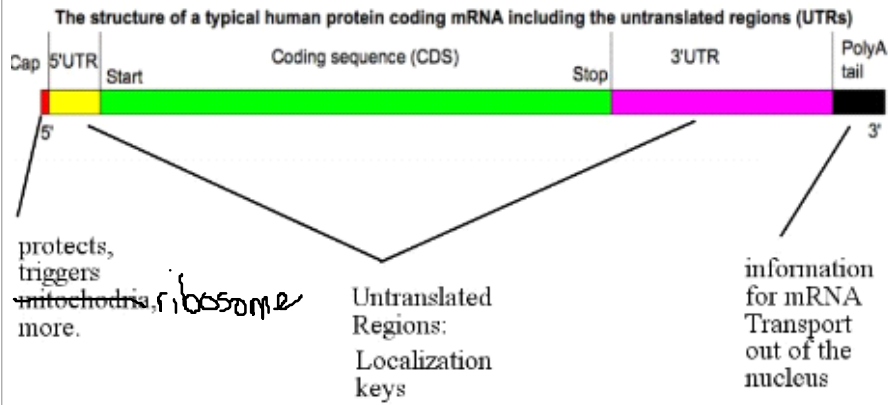
The triplets are called codons



20 amino acids

64 complete codons, some repeat

The entire mRNA sequence is going to be longer and have a few more parts than we will work with for our activities.

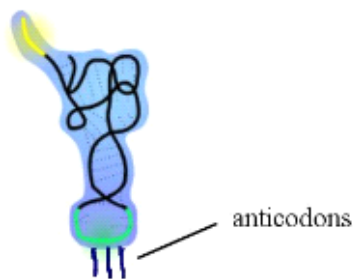


## The Central Dogma of Biology

👉 Transcription  
Translation  
Protein Folding

- amino acids:
- |     |     |     |     |     |
|-----|-----|-----|-----|-----|
| Ala | Arg | Asn | Asp | Cys |
| Gln | Glu | Gly | His | Ile |
| Leu | Lys | Met | Phe | Pro |
| Ser | Thr | Trp | Tyr | Val |

There are actually 64 total combinations



tRNA




Aminoacyl-tRNA synthetase

**There will be a specific match made.**

Learning about tRNA

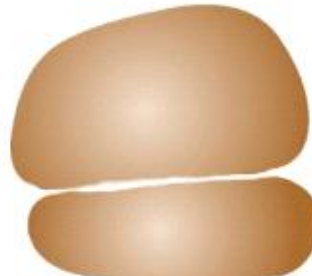
Need a screencast to put in here



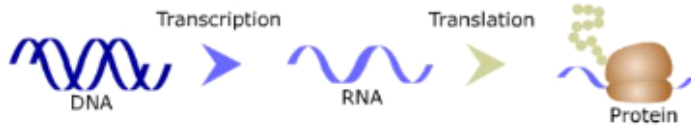
The diagram shows a tRNA molecule with a cloverleaf structure and a 3' end with a CCA sequence. To its right are the four RNA bases: Adenine (A), Cytosine (C), Guanine (G), and Uracil (U). Below these are colored circles representing amino acids: Arg (red), Gly (green), Val (purple), and Met (cyan).

	U	C	A	G	
U	UUU Phe UUC UUA UUG	UCU UCC UCA UCG	UAU Tyr UAC UAA stop UAG	UGU Cys UGC UGA UGG	U C A G C A G G
C	CUU CUC CUA CUG	CCU CCC CCA CCG	CAU His CAC CAA CAG	CGU CGC CGA CGG	U C A G U C A G U C A G
A	AUU AUC AUA AUG	ACU ACC ACA ACG	AAU Asn AAC AAA AAG	AGU Ser AGC AGA AGG	U C A G U C A G U C A G
G	GUU GUC GUA GUG	GCU GCC GCA GCG	GAU Asp GAC GAA GAG	CGU Gly GGC GGA GGG	U C A G U C A G U C A G

