A guideline for 3D printing of macromolecular models on the cheap

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1. Macromolecular models are needed

for teaching and demonstration

The models should be:

- Based on real scientific data;
- Depicted using standardized representations;
- Easy to edit and adapt to the outcomes of a specific lesson;
- Cheap to fabricate and reproduce;
- Easy to distribute

3D printing

2. Steps involved when fabricating a macromolecular model

Download structure from PDBe PDB PDBj

PDB or CIF file

Visualize and prepare the model in UCSF Chimera

STL file

Prepare the file for printing using Ultimaker Cura

GCODE file

Print

1. Chose or combine visualization styles;
2. Add H bonds or create struts to make the model more sturdy (mandatory for cartoon and balls and sticks models, not required for surface);
3. Increase the thickness of each printed element and/or improve the smoothness for molecular surfaces.

A. Generate the computer model

1. Set the printing **scale**;
2. **Orient** the model on printing bed;
3. Set printing **resolution**;
4. Set shell **wall thickness** and **infill** %;
5. Automatically **add support**;
6. **Slice** the model;
7. **Send** the resulting gcode to printer (via SD-Card, USB or WiFi)

B. Print the model

Support material removal

C. Clean up and finalize the physical model

3. Examples of 3D printed models

Figure 1. Physical model of a DNA replication fork

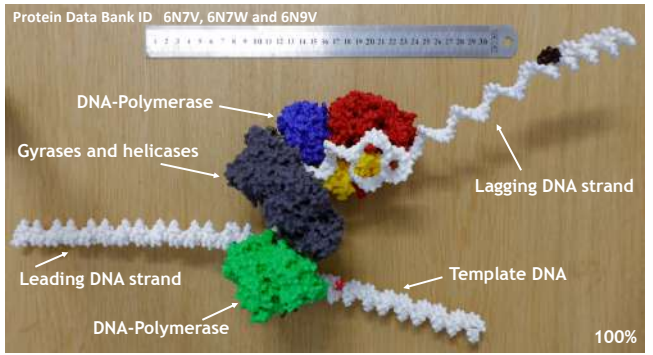
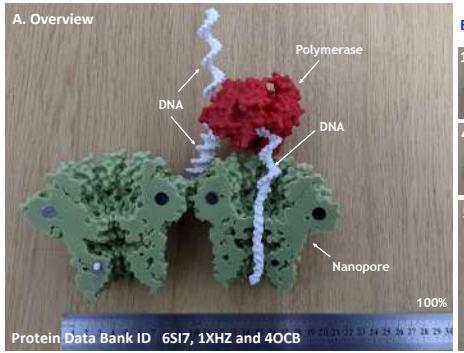
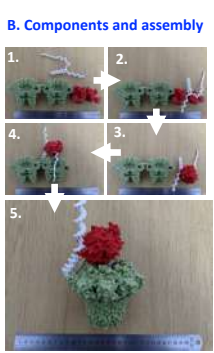


Figure 2. Physical model of a DNA-sequencing protein nanopore





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3. Examples of printed models (continued)

Figure 3. Antibodies interacting with an antigen

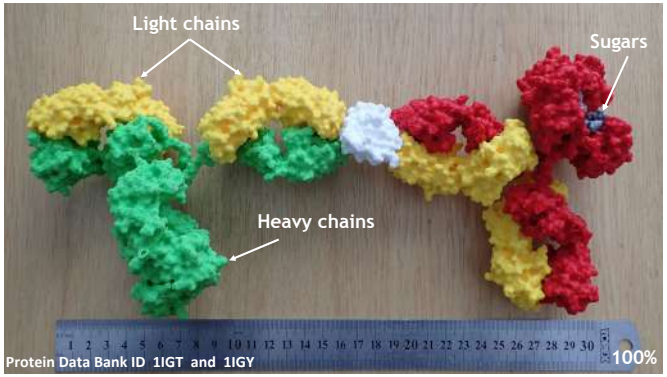


Figure 4. Main components a the 20S yeast proteasome

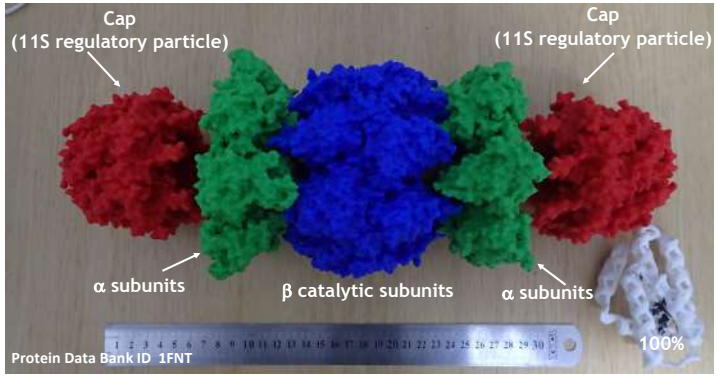


Figure 5. Catalytic and cofactor binding sites in enzymes

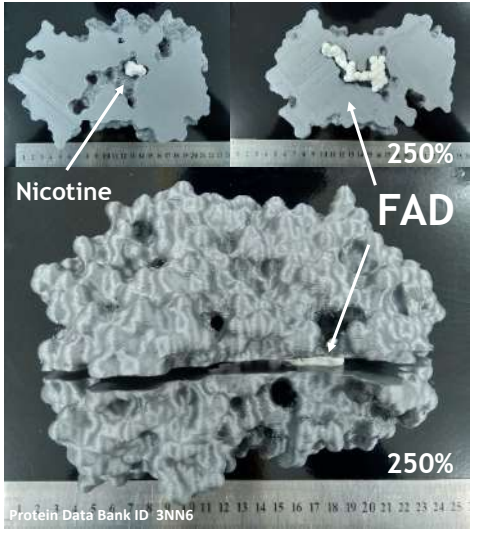


Figure 6. Main components a bovine mitochondrial ATP synthase

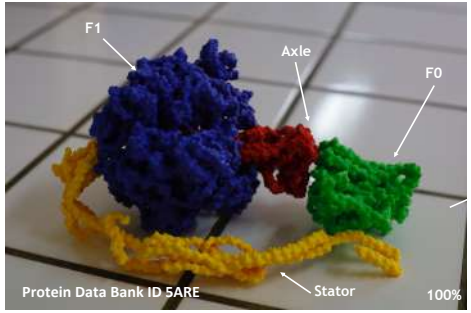
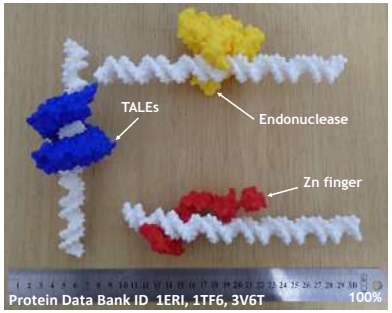


Figure 7. Protein domains interacting with DNA



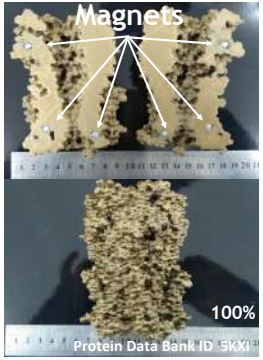


Figure 8. Physical model of a transmembrane channel - Human Alpha4Beta2 nicotinic receptor

4. The "real" guide complete with technical details :

SCAN ME

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