***Student manual:***

**Lab 1 - Spooling purified DNA:**

**Description:**

**DNA is the material that contains all of the instructions that are required for building your cells and keeping them alive. Each of the 46 chromosomes that are contained in one of your cells contains one DNA molecule that is an inch or two long, though it is far too slender to be seen with any but the most powerful electron microscopes. If we could enlarge one of these DNA molecules enough so that we could see it…approximately the same diameter of one of the hairs on your head for example…we would find that it would be several miles long.**

**In this activity we will take advantage of this long, thin, “threadlike” shape of DNA molecules to “spool” them, which is to say, we will wind them around a wooden stick like a piece of thread. As you may know cotton fibers being only a couple of inches long individually and quite thin, can be combined into one long, continuous thread, because they tend to stick to one another and line up side by side. The same thing can happen when DNA molecules come out of solution if we pull on them from one end. We will do this by slowly twisting a stick in the region where DNA is beginning to precipitate. Each DNA molecule that is initially caught and wound around the stick then catches and pulls others. Thus, if we work carefully, we can wind all of the DNA molecules into one long continuous thread. Although DNA molecules are so thin that they cannot be seen with the naked eye, if you wind up many such molecules together, as described above, the DNA becomes visible and the properties can then be studied.**

**Materials: (For each group):**

1. **Test tube (1) of DNA *(DNA Source: Carolina Labs)***
2. **Test tube (1) of alcohol**
3. **Wooden stick (1)**

**Procedure:**

**Step 1: Your teacher will give you a test tube of DNA *(isolated from salmon sperm)*, another test tube of alcohol, and a wooden stick. Record your observations of the liquids on your observation sheet. *(Can you tell which id DNA? How, why? Color, etc…)***

**Step 2: Uncap the tubes and hold the one that contains DNA at a 45degree angle.**

**Step 3: Carefully transfer the alcohol from its tube into the tube of DNA by pouring very slowly. We do not want the alcohol to mix the DNA by stirring it up during the pouring process. Record your observations *(What does the alcohol do?)***

**Step 4: Gently insert your stick through the alcohol layer to the interface where the two liquids meet. Twirl the stick gently trying to keep the tip at that interface zone the whole time.**

**Step 5: Now slowly lift the stick from the tube and observe the material clinging to it. How long a fiber can you lift from the tube? *(Approximate the length in inches, and centimeters)***

**Step 6: Put the stick back into the tube and gently twirl it in the vicinity of the interface again. Can you get more DNA to attach to the stick?**

**Step 7: When you have finished with the stick, cap the tube and shake it several times. Do you see more DNA in the tube now?**

**Observation Sheet:**

1. **Describe the appearance of the liquids in the two tubes**
2. **Can you tell which tube contains the DNA? How? *(be specific)***
3. **Describe what happened when you first twirled the stick in or near the DNA –alcohol interface**
4. **When you lifted the stick out of the tube, and a fiber of DNA followed, did you think that it was a single molecule of DNA? Why or why not?**
5. **How would you describe the appearance of DNA of someone who has never seen it?**
6. **What do you think it is about the biology of salmon and sperm cells that makes it easy to isolate a large quantity of DNA from salmon sperm?**

**Optional Hands on Lab 1 (DNA Extraction)**

Procedure:

First go through virtual lab: [Pre Lab Virtual Activity](http://learn.genetics.utah.edu/content/labs/extraction)

Now do this lab and complete questions below: [Hands on Lab 1a Activity](http://learn.genetics.utah.edu/content/labs/extraction/howto/)

Materials:

* Peas
* Blender
* Salt
* Meat tenderizer
* Rubbing alcohol
* Detergent

Observation Questions:

1. Name three other DNA rich sources besides the split peas we used that could be substituted for the experiment?
2. Why do you think we blend the peas?
3. Why do we add detergent to the pea soup?
4. Why must we be careful when stirring the enzymes into the pea slurry?
5. Why does alcohol float when added to the mixture?
6. What is the term for when a substrate becomes undissolved in a solution?

**Initial Case Study:**

…On a plane bound for Tijuana Mexico, Suzanne remembers the day she received a frantic phone call from her sister Karen about the news from her doctor:

“The doctor says I have cancer!” she exclaimed. “He says it is an aggressive but treatable form of Lymphoma. I don’t even know where these cells are in my body and the disease might kill me!” Karen continued “I’m scared and I don’t know what to do. I don’t want to die Suzanne.” “Calm down Karen,” Suzanne remembers telling her sister, “we are going to beat this, don’t you worry. Everything will be okay.”