The triplets are called codons

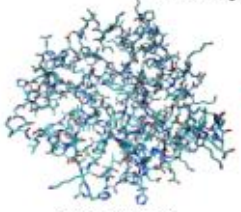
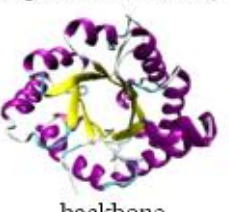
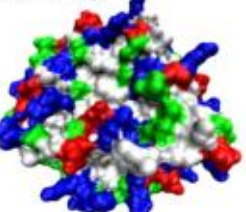


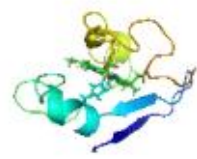





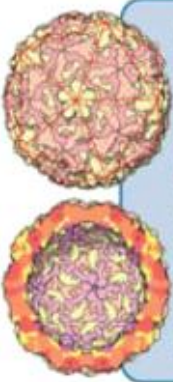
nRNA nucleotides



## The Central Dogma of Biology

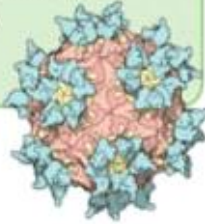
Transcription  
Translation  
👉 Protein Folding

Carbohydrates	Lipids	Proteins	Nucleic Acid	Organic Molecules
Triose-phosphate isomerase (TPI or TIM)				
				
atom type	backbone confirmation	surface color coded to solvent-accessibility		
				
Real molecules are dynamic	Immunoglobulin G (IgG)			

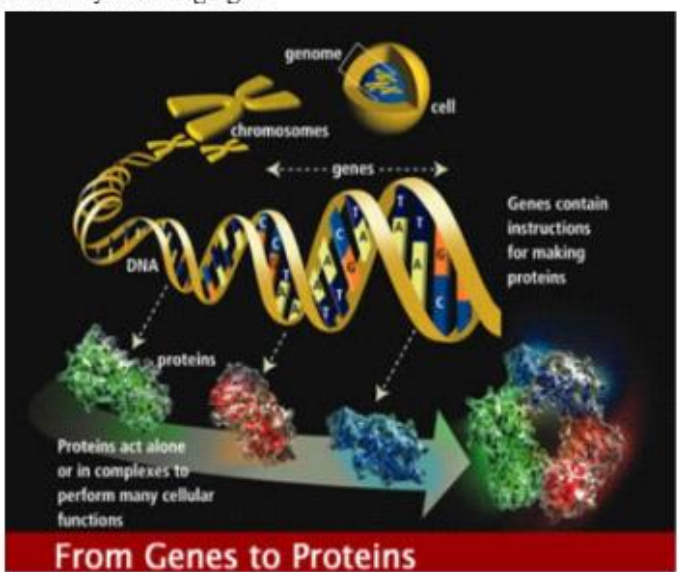


Many virus structures, like the common cold, are **icosahedrons, which means they have 20 sides**. This symmetrical shape makes the virus structure quite simple. The cold virus shown here is composed of the same four proteins – copied 60 times.

**Antibodies** (shown in blue) **bind to the surface of viruses** to block their attachment to the surfaces of cells.



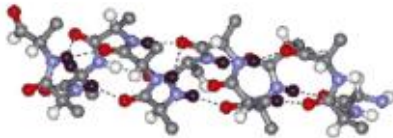
Genes are relatively unchanging ...



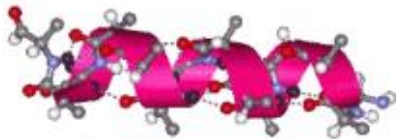
**From Genes to Proteins**

... proteins can change on a second by second basis.

One common structure is a helix ...



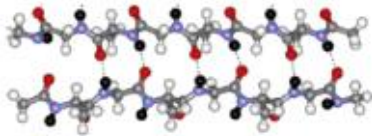
$\alpha$  helix



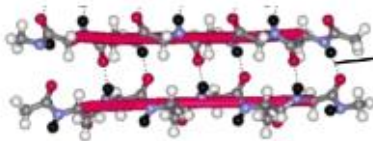
$\alpha$  helix

side chain

... some look more like slightly crinkled thin strips.



