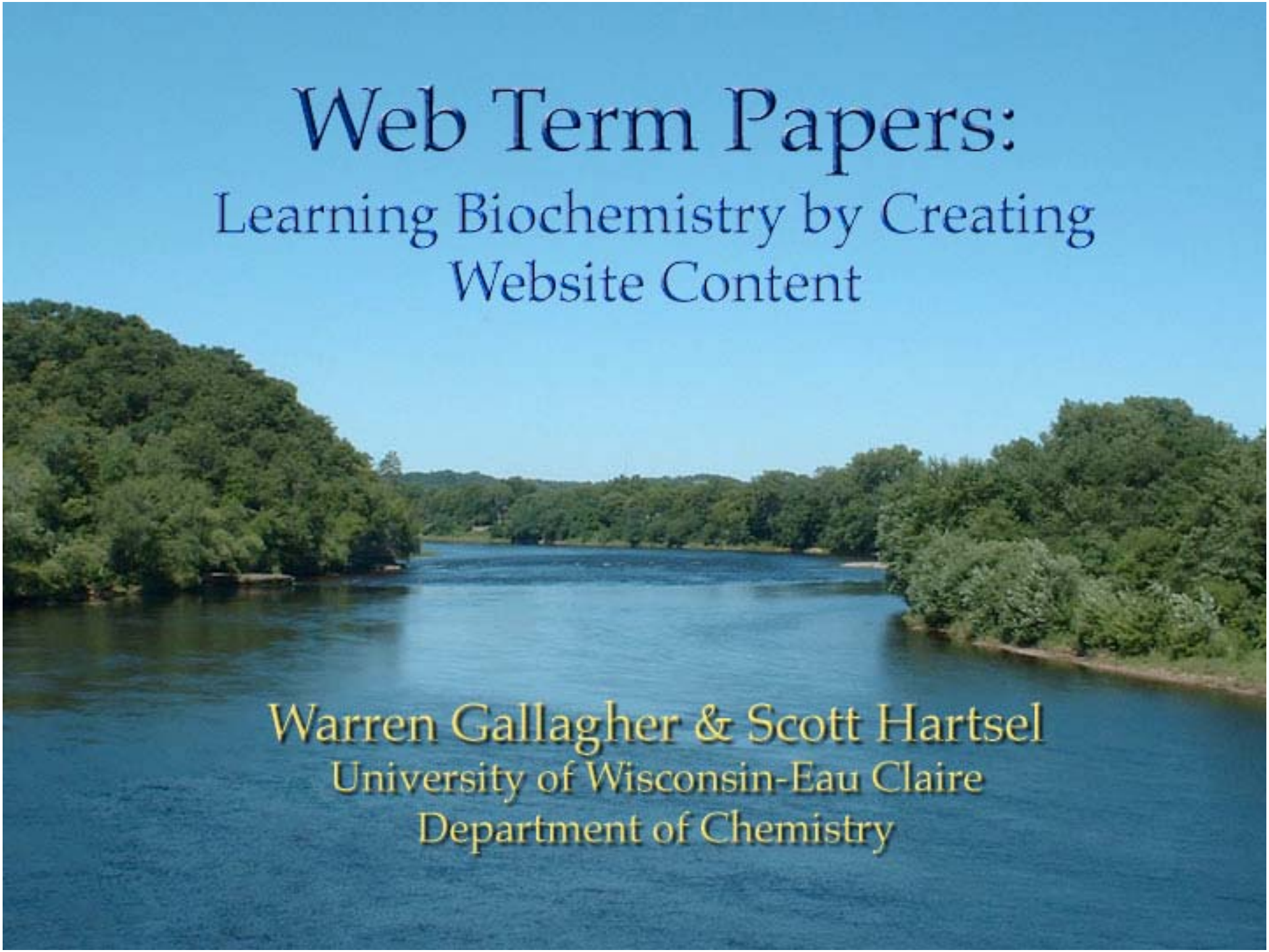

Web Term Papers:
Learning Biochemistry by Creating Website Content
Warren Gallagher & Scott Hartsel
University of Wisconsin-Eau Claire
Department of Chemistry

