Teaching Tips and Classroom Resources
from the Genetic Science Learning Center

The GSLC is a joint project of the University of Utah's Eccles Institute of Human Genetics, School of Medicine and Utah Museum of Natural History
WEBSITE: http://gslc.genetics.utah.edu EMAIL: gslc@genetics.utah.edu
newsletter available online at http://gslc.genetics.utah.edu/workshops/newsletters.html

Teaching Activities

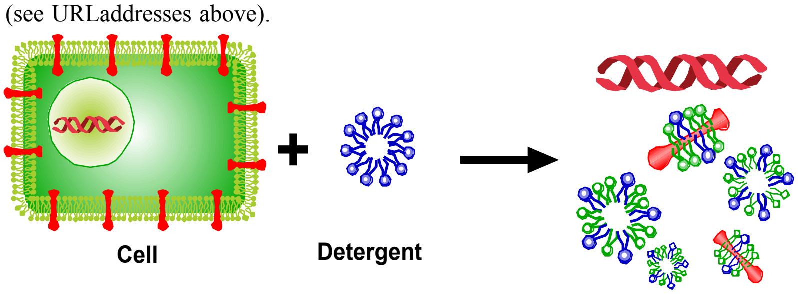
How to Extract DNA from Anything Living
http://gslc.genetics.utah.edu/basic/howto/teacher.html
DNA Extraction from Wheat Germ
http://gslc.genetics.utah.edu/basic/wheatgerm/activityoutline.html

Wow! DNA! You mean I can see it? How? Students and adults alike are intrigued by the prospect of seeing DNAusing these simple protocols. This activity demonstrates that DNAis found in all living things, a concept about which students are often confused. Many students are surprised that they can see DNAwithout a microscope, although it is necessary to clarify that the DNAdouble helix (molecular structure) cannot be seen even using a microscope.

Uses: DNAextraction is appropriate for students aged 10-20 (U.S. grades 5-14). "How to Extract DNAfrom Anything Living" is a quick-and-dirty protocol that can be done easily with cheap ingredients. "DNAExtraction from Wheat Germ" is a more specific protocol that consistently yields large quantities of DNA. Both are easy to do in the classroom.

Contents: Each activity includes a protocol, an illustrated explanation of how the protocol works, and suggestions for further activities and research.

Teaching aids: Overhead copymasters, PowerPoint presentation for classroom use, and teacher guides. All materials are available free on the GSLC website (see URLaddresses above).



Tell us what you need!

Website activities We work hard to provide accurate, useful information about genetics on our website and we want to know how it works for you. What do you like about it? What doesn't work for you? What could be added? Email comments to webmaster@gslc.genetics.utah.edu.

These activities have individual online feedback forms. If you use the activity, please send us your comments by filling out the form.

Just what is a genetic disorder?
http://gslc.genetics.utah.edu/disorders/definition/index.html

What is a mutation?
http://gslc.genetics.utah.edu/thematic/nf1/proteinrole/sentence.html

How do mutations occur?
http://gslc.genetics.utah.edu/thematic/nf1/mutations/index.html

How do mutations in our genes cause genetic disorders?
http://gslc.genetics.utah.edu/thematic/nf1/proteinrole/index.html

Newsletter If you want to see particular topics or features covered in this newsletter, please send us your ideas for consideration. Email suggestions to kristen.kamerath@genetics.utah.edu.

Ideas From the Classroom

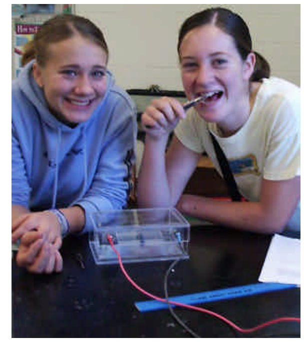


Photo credit: Mary Bucklew
Students in Mary Bucklew's class conducting an electrophoresis experiment.

Last summer I took the Exploring Gel Electrophoresis course offered by the Genetic Science Learning Center and was given the assignment to implement a plan for my classroom to use the electrophoresis equipment I made during the course.

To do this, I first had to acquaint my students with the structure of DNA. Then the students created a DNAmolecule of their own. To introduce restriction enzymes, we compared the students'fingerprints. At this point they were ready to be introduced to case studies and gel electrophoresis chambers.

I used the scenarios that were created in the GSLC course as examples and allowed the students to choose among forensics, paternity, or genetic disease scenarios. I showed them how to do the setup by placing the gel chamber directly on a standard overhead and demonstrating how to run it. It created a great deal of excitement as the students solved their chosen case because they were playing the role of the lab technicians running a DNAfingerprint.

After this introductory activity I asked my students to write a scenario that illustrates an actual use for DNAfingerprinting. The creativity of these ninth graders surpassed anything that I expected. Many of the scenarios were better than the ones I used as examples. On the day that we ran the students'scenarios, the excitement was even higher than before. It was unbelievable. They still talk about it. One of my students has a great science fair project on forensics going to the district science fair.

Without this activity, the students'enthusiasm for genetics and DNAwould have been much more limited. Thanks to the GSLC course, I had the equipment in my classroom and the knowledge to involve students in solving real genetics problems on real equipment, not just on paper.

