CHEM 3130
Introduction to Biochemistry

Incorporation of 3-D Molecular Models

Course Statistics

200-250 biology and chemistry majors take Introduction to Biochemistry each year (only chemistry majors take lab)

Pr-requisite is Organic Chemistry II

Mostly juniors, large minority of seniors, several non-degree seeking, and occasionally few sophomores in spring

3x50 minutes per week

20-65 students per section (target is 40)

5-7 sections per year, 2-4 sections per semester

3-D Printing of Molecular Models

Previously have used an expensive model kit with limited representations, and which is easily damaged

Of ~30 models used each class, 2-3 would break, 1 irreparably

Only useful for 1-2 classes during the semester

In 2014, the National Institutes of Health launched 3dprint.nih.gov, a tool for converting atomic coordinates of molecules into 3-D printable models

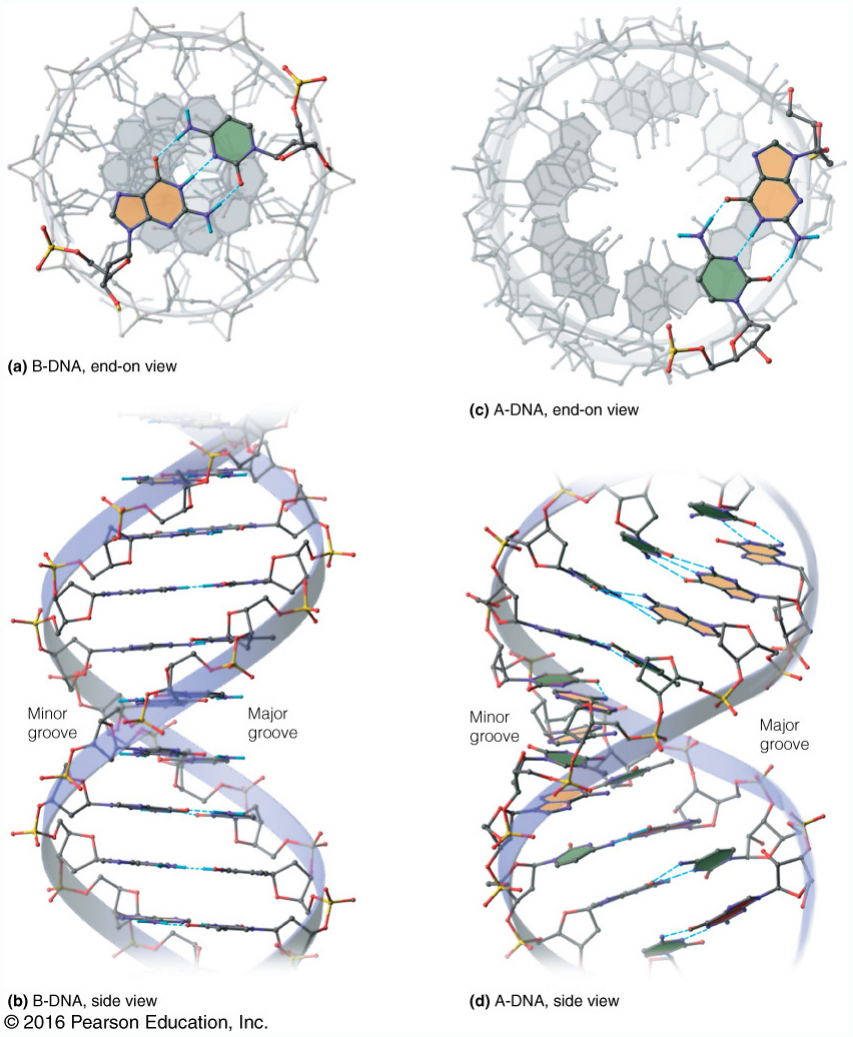
Also allows sharing of model files of any sort

Purchased a Stratasys Mojo printer, recommended by the Center for Biomolecular Modeling at Milwaukee College of Engineering, which first developed usable 3-D models (2005)

