

# Proteins and Peptytides



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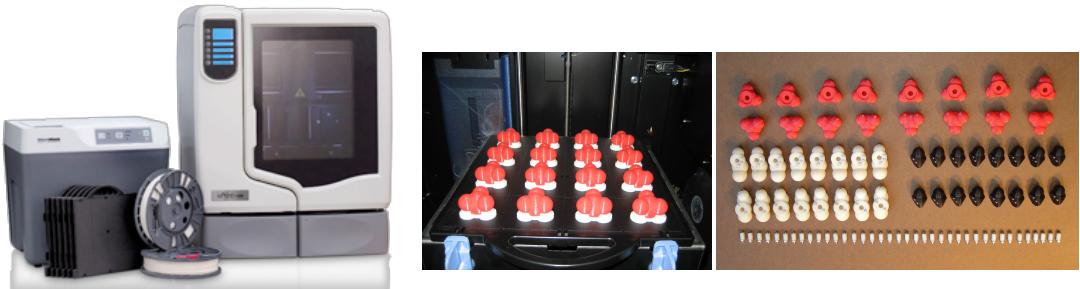


See how to build an accurate 3D-model of a peptide, called Peptytide, that can be folded into basic protein structures. The Peptytide model is made from 3D-printed molecular units linked together with a series of precisely placed magnets and screws. Also see a web application in Autodesk's Project Cyborg through which in future one would be able to customize and build a specific protein model of their own with the Design, Print, Build philosophy.

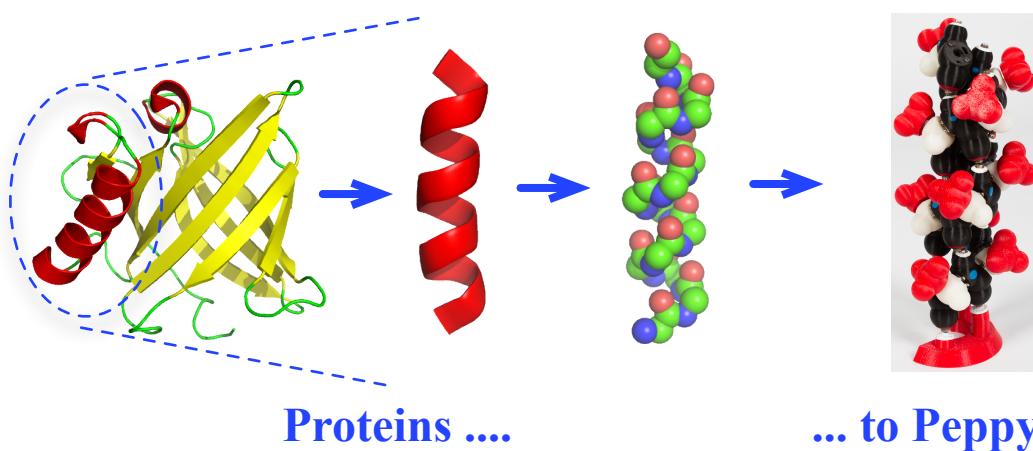
**Peptytide is a 3D-printed,  
foldable molecular model**

**Learn how to build one  
for yourself!**

Photo shows Peptytide folded into alpha-helix, a secondary structure found in proteins. Each sphere represents one atom of carbon, nitrogen, oxygen or hydrogen.



**... and have fun with protein folding!**



Proteins are biological molecules that consist of hundreds of amino acids linked together in a long chain. These chains fold into distinct 3D shapes. They contain beta sheets and alpha helices.

Contact info: Promita Chakraborty  
Ron Zuckermann

pchakraborty@lbl.gov, promitac@gmail.com  
rnzuckermann@lbl.gov, http://www.ronznet.com

Peptytide website: <http://www.peptytides.com>



## Links to articles, videos and papers:

### Make:

Make Magazine article on building Peptytides: <http://makezine.com/projects/peptytides/>



Lawrence Berkeley National Laboratory video on the model: "Peptytides: Interactive Models of Polypeptide Chains"

<http://www.youtube.com/watch?v=y1UKEo4F5p4>

### PNAS

Proceedings of the National Academy of Sciences article on Peptytides: "Coarse-grained, foldable, physical model of the polypeptide chain"

<http://www.pnas.org/content/110/33/13368.full>

### berkeley science review

Berkeley Science Review article on Peptytides: "Molecular Models of the Future" <http://sciencereview.berkeley.edu/peptytides-molecular-models-of-the-future/>

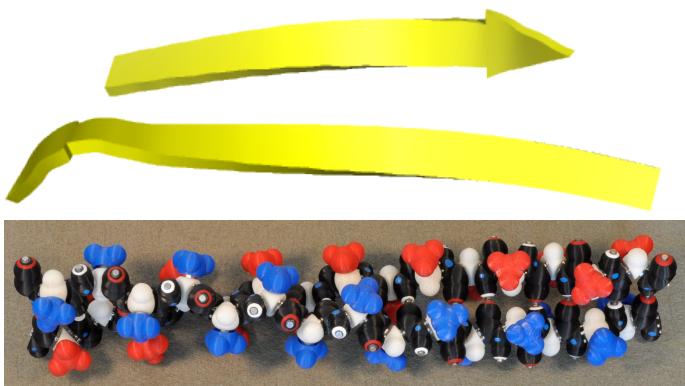
## Fold Peptytides into these structures:

### Alpha helix



An **alpha helix** consists of a chain that coils on itself. It looks like a spiral ribbon.

### Beta sheet



A **beta sheet** consists of straightened chains that line up parallel to each other. It looks like a flat ribbon.

#### Steps for making an **alpha helix** with Peptytides:

1. Place the helix template on a flat surface.
2. In the model polypeptide chain and in the template, identify the starting points (yellow dots).
3. Connect the first amide (red magnet) with the start-magnet in the template to make a hydrogen bond such that the oxygen atom (red ring) faces down, and the side chain (red / blue part) faces the outer side of the helix.
4. Similarly connect the next two amides with the next two template magnets.
5. Connect magnet in the fourth amide (red magnet) on top of the first amide (white magnet) making a hydrogen bond.
6. Continue Step 5 until end of chain, spiraling up along the chain.
7. Take the newly-formed helix off the template.

#### Steps for making a **beta strand** with Peptytides:

1. Grab a Peptytide chain at the two ends.
2. Bring it to fully stretched conformation by lightly pulling from the ends. It will form a beta strand.

#### Steps for making a **beta sheet** with Peptytides:

1. Take two model polypeptide chains, and make two beta strands as above.
2. Identify the oxygen (red ring) and hydrogen (white ring) magnets. These two magnets will attract and form one hydrogen bond.
3. Connect the magnets in both chains starting from one end. Connect each set of magnets to make the hydrogen bonds along the chains.