Overview

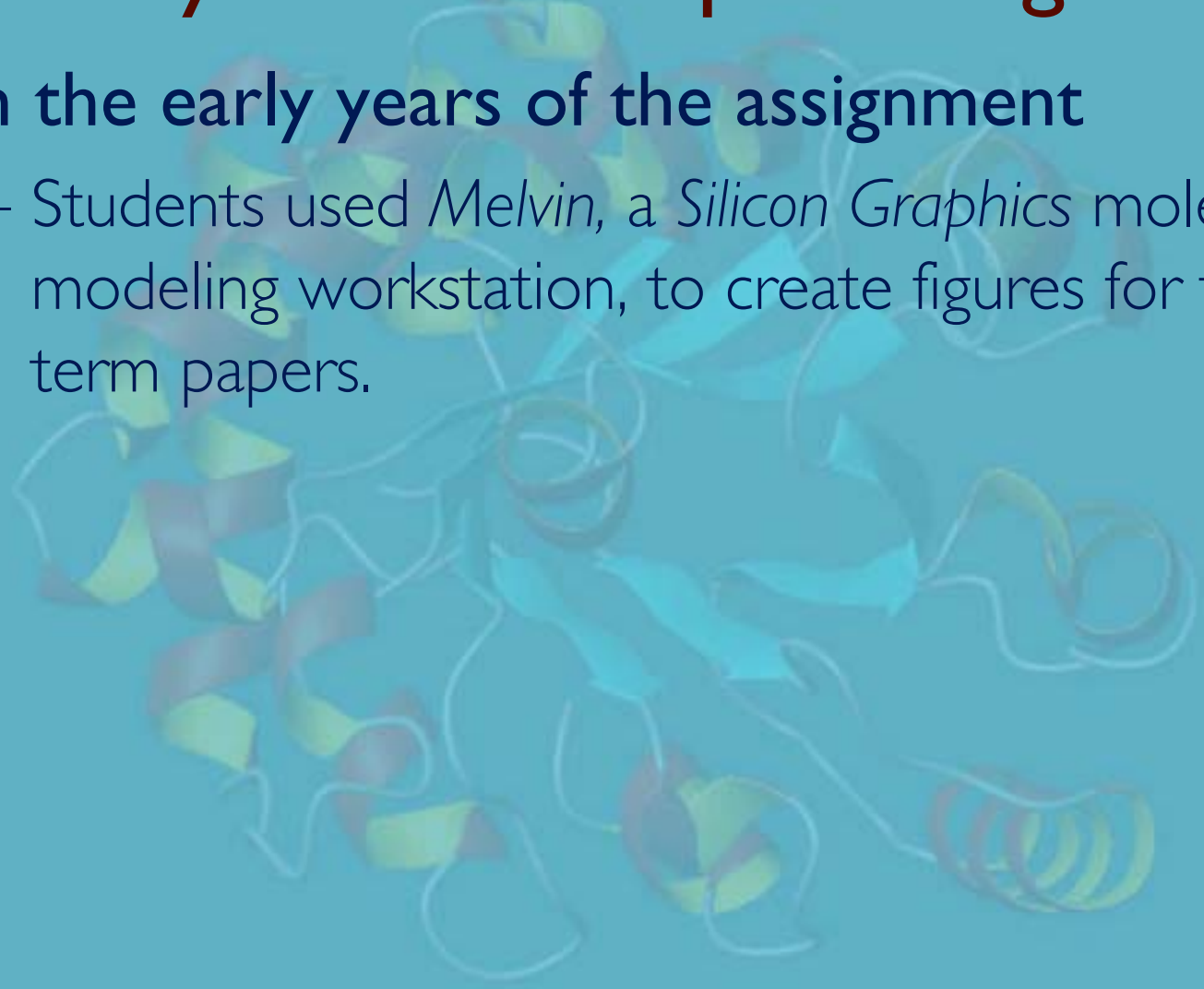
- History of the Web Term Paper Assignment
- The Curriculum
  - Biochemistry/Molecular Biology Program
  - Chem 406 (Biophysical Chemistry)
- The Web Term Paper Assignment

History of Term Paper Assignment

- Since 1990, a term paper has been assigned to students taking Chem 406 (Biophysical Chemistry)
  - A review article discussing the structural aspects of some well-characterized biological macromolecule
  - A goal of the assignment has been to give students hands-on experience with using molecular modeling

History of Term Paper Assignment

- **In the early years of the assignment**
  - Students used *Melvin*, a *Silicon Graphics* molecular modeling workstation, to create figures for their term papers.