Although Suzanne succeeded in calming her sister, she remembers how she immediately jumped onto the computer and looked up “Mantle Cell Lymphoma” to start researching the best doctors, treatment plans, and options available. Suzanne recalls finding the best oncologist in the city to take Karen’s case…and how he suggested a very aggressive regimen of chemotherapy which should be started immediately.

Karen had taken only two of the aggressive chemotherapy treatments when she became very ill, had to skip a treatment, and ended up spending a week in the hospital. Disillusioned with the experience Karen then began looking for alternative treatments. She found a clinic in Mexico that claimed to specialize in the treatment of Mantle Cell Lymphoma, so she decided to try the alternative before continuing her previous treatment regime with her doctor in America.

Upon hearing of her sisters decision Suzanne was hesitant. “Karen”, Suzanne said, “I understand you are frustrated and scared, but I think you should give the conventional treatment more time”. However, Suzanne would soon discover that this advice had come too late for Karen; she had already contacted the clinic and booked a flight for the both of them to fly to Mexico. “I’m not sure this is a good idea”, thought Suzanne, “but how can I tell Karen no; I don’t know that I wouldn’t do the same thing if I were in her position”. As they flew on above the clouds, piercing the serenity one finds 30,000 feet above sea level, Suzanne’s mind finally yields to the stark reality of the situation at hand: “I just hope this not only cures her, but also gives her peace of mind” Suzanne suppresses her sudden enlightenment, until now she has been so preoccupied with the emotions and needs of her sister, but now her deepest fears gnaw at the fringes of her consciousness…“I’m just not ready to lose my only sister yet.” as she looked at Karen sleeping in the seat next to her.

Karen and Suzanne arrived early evening at the clinic. As they began to settle in, their attention turns toward making sure they had all of the paper work in order. The last thing they want is problems with the records they need provide the nurse when she comes to take her information and vital signs. The wait seems immeasurable. Eventually the nurse does come, collects all the information, paper work, and money…then she promptly leaves.

“Well, I guess they will have you sign release forms and paper work in the morning” Suzanne commented. “Although, it seems odd to me that they would not have you complete everything tonight.” Karen’s response catches Suzanne by surprise, “I don’t care if they don’t have me sign a single paper. As long as the treatment works the way it is supposed to…it doesn’t matter to me what they do, or do not do, with regard to paperwork…or anything else.” Karen finishes her opinion with a look of peace and satisfaction.

“Surely you don’t mean that Karen.” Suzanne almost retorts. “I most certainly do” announces Karen, sitting erect and looking at her sister with conviction. “Why should I care about release forms and such? I have already completed my fill of release forms back in America. Besides, what purpose do they really serve?” Karen continues as Suzanne looks on in disbelief with her sister’s obvious lack of forethought regarding the ramifications of her aloofness. “No one reads them; they just take up space in my file because I’m told this is all part of procedure to ‘keep people from suing’ if the treatment doesn’t work.” Karen now settles back into the lounge chair feeling purged of her initial angst about the subject, and now gazes peacefully from their balcony overlooking a beautiful beach.

“Karen, those papers are meant to protect you as much, if not more than, the doctors” Suzanne gently comments. “Your information could be used without your permission, or your knowledge, and if you don’t sign those forms you are powerless to do anything about it” Suzanne says with a look of concern. “What could they do with my information that would matter to me?” Karen asks impetuously. “They could use your cells for research without your knowledge.” Suzanne remarks sounding a little agitated. Karen’s subsequently casual reply, “I don’t care what they do with them as long as I am rid of them and treatment can begin” leaves Suzanne all the more disconcerted.