3-D printing has recently become almost reasonably priced

A single model requires 2-24 hrs and $3-15 of plastic to print

Comparing Representations: Nucleic Acids



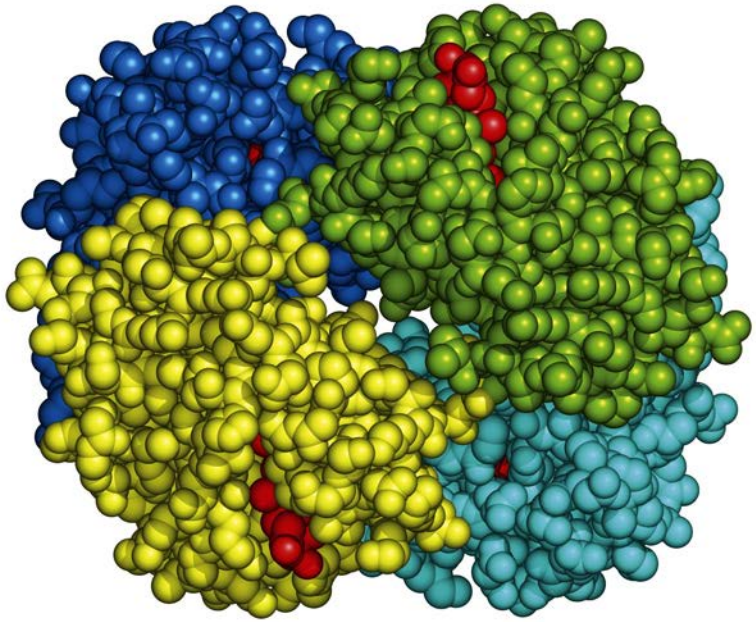
(a) B-DNA, end-on view

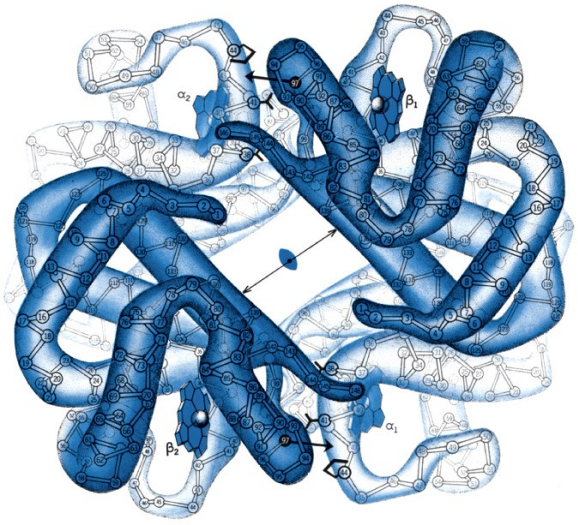
(c) A-DNA, end-on view

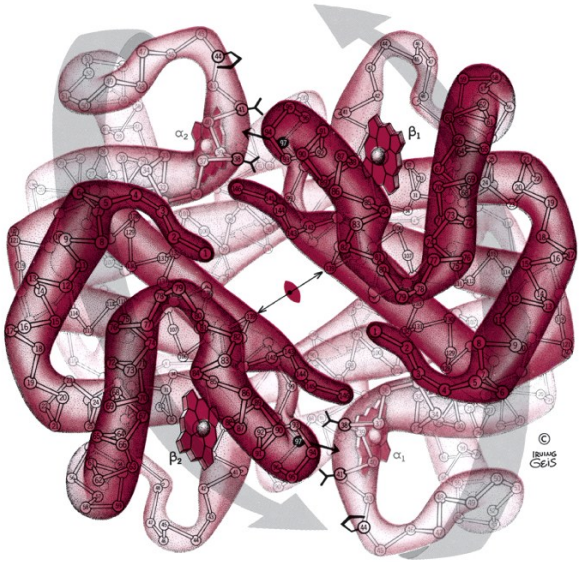
(b) B-DNA, side view

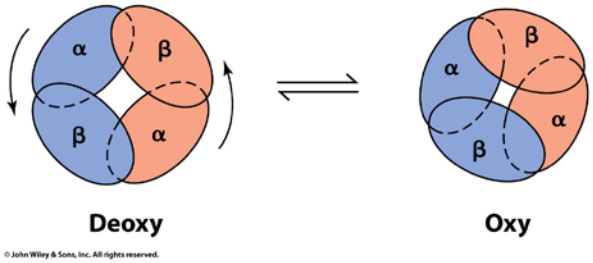
(d) A-DNA, side view

Comparing Representations: Hemoglobin









Current Status

Slightly over 700 models printed

Most printing 40-45 copies of each so that each student can have one

Beginning to paint models to allow easy differentiation and highlighting of specific features

Plan is to use during 7-10 classes during upcoming semester

Initial trials with a few models (few copies) during spring 2017

Have also used a few specific models in CHEM 4060 and CHEM 4150L

Eventually expect to reach ~1200 models

Also want to include some with flexibility, for which models exist but require extensive additional hardware and effort (drilling, insertion of magnets and screws)

Assessment

Have used pre-test/post-test in CHEM 3130 for several years to test for progress on specific topics (not always the same)

For spring 2017, slightly modified pre-test to emphasize mostly protein structure (5 of 8 questions)

7 of the 8 (4 of 5) questions previously used in fall 2016

Also in spring 2017, used 7 of the questions (all 5 of structure ones) as a pre-test in 4000-level biochemistry courses to assess longer-term gains

Baseline Assessment Outcomes

CHEM 3130 pre-test vs post-test correctly answered

Question	Fall 2016 [102]	Spring 2017 [86]
2	N/A	66% → 90%
3	37% → 78%	39% → 72%
5	6% → 63%	8% → 59%
6	5% → 60%	7% → 53%
7	15% → 48%	13% → 50%

CHEM 4xxx pre-test correctly answered by CHEM 3130 sem.

Question	Spring/Fall 2015 [11]	Spring 2016 [8]	Fall 2016 [6]
2	91%	100%	100%
3	55%	63%	83%
5	55%	50%	67%
6	36%	25%	100%
7	18%	38%	50%