$\beta$  sheet



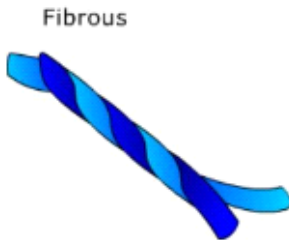
hydrogen bond

side chains

One sheet is attracted to another

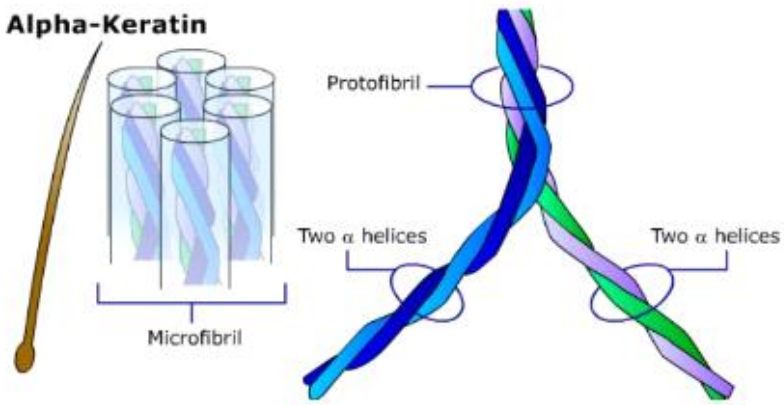


Globular

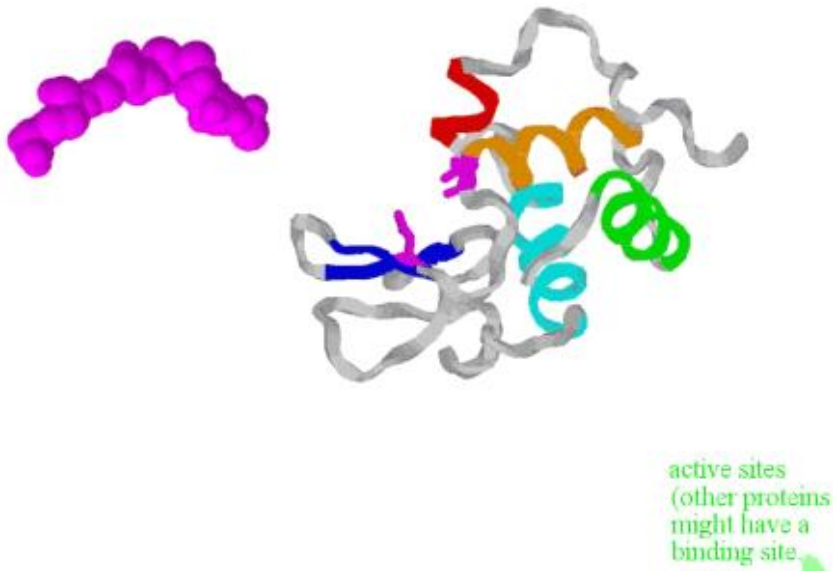


Fibrous

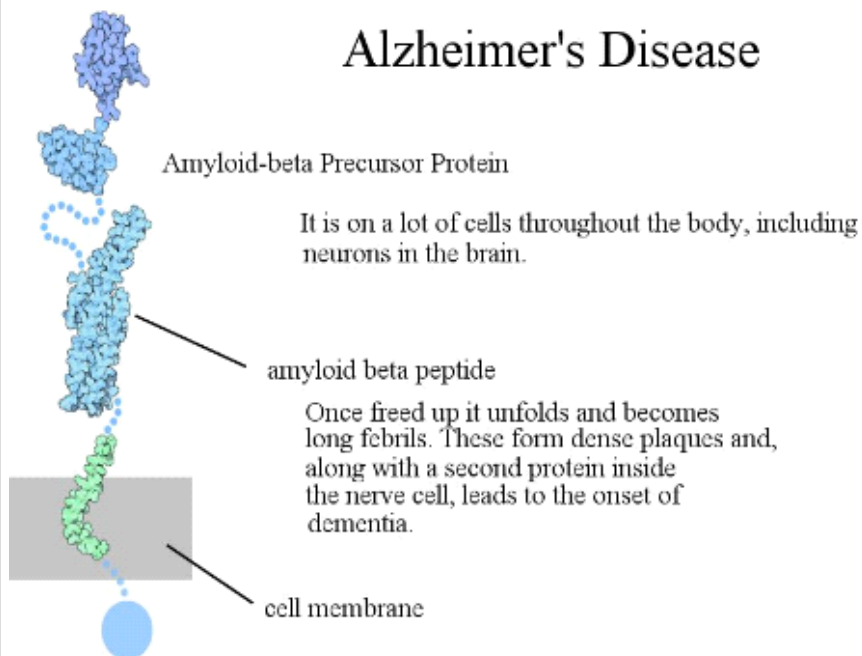
## Alpha-Keratin



Globular proteins have spaces that fit hand-in-glove ...



## Alzheimer's Disease



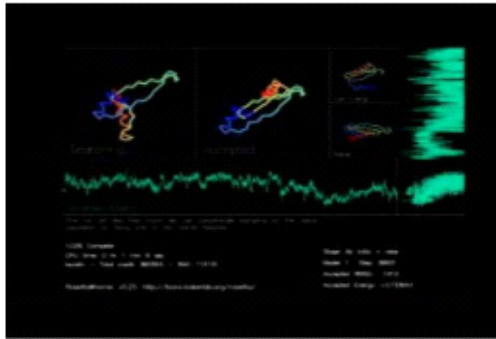




Discovering the structure of proteins has traditionally been done by experimentation in a lab. This is very s-l-o-w.  
There are 100,000 different proteins in the human body.



distributed computing





400-500 computers it would still be decades

Computers and PlayStations