“Well, you should.” Suzanne says as she grabs her laptop. After a few minutes of hurried tapping on the keyboard, Suzanne then hands the laptop over to her sister… “Here, take a look at what can happen when people use your cells without your knowledge, or permission, and reap all the benefits from it without any credit or compensation to the donor.” Suzanne continues “Read the story of Henrietta Lack. She is probably responsible, at least indirectly, for many modern scientific procedures, most likely including the treatments you are about to receive…and she died penniless.” Karen took the laptop and started reading……

***Before you read the subsequent case which Suzanne has brought to Karen’s attention via internet resources, I want you to consider a few questions and possibly do some research to help you answer these questions. Formulate some ethical opinions based on your research …Then I will distribute the information Suzanne presented for you to consider.***

**Terms to use or define as a guide to independent or extended research:**

* Gene Therapy
* Genetic Privacy
* Gene Ownership
* Proprietary Reimbursements
* Electrophoreses
* Karyotype
* Pedigree
* Inheritance
* Dominance and Recessive
* Discrimination
* Research rights
* Transparency / Disclosure

# Research Questions and Ethical Considerations:

# Can you brainstorm 3 possible things that might support Suzanne’s case prior to any research? If so write them down as a starting point.

# Use Google: ([Heath Care dilemma](http://www.issuesinmedicalethics.org/151cs31.html)), ([Cloning Dilemma](http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Cloning)), ([Stem Cell Research](http://newsbatch.com/stemcells.htm)), or [Mr. Taylor’s Webpage: Ethical Considerations](http://mathandsciencewithmrtaylor.weebly.com/ethical-considerations.html), as a resource to research possible supporting examples of why Karen should be more protective of her biological property.

# What ethical problems can arise from unsecured biological resources?

# If you could not find any resources independently, use the sites with URL’s offered above and summarize what those sites contained *(only the part you are using to support your viewpoints)*. There should be a minimum of six supporting citations.

# When finished take 5 minutes to prepare to share out what you have found in a small group presentation as a “think-pair-share” activity.

**Subsequent Case (Suzanne’s Illustration):**

# *Now please read this relevant case and think through your previously held position(s). If you find important issues you would want to use in an informative way for group discussion you might consider making brief notes about these points in an outline format. Do not be afraid to read the other links and supplemental materials before formulating your final thoughts. This may take some time so be patient and thorough.*

# Henrietta Lacks’ ‘Immortal’ Cells

## Journalist Rebecca Skloot’s new book investigates how a poor black tobacco farmer had a groundbreaking impact on modern medicine

* By Sarah Zielinski
* Smithsonian.com, January 22, 2010



Courtesy of the Lacks family

**Henrietta Lacks' cells were essential in developing the polio vaccine and were used in scientific landmarks such as cloning, gene mapping and in vitro fertilization.**

Medical researchers use laboratory-grown human cells to learn the intricacies of how cells work and test theories about the causes and treatment of diseases. The cell lines they need are “immortal”—they can grow indefinitely, be frozen for decades, divided into different batches and shared among scientists. In 1951, a scientist at Johns Hopkins Hospital in Baltimore, Maryland, created the first immortal human cell line with a tissue sample taken from a young black woman with cervical cancer. Those cells, called HeLa cells, quickly became invaluable to medical research—though their donor remained a mystery for decades. In her new book, The Immortal Life of Henrietta Lacks, journalist Rebecca Skloot tracks down the story of the source of the amazing HeLa cells, Henrietta Lacks, and documents the cell line's impact on both modern medicine and the Lacks family.

**Who was Henrietta Lacks?**  
She was a black tobacco farmer from southern Virginia who got cervical cancer when she was 30. A doctor at Johns Hopkins took a piece of her tumor without telling her and sent it down the hall to scientists there who had been trying to grow tissues in culture for decades without success. No one knows why, but her cells never died.

**Why are her cells so important?**  
Henrietta’s cells were the first immortal human cells ever grown in culture. They were essential to developing the polio vaccine. They went up in the first space missions to see what would happen to cells in zero gravity. Many scientific landmarks since then have used her cells, including cloning, gene mapping and in vitro fertilization.

**There has been a lot of confusion over the years about the source of HeLa cells. Why?**  
When the cells were taken, they were given the code name HeLa, for the first two letters in Henrietta and Lacks. Today, anonymizing samples is a very important part of doing research on cells. But that wasn’t something doctors worried about much in the 1950s, so they weren’t terribly careful about her identity. When some members of the press got close to finding Henrietta’s family, the researcher who’d grown the cells made up a pseudonym—Helen Lane—to throw the media off track. Other pseudonyms, like Helen Larsen, eventually showed up, too. Her real name didn’t really leak out into the world until the 1970s.