Submitted by Mary Bucklew
Science teacher
Orem Junior High, Orem, Utah

Current Events in Genetics

If amphibians lose a limb or tail they can grow another one, but humans and other mammals can't. Or can they? Drs. Mark Keating and Shannon Odelberg, cardiologists and geneticists at the University of Utah, decided to investigate whether it might be possible.

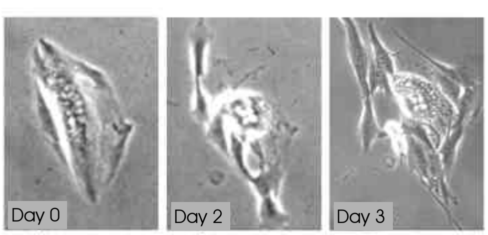
When newts (a type of amphibian) lose an arm, the skin, muscle, and other types of cells at the edge of the wound begin a reverse-development process in which they lose their specialized character and become stem cells. Stem cells are a different type of cell that has the capability to grow and divide into a new arm. Unfortunately, mammalian cells have never been known to reverse their development – once a muscle cell, always a muscle cell.

Recent research by other scientists showed that a certain gene, called *msx1*, probably played a role in normal limb development as well as regenerating limbs in several animals. Additionally, Keating and Odelberg knew that *msx1* prevents early muscle cells in mice from specializing. Putting these clues together, they decided to investigate whether *msx1* could cause mammalian cells to change their fate.

They began by stimulating mouse muscle cells to turn on the *msx1* gene and then monitored the presence of certain specialized muscle proteins. As *msx1* turned on, they noticed that levels of these muscle proteins decreased. Some of the muscle cells broke apart to create stem cells and began to grow and divide. Next, these stem cells were placed in growth conditions conducive for specialization of other types of cells, such as bone and cartilage.

After some time, these stem cells acquired characteristics of bone, fat, and cartilage. Essentially, the muscle cells had now transformed into other types of cells, a process that doesn't occur naturally in mammals. Although there are many more experiments to be done, Keating and Odelberg hope that their research will someday enable humans to regrow missing body parts.

Scientific Article: Odelberg S, Kollhoff A, Keating M. "Dedifferentiation of Mammalian Myotubes Induced by Msx1." *Cell*. 22 Dec. 2000.
News Article: Lavine, Greg. "U. Study May Lead to Limb Regrowing." *The Salt Lake Tribune*. vol. 261, no. 69. 22 Dec. 2000.



Day 0: normal mouse muscle cell. Day 2: muscle cell begins to break apart as msx1 *gene turns on. Day 3: single muscle cell becomes several cells that start to resemble stem cells.*

Careers Focus: bioinformatics

Bioinformatics? Don't worry if you haven't heard of it. It's a new career that is growing rapidly due to the demand created by genetic research. Enormous amounts of data are generated by this research every day, so much that it would be impossible to analyze the data without computers. That's where bioinformatics comes in.

People with jobs in this area use programming skills to create software tools that analyze and interpret genetic data. For example, they help scientists determine how similar one gene is to another -- such as how a gene for development of a human arm compares with a gene for wing development in a fly -- by using computers to compare the genetic sequences.

Since bioinformatics is a new area, there is a shortage of qualified people to fill the available jobs. Working in bioinformatics requires skill and knowledge in biology and computer programming, which not many people currently have. Those who do can receive job offers from companies and universities all over the United States, with yearly salaries ranging from $50,000-70,000.

The GSLC spoke with a graduate student and an undergraduate student, both at the University of Utah, who are training for careers in this area to get an insider's perspective. Here are their comments:

Q: What is your background?
A: computer engineering, electrical engineering and molecular biology.

Q: What is your job description?
A: Analysis of genetic sequence data guided by scientists -- identifying introns, exons, and single nucleotide polymorphisms (SNPs). Providing support for identification of disease-related genes.

Q: What computer programs or programming languages do you use?
A: Perl, Java, JavaScript, CGI, SQL/PL, XML, Matlab, BLAST, Shell Script.

Q: Why are you interested in bioinformatics?
A: It is an excellent opportunity to combine my computer and biology skills. Using programming to support genetics is interesting. Good salary. There are opportunities to have my work published in scientific journals.

Q: Where do you see yourself in 5 years?
A: Pursuing a master's degree in computer science or business. Working in industry as a bridge between bioinformatics and biological scientists.

Q: How will bioinformatics change in the next 5-10 years?
A: The successful bioinformatics candidate will change from a pure computer specialist who knows nothing about DNA and proteins to a biological scientist who has strong skills in computer sciences and technology.

Q: Any advice for students who are considering bioinformatics?
A: Good choice. Take cell biology classes and get some computer programming experience.

Teacher Summer Course

Exploring Gel Electrophoresis: July 16-20, 2001

Supplies and equipment provided by course.

Have you wanted to carry out gel electrophoresis laboratory activities with your students but lack the necessary equipment? In this course you will construct a classroom set of eight electrophoresis chambers and use them to explore electrophoresis applications in genetic testing, paternity testing, and forensics. Cost: $250/Utah teachers; $750/other teachers. Credit: 3 hours inservice or University of Utah graduate credit. See **http://gslc.genetics.utah.edu/workshops/gel.html** for details and application.