

# El Molino High School Biotechnology Middle School Step-Up Class

## Course Curriculum

### Biotechnology Middle School Step-Up Class Course Goals:

- Introduce middle school students to biotechnology content
- Motivate students to pursue a science career in biotechnology
- Motivate students to take more science classes in high school
- Excite students about scientific inquiry and science technology
- Focus on hands-on laboratory experiences with scientific inquiry

### GREAT EXPERIENCES FOR STUDENTS IN BIOTECHNOLOGY:

- Focused on lab protocols
- Inquiry that progresses from guided to OPEN!
- Projects with presentations
- Guest lectures from professors and industry
- Field trips to biotechnology industry
- Internships
- **Step-Up Biotechnology Class for Middle School Students: high school students are volunteers and are very good role models for the younger students. This gets many students motivated to pursue a science career!**

### Biotechnology Middle School Step-Up Class Course Content:

1. **Begin the first class with Cheese lab where students test different enzymes for their speed of cheese production and for their volume of cheese production.**
  - Students are excited to start immediately with inquiry and they are surprised that cheese production is a sector of biotechnology.
  - Once students have received their milk and enzymes and they incubate their cheese tube under their arm, they check results every 5 minutes.
  - During the observations of their cheese production they are introduced to biotechnology with a power point presentation and demonstrations of biotechnology products.
  - Students take home their cheese tube and return it the next day to filter out the whey and measure their results
  - Students share their results and discuss what they think is best for the production of cheese based on shared results. They discuss potential errors too.
2. **Experimental Design lab: Students design an experiment to test the effect of bleach on denim.**
  - Students produce a hypothesis and write down their lab protocol
  - Students use 5 different dilutions of bleach solution that they use the same volume measurement added to the same type of denim fabric samples and they are exposed to the bleach solutions for the same amount of time.
  - Students discuss experimental design focusing on hypothesis and experimental controls and discussion of potential errors.
  - Students share results with the whole class and they form a conclusion about the effect of bleach on denim.
  - This lab introduces students to the industrial sector of biotechnology; the students view a power point from Novozyme.
3. **Strawberry DNA Extraction lab: students extract DNA from strawberries.**
  - Students learn about the different techniques to extract DNA from the strawberry and this teaches them about plant cell structures.

- Students learn about DNA with interesting short videos showing DNA structure and function
  - Students take home their tube of DNA and explain the lab to their parents.
- 4. Student DNA Extraction Necklace: Students use the Bio-Rad DNA necklace kit or the Carolina Biological Supply DNA necklace kit to extract their own DNA from their cheek cells and put their DNA into a necklace that they wear home.**
- Students learn that they can easily extract their own DNA from cheek cells.
  - Students compare the similarities and the differences in the laboratory protocols for extracting DNA from plant cells vs. animal cells
  - Students learn where DNA is located inside cells
  - Students learn the function of DNA
- 5. Making a model of DNA: Student uses the Carolina Biological Supply Understanding DNA Kit to build a model of DNA.**
- Students learn the structure of DNA
  - Students learn the function of DNA
  - Students explain how the DNA model of other students is the same as their model and how it is different from it too.
  - This lab introduces students to protein synthesis too.
- 6. Making a model of DNA: Students now make a candy model of DNA out of licorice, marshmallows and gum drops and tooth picks.**
- Students learned DNA structure with the previous lab and now they make their new DNA model.
  - After students have made their DNA candy model, they explain the structure and function of DNA to the teacher and teacher assistants as an Oral Quiz.
  - When students complete their Oral Quiz, they can eat their DNA!
- 7. Measuring Volume: Students use a graduated cylinder, a beaker, a serological pipette, and a digital micropipette to measure volume.**
- Introduce students to different ways to measure volume starting with beakers and graduated cylinders
  - Students learn how to use serological pipets and they compare volume samples that they measure with the serological pipette and the graduated cylinder.
  - Students learn how to set the volume on a digital micropipette and how to use it, measuring different volumes of different colors of food coloring
  - Students learn why digital micropipettes are used so much in biotechnology
  - Students next move to using a micro assay tray that they follow the secret code handout to fill in the correct colors into the correct spots.
  - Students show the teacher their final product and if they did it correctly, they win a tootsie roll pop!
- 8. Practice Loading Gels in Gel Electrophoresis Chambers: Use the practice gels in the electrophoresis chambers with practice dye.**
- Students now use the digital micropipette to load practice dye into the practice gel
  - Students are introduced to gel electrophoresis with a video and a power point, focused on DNA fingerprinting
  - Students are using handouts of DNA fingerprints and read orally the question about the fingerprints and they examine the DNA fingerprints to answer the question. They understand how DNA fingerprints are used.

- Students learn the principles of gel electrophoresis: how the DNA bands are formed, the charge of the DNA model, the cathode and anode and how the size of the DNA bands is related to the position on the gel.

**9. Gel Electrophoresis of Dyes: Students use the *Carolina Biological Supply Gel Electrophoresis of Dyes Kit* to learn how to set up and run a simulation of DNA fingerprinting.**

- Students load the different colored dyes and run their gels
- Students observe their results and share their results with the class

**10. Spectrophotometer lab: Introduce students to how to use the spectrophotometer and how it is used in biotechnology.**

- Explain the wavelengths of light and the different colors produced with different wavelengths
- Put a piece of white paper into the spectrophotometer tube and have students observe the different colors that show up at different wavelengths.
- Students change the wavelengths and test the difference in colors that they are able to detect and then they compare this to their peers.
- Students test 3 different concentration solutions in the spectrophotometer at the same wavelengths and they record the different absorbance based on concentration of the solution.
- Students learn the many applications of the spectrophotometer in biotechnology.

**11. Digital Balances and Electronic Balances: Students learn how to use the different balances to measure mass.**

- Students learn the difference in accuracy of different types of balances. Short discussion
- Students weight the same items: coins and paper clips on different balances.
- Students use the serological pipettes and digital micropipettes, and weigh the volume samples and compare the accuracy of the different pipettes and different balances.
- Students discuss results and why the accuracy matters

**12. What is Biotechnology? Carolina Biological Inquiry Kit Biotechnology: students examine different sectors of biotechnology and gather data and share their results with the class.**

- Use the guidelines and instructions in Carolina Kit and divide the class into 5 groups where students investigate questions on the student guides on a sector of biotechnology
- Topics covered: Cloning, DNA fingerprinting, Human Genome Project, Genetic Modification, Stem Cells
- Each group makes a class presentation on their investigation
- Students record the basic information from each group presentation that they save, and take home and explain to their parents.

**13. Glo-Germ Investigation: Use the glo-germ solution to introduce students to epidemiology.**

- Set up the Glo-Germ solution on the door handle and on several other classroom locations.
- After the students work on another lab and they have moved around and interacted, test the contamination results using the UV light.
- Have students discuss how they “caught” the germ
- Explain to students how this is related to sterile technique in biotechnology

**14. Traditional Fingerprinting Lab: Students produce their own traditional fingerprints and they work with a handout on fingerprint descriptions to find out “who did it”, with a practice criminal investigation.**

- Students learn the difference between traditional fingerprinting and DNA fingerprinting.
- Students solve a crime situation with use of traditional fingerprinting of all students in the classroom. This is a lot of fun!
- Students are introduced to Forensic Science.