Science labs that are trying to solve protein-based medical mysteries can post their amino acid sequences into the Foldit game and humans set to work to find its correct fold.

Audio fix - Rosetta at Home not Rosetta Stone

 **99 (<150): Something Out of Place 2** Expired: 10/29/08  
Top Group: **Freedom Folders**  
Top Player: **coltzan (# #)**  
Top Score: **9,330**  
This puzzle contains a unique problem that the Baker Lab is working on. Can you help us solve it? For players with less than 150 global points.

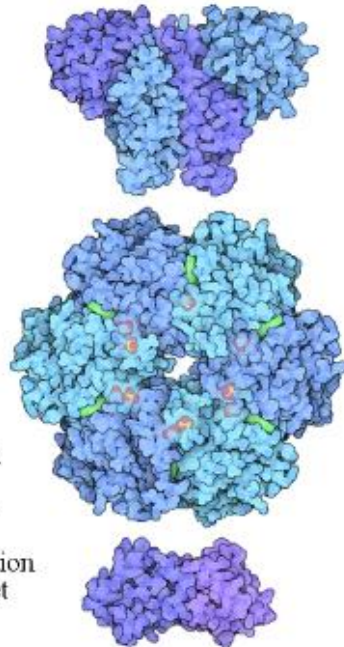
 **93 (<150): Spider Toxin** Expired: 10/13/08  
Top Group: **ROMANIA Team**  
Top Player: **swish17 (# #)**  
Top Score: **8,463**  
This protein is from a neurotoxin found in the funnel spider. It has 48 sidechains. For players with less than 150 global points.

