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DNA History Lesson: A Cooperative Method for Learning About the Discovery of DNA Structure and Function

Molecules of Life Dissemination Conference
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General Studies Program

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What is the General Studies Program?

- Two year
- Referral program not direct admission
- Avg. SAT≈ 1350, gpa ≈ 3.3
- Guaranteed a transfer to original school
- Small classes 15 – 35 students

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GSP Mission

"creates the ethos of a small liberal arts college while providing students access to the range and depth of resources at one of the world's leading metropolitan research universities. "

http://gsp.nyu.edu/page/GSPhome

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GSP Curriculum

- “Great works” program
- Core: 2 Writing, 2 Social, 2 Cultural, Global Cultures, 2 Sophomore Seminars, 2 Sciences
- Soon expanding into 4 year BA program

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GSP Science Courses

- History of the Universe
- Environmental Studies
- Life Science
- All for non-majors
- Same instructor for lecture and lab
- Two science related sophomore seminars “The Darwinian Revolution” and “Environmental Ethics”

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Life Science Course

Topics include:

- Nature of science
- Cells
- Protein structure and function
- DNA structure and function
- Cell cycle and cancer
- Genetics – mostly Mendelian
- Evolution - including pop. gen., and cladistics
- Biotechnology and bioethics

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Life Science Course

- To cover the topic of DNA structure and function in the context of the process of science
- Have class lectures previous to week of student lessons
- In lab students teach peers about the scientists and their work

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Goal 1:
Use of primary sources

- Unique opportunity to understand and evaluate scientific data.
- Communicates sense of discovery felt by scientists when generating molecular biology data.
- Provides some sense of how scientific knowledge is generated.
- Develops and fosters scientific literacy.

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Goal 2: Relating experiments to a timeline of discovery

- Textbooks rarely communicate blind alleys and unexpected findings that characterize research.
- Students seldom relate discoveries as a consequence of available technology during a given time period.
- Opportunity to relate achievements into the overall big picture.

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Goal 3:
Learning about DNA

- Realizing DNA not protein is the molecule of heredity
- Relate structure and function of a molecule.
- Connect discovery of DNA structure and function in relation to real dilemmas.
- Apply learned concepts and strategies to other biomolecules.

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Goal 4: Collaborative Learning

- Increase achievement and engage in collaboration.
- *Motivational* device –reinforces student and teammates to master material.
- *Facilitative* device – encourages sharing of ideas, brainstorming, and structuring an activity.

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Collaborative Learning, cont.

- High student autonomy and participation in decision-making.
- Active learning.
- Research indicates students like courses using CL more than traditionally taught courses.
- Individual accountability issues.
- Substantial change in instruction.

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Goal 5: Greater appreciation of scientists

- By analyzing/interpreting data.
- By getting personal and intellectual insights about scientists' work.
- Scientific process as a collaborative and competitive process.
- Places the science into a historical context

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Goal 6: Paradigm Shift in Biology

- Discovery of DNA structure/function changed the way biology was perceived.
- References used portray biology as highly experimental.
- Additional layer of quantitative skills in the study of biology.

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Goal 7: Intersection of biology, chemistry and physics

- Many discoveries related to DNA were done by chemists and physicists.
- Understanding structure/function of DNA required applying techniques from chemistry and physics.

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DNA History Lesson

- Students select own collaborative groups (2 - 3) and scientist(s)
- Investigate the biography of the scientist up to and including their work on DNA
- Describe their contribution to the discovery of DNA as the genetic molecule or the structure of DNA

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Scientists

Frederick Griffith

Oswald Avery, Maclyn McCarty, Colin MacLeod

Alfred Hershey and Martha Chase

James Watson and Francis Crick

Rosalind Franklin

Maurice Wilkins

Erwin Chargaff

Jerry Donohue

Linus Pauling

Sir Lawrence Bragg

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DNA History Lesson - Materials

- PDF copies of original journal articles for most of the scientists
- “The Double Helix” by J. Watson
- “Secret of Photo 51” NOVA film
- Secondary source, one Internet source
- Materials used by students for lesson

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DNA History Lesson - Methods

- Teach their peers about their scientist(s) and their work on DNA
- Submit a paper in first person about their scientist and their work on DNA.
- Can use any method to convey their information EXCEPT Power Point
- 3 class periods – 75 minutes each

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DNA History Lesson - Results

- Variety of materials : posters, short films, illustrated books and pamphlets, models, skits, board games, “60 minutes” style interviews and more.
- Many also included handouts with crossword puzzles or fill-in-the blank quizzes etc.

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DNA History Lesson - Results

Assessment of student knowledge was done two ways:

1. Lesson and papers are graded, included as part of lab grade
2. Questions about the scientists and their work on lecture exam

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DNA History Lesson - Results

- Students were asked about the importance of the scientists before and after the activity
- Very preliminary
- Students expressed that they enjoyed the lesson and liked learning about the scientists
- Put it into a context they could relate to

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Summary of survey data on eleven scientists involved in the various discoveries leading to the understanding of the structure and function of DNA as the genetic material. (n = 74)

Scientist	Student Pre-Activity Evaluation of Importance (%)	Student Post Activity Evaluation of Importance (%)
O. Avery, M. McCarty, & C. MacLeod	0	49
L. Bragg	0	13
E. Chargaff	0	51
F. Crick	15	22
J. Donohue	0	9
R. Franklin	3	74
F. Griffith	0	25
A. Hershey & M. Chase	1	39
L. Pauling	8	10
J. Watson	16	30
M. Wilkins	0	11

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