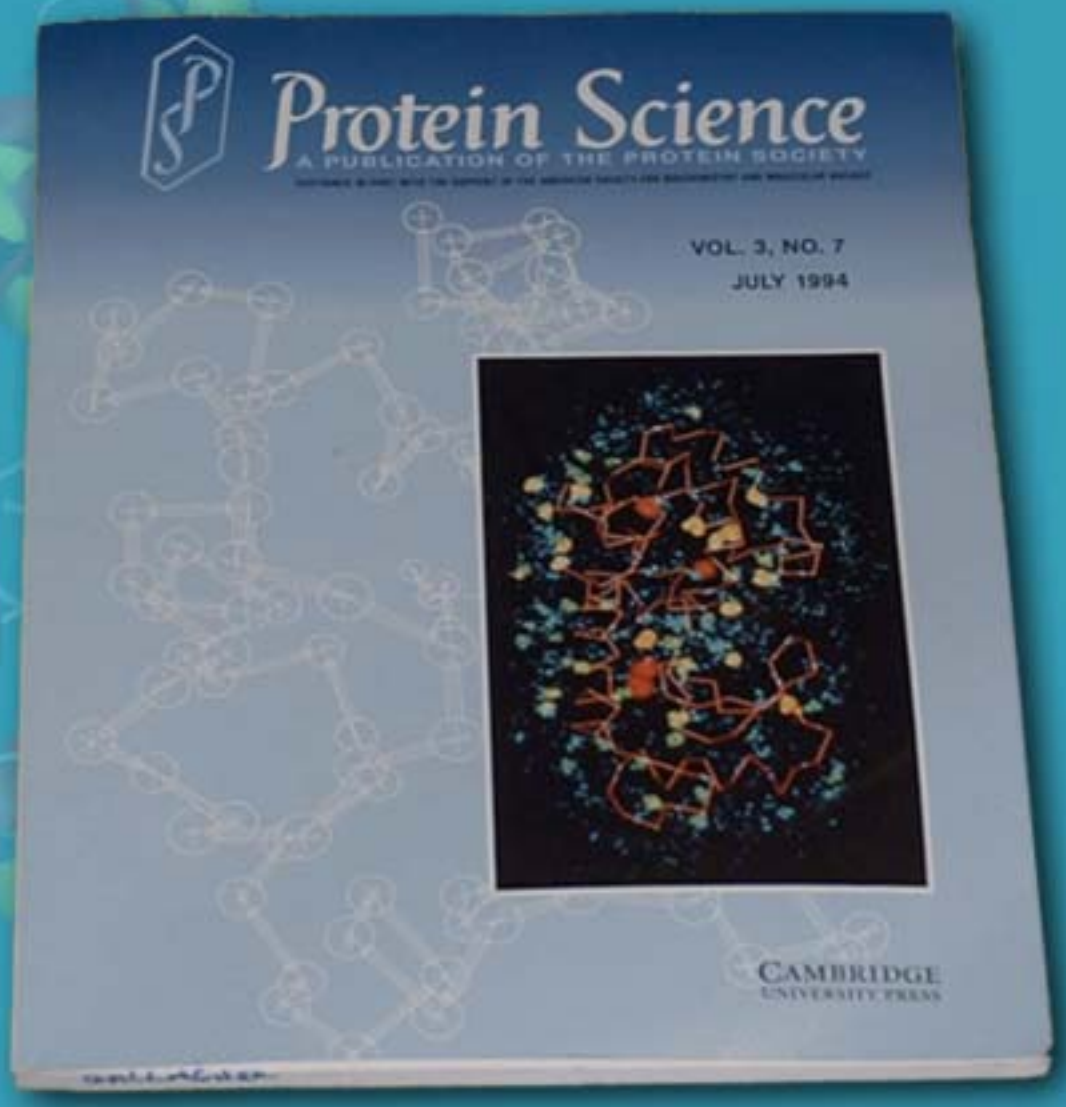
History of Term Paper Assignment

History of Term Paper Assignment

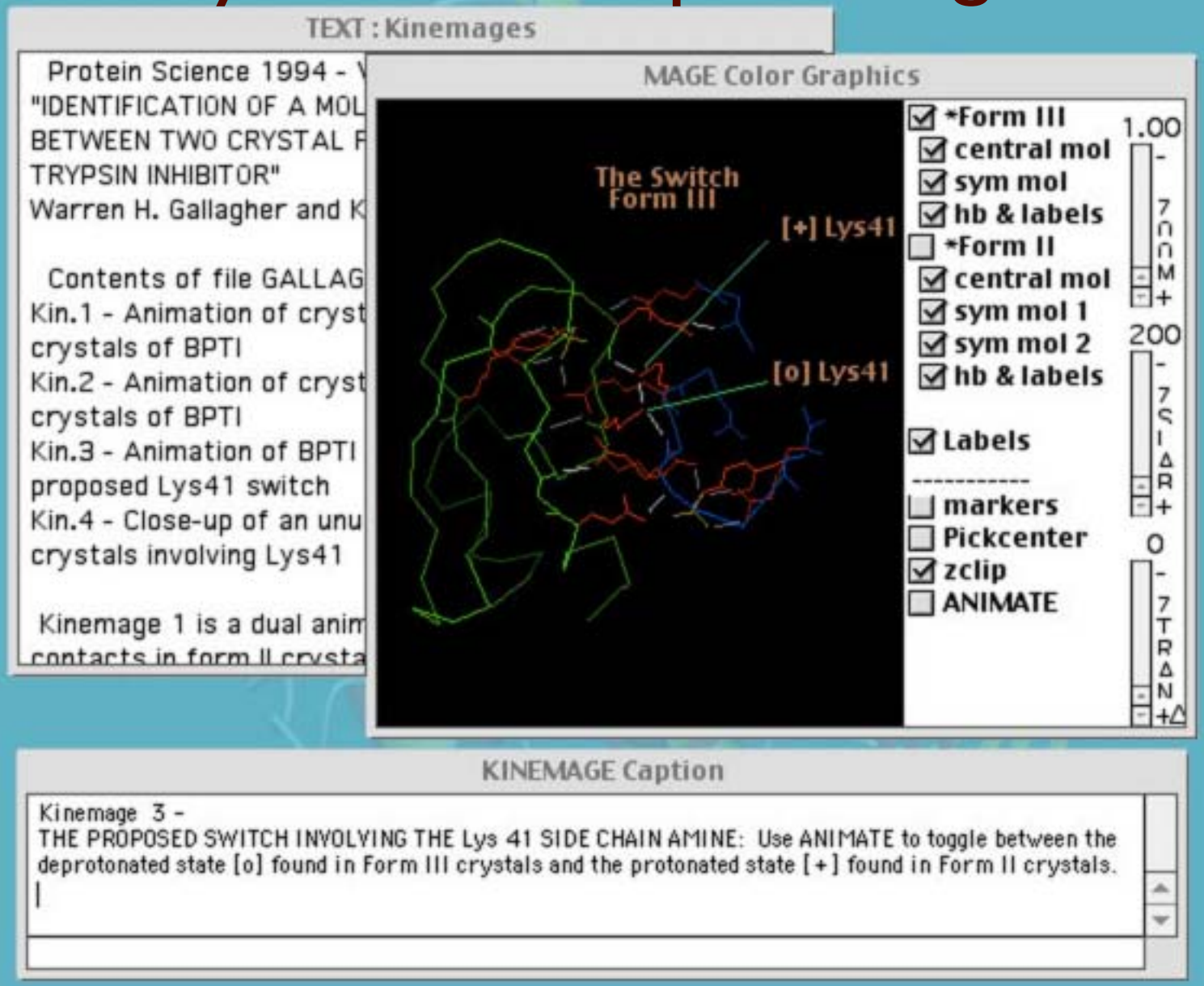
- In 1995, switched to having students created *Kinemages (kinetic images)*
  - Developed by David and Jane Richardson at Duke University

History of Term Paper Assignment

From 1992-1996 *kinemages* were used to illustrate articles published in the journal *Protein Science*.



History of Term Paper Assignment



History of Term Paper Assignment

- **Advantages for using *Kinemages*:**
  - Compels students to interact more intimately with their macromolecules.
  - The modeling application *RasMol* was also used to help develop the *Kinemages*.
  - *RasMol's* command line provides a effective tool for interrogating macromolecular structures.