RCSB **PDB**  
PROTEIN DATA BANK

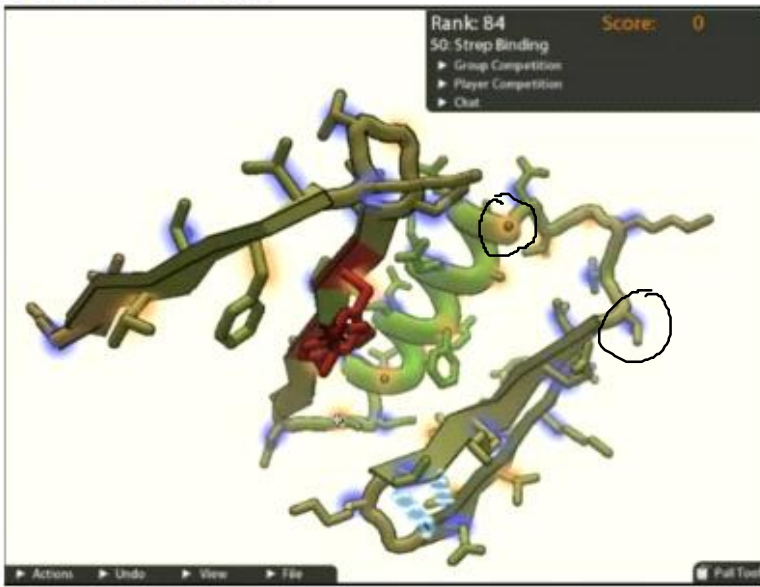
One of the proteins in their database ...

a circadian clock protein

It is set for about a 24 hour cycle. It is in almost all of our cells. Sensory information can trigger the brain to reset all the clocks.



## Welcome to Foldit!!



Foldit!

<http://fold.it/portal/>

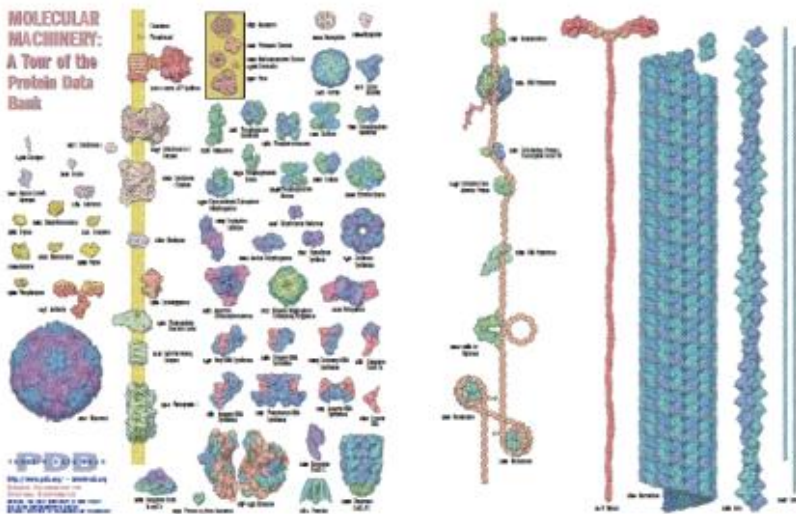
<http://fold.it/portal/blog>

<http://fold.it/portal/puzzles>

hydrophobic

hydrolyphic

Want to see how the proteins compare to one another by size?



[http://www.pdb.org/pdb/education\\_discussion/molecule\\_of\\_the\\_month/poster\\_quickref.pdf](http://www.pdb.org/pdb/education_discussion/molecule_of_the_month/poster_quickref.pdf)

[http://www.pdb.org/pdb/education\\_discussion/molecule\\_of\\_the\\_month/poster\\_quickref.pdf](http://www.pdb.org/pdb/education_discussion/molecule_of_the_month/poster_quickref.pdf)

8am: <http://www.virtualhomeschoolgroup.com/mod/quiz/view.php?id=832>

9am: <http://www.virtualhomeschoolgroup.com/mod/quiz/view.php?id=10904>

2:30 pm: <http://www.virtualhomeschoolgroup.com/mod/quiz/view.php?id=13910>

2010/11: <http://www.virtualhomeschoolgroup.com/mod/quiz/view.php?id=18289>