
Biology Labs and Record Keeping

Science Grade 9

This work includes three main components:

1. **Record Keeping Guidelines:** Good Laboratory Practice (GLP) guidelines for record keeping have been adapted for use with high school laboratory notebooks. Proper laboratory record keeping techniques are legally required in industry; developing this skill early could help students with future careers.
2. **DNA Modeling:** If students are learning about or modeling base pairing, they should also be building real segments of DNA. This lab/activity requires that students build specific segments of disease-associated genes. At the end of the DNA modeling lab, students will understand and be able to model nucleotide structure, base pairing, telomeres, promoters, and point mutations.
3. **Thin Layer Chromatography (TLC):** In the prelab, students will learn about intramolecular and intermolecular interactions. Students will apply this knowledge to plant pigment separation. This experiment incorporates an element of student-driven experimental design. At the end of the TLC lab, students will understand and be able to apply information on biologically relevant intermolecular interactions, differences between plant pigments, and simple chromatographic techniques.



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Please provide us some background information on the unit development. In order to help others who are interested in this topic understand a bit more about what you created, we will write a short introduction to each unit and provide some images, in addition to posting the completed units on the Cape Cod Regional STEM Network website (www.capecodstemnetwork.org). Please help us by answering the questions below after you have completed your unit.

1. Who helped to create this unit?

Names	School (Grade/course taught)
Siobhan Curran	Massachusetts Academy of Math and Science, STEM teacher

2. What were some sources of inspiration for this unit?

I was asked to develop Good Laboratory Practice (GLP) labs and/or guidance for high school teachers. I was also interested in improving some common introductory biology activities (like DNA modeling) to improve the quantity and quality of the connections students were building.

3. In your own words, what are you hoping students learn—big picture—through this unit?

I am hoping that GLP record keeping becomes second nature for students by the time they complete a high school science sequence. I am also hoping that more students are exposed to the complexity of DNA and the interdisciplinary nature of biochemistry experiments. Biology students should have an intuitive understanding of how chemistry and biology intertwine.

4. What might students find exciting in this unit?

Students enjoy model building. They might also be excited to work with specific disease-associated genes in the modeling lab. In the chromatography lab, students might be excited about the experimental design component of the process.

5. What science standards or real-world content did you strive to emphasize?

I tried to emphasize the following biology standards:

HS-LS1-1. Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life.

HS-LS1-4. Construct an explanation using evidence for why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model

the major events of the cell cycle, including (a) cell growth and DNA replication, (b) separation of chromosomes (mitosis), and (c) separation of cell contents

HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of sugars and other carbohydrates.

HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules.

HS-LS3-4. Use scientific information to illustrate that many traits of individuals, and the presence of specific alleles in a population, are due to interactions of genetic factors and environmental factors

The labs I developed also had some significant cross-curricular content, particularly with chemistry: Predicting sizes of molecules [**HS-PS1-1**], separating mixtures [**HS-PS1-11**], and understanding chemical interactions between substances [**HS-PS1-3**].

6. How would you say that this unit “matters” to the STEM community? Or to our community on Cape Cod? Or to the larger community?

I believe these labs are important because they encourages students to think deeply about the connections between ideas. Good Laboratory Practice is also an important piece of a well-run laboratory. The legal requirements for laboratory notebooks in industry are very specific. In many cases, these GLP requirements are similar to what teachers already do in the classroom. With a few small tweaks, that alignment can be improved. Students who have learned GLP record keeping have an advantage when entering the workforce; students could gain real-world benefits from acquiring this important transferrable skill.

7. What’s the most important lesson you learned as you created this?

GLP record keeping is important to people at all levels of an organization. Incorporating these skills early in student education can have far-reaching impact.

8. Anything else you would like fellow teachers or others to know about this unit?

The materials developed during this externship are not as closely connected as you might expect from a traditional unit. The goal of this unit was to develop some materials that could bridge the gap between industry expectations and current educational practices. Most of the skills and background information scientists want new hires to have are present in existing curriculum. However, simple redesigns of existing material could improve the strength of these connections.



Materials included with this unit

- GLP record keeping handout
- Modeling DNA prelab
- Modeling DNA lab
- Modeling DNA teacher notes
- TLC prelab/lab/postlab
- TLC teacher notes

Recommendation for GLP Record Keeping

1. Remind students of pertinent rules before each lab (or have students remind each other).
2. Stress the importance of internalizing this skill. It returns in college and any science or engineering careers. When students hear that there are legal and financial implications for people who do not follow these rules in the real world, they take these rules more seriously.
3. You may want students to have a copy of the agreement just after the table of contents in their laboratory notebook.
4. Significant figures should be second nature. However, if you are in a biology first school, students may not have had exposure to sigfigs. If your students have learned about significant digits in the past, include a requirement for them in the record keeping agreement.

At large schools, guidance might have trouble getting to know students. If students do particularly well with any major laboratory areas (including GLP record keeping), science teachers should share the information with guidance. The extra information may be useful for career advice and guidance counselor college letters. Students who cannot do a four-year degree may be able to pursue a two-year degree; advice from guidance may help these students discover a career path in science.