History of Term Paper Assignment

- **Advantages for using *Kinemages*:**
  - *Kinemages* and *RasMol* are much more accessible than a single $40k *Silicon Graphics* molecular modeling workstation
    - » Personal computers are relatively inexpensive
    - » The software is free

History of Term Paper Assignment

- **In 1996 we began having the students submit their term papers as web sites**
  - The *Chime* browser plugin was used to incorporate interactive 3-dimensional models of macromolecules into the web sites

History of Term Paper Assignment

- **Advantages to using *Chime*:**
  - Creating *Chimes* is easier than creating *Kinemages*
  - The images look the same as those produced by *RasMol*
  - The *Chime* button scripts use the same commands as *RasMol*.
  - The *Chime* buttons can be used in context with the narrative of a term paper

History of Term Paper Assignment

- Advantages to using *Chime*:
  - The web site format allows the students to share their efforts with a much wider audience.

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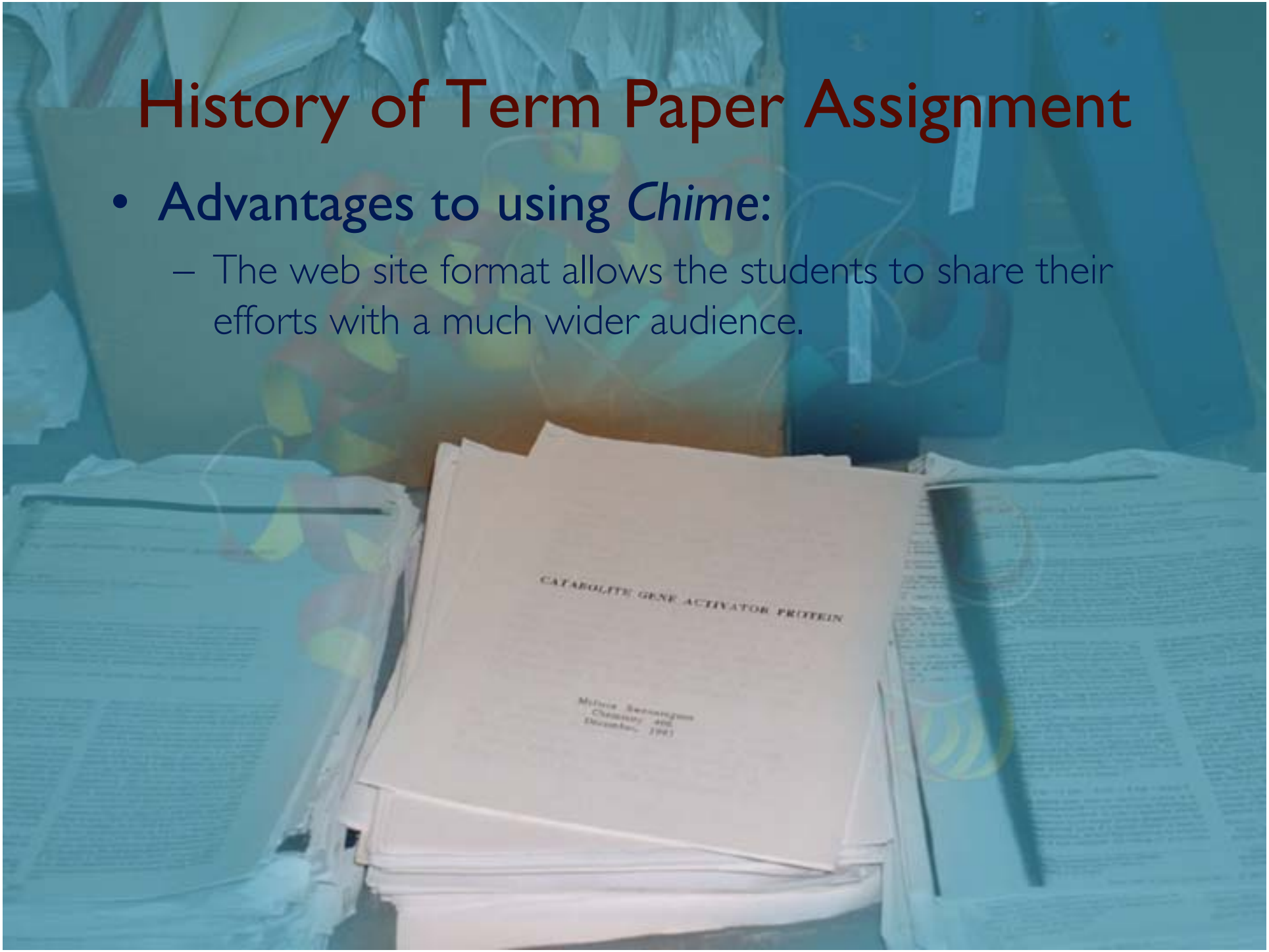

World Index of Molecular Visualization Resources
www.molvisindex.org

A Visitor-Maintained Indices (VMI)™ Site by Eric Martz and Trevor D. Kramer.
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Thanks to Josh Polterock, Ray Bean, and Andrew Sanderson at SDSC for dedicated efforts to keep this site healthy!