**How did you first get interested in this story?**  
I first learned about Henrietta in 1988. I was 16 and a student in a community college biology class. Everybody learns about these cells in basic biology, but what was unique about my situation was that my teacher actually knew Henrietta’s real name and that she was black. But that’s all he knew. The moment I heard about her, I became obsessed: Did she have any kids? What do they think about part of their mother being alive all these years after she died? Years later, when I started being interested in writing, one of the first stories I imagined myself writing was hers. But it wasn’t until I went to grad school that I thought about trying to track down her family.

**How did you win the trust of Henrietta’s family?**  
Part of it was that I just wouldn’t go away and was determined to tell the story. It took almost a year even to convince Henrietta’s daughter, Deborah, to talk to me. I knew she was desperate to learn about her mother. So when I started doing my own research, I’d tell her everything I found. I went down to Clover, Virginia, where Henrietta was raised, and tracked down her cousins, then called Deborah and left these stories about Henrietta on her voice mail. Because part of what I was trying to convey to her was I wasn’t hiding anything, that we could learn about her mother together. After a year, finally she said, fine, let’s do this thing.

**When did her family find out about Henrietta’s cells?**  
Twenty-five years after Henrietta died, a scientist discovered that many cell cultures thought to be from other tissue types, including breast and prostate cells, were in fact HeLa cells. It turned out that HeLa cells could float on dust particles in the air and travel on unwashed hands and contaminate other cultures. It became an enormous controversy. In the midst of that, one group of scientists tracked down Henrietta’s relatives to take some samples with hopes that they could use the family’s DNA to make a map of Henrietta’s genes so they could tell which cell cultures were HeLa and which weren’t, to begin straightening out the contamination problem.

So a postdoc called Henrietta’s husband one day. But he had a third-grade education and didn’t even know what a cell was. The way he understood the phone call was: “We’ve got your wife. She’s alive in a laboratory. We’ve been doing research on her for the last 25 years. And now we have to test your kids to see if they have cancer”, which wasn’t what the researcher said at all. The scientists didn’t know that the family didn’t understand. From that point on, though, the family got sucked into this world of research they didn’t understand, and the cells, in a sense, took over their lives.

**How did they do that?**  
This was most true for Henrietta’s daughter. Deborah never knew her mother; she was an infant when Henrietta died. She had always wanted to know who her mother was but no one ever talked about Henrietta. So when Deborah found out that this part of her mother was still alive she became desperate to understand what that meant: Did it hurt her mother when scientists injected her cells with viruses and toxins? Had scientists cloned her mother? And could those cells help scientists tell her about her mother, like what her favorite color was and if she liked to dance.

Deborah’s brothers, though, didn’t think much about the cells until they found out there was money involved. HeLa cells were the first human biological materials ever bought and sold, which helped launch a multi-billion-dollar industry. When Deborah’s brothers found out that people were selling vials of their mother’s cells, and that the family didn’t get any of the resulting money, they got very angry. Henrietta’s family has lived in poverty most of their lives, and many of them can’t afford health insurance. One of her sons was homeless and living on the streets of Baltimore. So the family launched a campaign to get some of what they felt they were owed financially. It consumed their lives in that way.

**What are the lessons from this book?**  
For scientists, one of the lessons is that there are human beings behind every biological sample used in the laboratory. So much of science today revolves around using human biological tissue of some kind. For scientists, cells are often just like tubes or fruit flies—they’re just inanimate tools that are always there in the lab. The people behind those samples often have their own thoughts and feelings about what should happen to their tissues, but they’re usually left out of the equation.

**And for the rest of us?**  
The story of HeLa cells and what happened with Henrietta has often been held up as an example of a racist white scientist doing something malicious to a black woman. But that’s not accurate. The real story is much more subtle and complicated. What is very true about science is that there are human beings behind it and sometimes even with the best of intentions things go wrong.

One of the things I don’t want people to take from the story is the idea that tissue culture is bad. So much of medicine today depends on tissue culture. HIV tests, many basic drugs, all of our vaccines—we would have none of that if it wasn’t for scientists collecting cells from people and growing them. And the need for these cells is going to get greater, not less. Instead of saying we don’t want that to happen, we just need to look at how it can happen in a way that everyone is OK with.Medical researchers use laboratory-grown human cells to learn the intricacies of how cells work and test theories about the causes and treatment of diseases. The cell lines they need are “immortal”—they can grow indefinitely, be frozen for decades, divided into different batches and shared among scientists. In 1951, a scientist at Johns Hopkins Hospital in Baltimore, Maryland, created the first immortal human cell line with a tissue sample taken from a young black woman with cervical cancer. Those cells, called HeLa cells, quickly became invaluable to medical research—though their donor remained a mystery for decades. In her new book, The Immortal Life of Henrietta Lacks, journalist Rebecca Skloot tracks down the story of the source of the amazing HeLa cells, Henrietta Lacks, and documents the cell line's impact on both modern medicine and the Lacks family.