Carroll, Carla (www.clunet.edu)
Nitrogen Regulatory Protein C (at The Online Macromolecular Museum) (transcription factor; nitrogen metabolism; phosphorylation, protein; NtrC)

Chem406 Class, Fall 1999, U Wisc-Eau Claire (www.chem.uwec.edu)
Student Webpapers: The Structure-Function Relationships for the Enzymes in the Glycolytic and Lactate Fermentation Pathways.
(glycolysis; gluconeogenesis; lactate fermentation; Classroom use of Chime; lesson plan)

Students taking Chem406 at the University of Wisconsin-Eau Claire are required to write a Web termpaper (Webpaper) that reviews the structure-function relationships of a protein. Chem406 is a biophysical chemistry course that is required of undergraduate students majoring in Biochemistry/Molecular Biology. For the Fall 1999 semester the students were assigned enzymes from the glycolytic, gluconeogenesis, and lactate fermentation pathways. The students were required to use Chime images to illustrate their papers and to use JavaScript buttons to modify these images in context with the narrative of their paper. We have found Web page authoring with Chimes to be a powerful tool for teaching students about the structure/function relationships of proteins. The homepage for this site contains two links: one to the detailed assignment that was given to the students, the other to a figure showing the metabolic pathways involved. Each enzyme named in this figure provides a link to a student Webpaper. These are student-authored reports, unedited by faculty, consequently the quality and accuracy does vary. All together there are 12 Webpapers with a average of three Chimes per Webpaper. The specific enzymes covered include:

- Hexokinase (E.C.2.7.1.1)
- Glucose 6-Phosphate Isomerase (E.C.5.3.1.9)
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Submitted by: Gallagher, Warren. (Entry 57).

Cox, Ricky (campus.murraystate.edu)
Noncovalent Interactions in Proteins (noncovalent interactions in proteins; ligand-protein complexes; pi-orbital interactions; cation-pi interactions; aromatic sidechains: face-to-face, side-to-face, face-to-cation; salt bridges)

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History of Term Paper Assignment

- **Adoption of web format also coincided with the rapid explosion in the quantity of structural data available on the Web.**
  - In 1991
    - » Obtained all 300 structures in the Protein Data Bank on a single tape
    - » Few tools for searching the data base.
  - Now
    - » There are over 18,000 structures in the Protein Data base
    - » There are powerful Web-based tools for finding and downloading structure files

The Curriculum

- **Chem 406 is a required course for Biochemistry/Molecular Biology (BMB) majors.**
- **The BMB program began in 1989**
  - Administered jointly by the Chemistry and Biology departments.
- **Program requirements include:**
  - 35 Credits of biology
    - » emphasis on cellular and molecular biology.
  - 32 credits of chemistry
    - » emphasis on biochemistry and biophysical chemistry.
  - Calculus and General Physics
  - General Education
    - » communications, humanities and social sciences.

The Curriculum

- **Chem406 (Biophysical Chemistry)**
  - Taken instead of Physical Chemistry by BMB majors.
  - First taught in 1990
  - Curriculum focuses on
    - » Thermodynamics
    - » Structure Determination
    - » Macromolecular Structure

The Curriculum

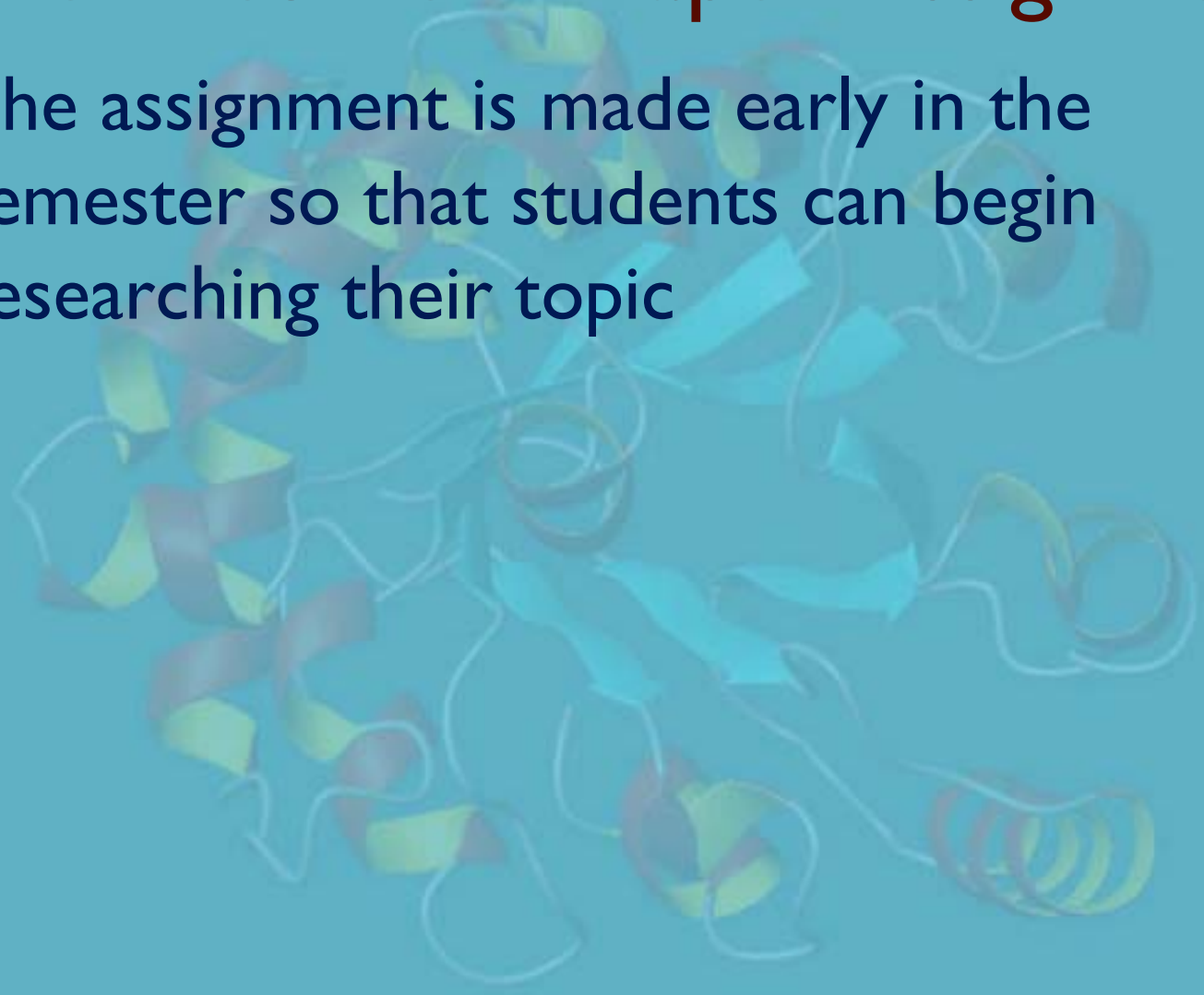
- **Chem 406 was expanded in 1998**
  - From 3 credits
    - » Lecture only
  - To 4 credits
    - » 3 hours/week lecture
    - » 2 hours/week computer lab

The Curriculum

- Lab time is used to investigate computer-based tools used in biophysical chemistry.

The Web Term Paper Assignment

- The assignment is made early in the semester so that students can begin researching their topic



The Web Term Paper Assignment

- **For the last three years we have had a theme**
  - Enzymes of the glycolytic and fermentation pathways
  - Enzymes of the citric acid cycle
  - Enzyme cofactors.
- **Student's draw their assigned enzyme/cofactor out of a hat.**

The Web Term Paper Assignment

- **Later in the semester we dedicate lab time to web authoring.**
- **Web-based tutorials**
  - Using a plain text editor (*BBEdit*) to write HTML code and to embed *Chime* images and buttons.
  - Using a high end web editor (*Adobe GoLive*) to create sites with embedded *Chime* images and buttons.

Acknowlegdgements

- NSF-ILI
- At UW-Eau Claire
  - Network for Excellence in Teaching
  - Computing and Networking Services
  - Media Development Center
- Scott Hartsel
- Chem 406 students