**Supplemental Resources:**

### *Take some time to review these resources, if not in great detail certainly look into these to some degree as to find a meaningful connection to this case.*

### Related Topics:

#### [Black History](http://www.smithsonianmag.com/topics/Subject-Black_History.html)

#### [Biology](http://www.smithsonianmag.com/topics/Subject-Biology.html)

#### [Vaccines](http://www.smithsonianmag.com/topics/Subject-Vaccines.html)

#### [Scientific Innovation](http://www.smithsonianmag.com/topics/Subject-Scientific_Innovation.html)

### Related Links:

[Surprising Science: "Fair" Use of our Cells](http://blogs.smithsonianmag.com/science/2010/02/02/fair-use-of-our-cells/)

### Related Books:

#### [The Immortal Life of Henrietta Lacks](http://clickserve.cc-dt.com/link/click?lid=41000000030173751)

By Rebecca Skloot  
Crown Publishing Group, 2010

**Supplemental readings:**

**More from Smithsonian.com**:

* [Gene Therapy in a New Light](http://www.smithsonianmag.com/science-nature/Gene-Therapy-in-a-New-Light.html?utm_source=relatedarticles&utm_medium=internallink&utm_campaign=SmithMag&utm_content=Gene%20Therapy%20in%20a%20New%20Light)
* [Black History Heritage Month](http://www.smithsonianmag.com/people-places/black-history-heritage.html?utm_source=relatedarticles&utm_medium=internallink&utm_campaign=SmithMag&utm_content=Black%20History%20Heritage%20Month)
* [Women's History Month](http://www.smithsonianmag.com/specialsections/womens-history/womens-history-month.html?utm_source=relatedarticles&utm_medium=internallink&utm_campaign=SmithMag&utm_content=Women's%20History%20Month)

**Subsequent Case Thought Questions:**

1. **What were some of your initial feelings as you read this case?**
2. **Do you believe the era of time played a role in attitudes?**
3. **Do you believe attitudes have changed? How? Better or worse?**
4. **What is your opinion on tissue culturing? Explain thoughtfully.**

**Linked Lab Activity 2:**

Electrophoresis Virtual Lab:

Go to virtual [Gel Electrophoresis Lab](http://learn.genetics.utah.edu/content/labs/gel/) and view it from beginning to end. Afterward go back to beginning and complete Observation Questions. Remember, just view lab and follow the continuity first time then go back for greater analysis.

Observation Questions:

1. How do you sort microscopic DNA strands in a tube even though you cannot see or touch them?
2. What does the gel act as in Gel Electrophoresis?
3. How do we push DNA strands through the gel filter?
4. In which direction do the DNA strands migrate, toward which charge and away from which charge?
5. Which size strand lengths move fastest through the gel and why?
6. What do we do to help us to see the DNA migration in the gel?
7. What are the five basic tools required to create and run a gel electrophoresis experiment?
8. What is Agarose made from and describe its characteristics?
9. What is added to the Agarose powder to begin the process of making the gel?
10. How do we get the Agarose to melt in with the buffer?
11. Why do we tape the ends of the mold?
12. What is the comb used for?
13. Why is the gel placed into the refrigerator?
14. What initially goes into the electrophoresis box?
15. List the six items needed to set up the electrophoresis experiment to run?
16. Why do we load buffer into the DNA samples before depositing them into the Gel reservoirs?
17. Why do we use the DNA size standard?
18. Which color lead generates the positive charge from the power supply?
19. Why is DNA attracted to the positive charged area?
20. What serves as proof that the current is indeed running in the electrophoresis box?
21. What is the dye used to make the DNA visible in the gel?
22. What do the words Mutagenic and Carcinogenic mean?

Mutagenic:

Carcinogenic:

1. Which term applied to Ethidium Bromide?
2. About how long does it take to stain the gel?
3. What type of light table do you view your stained gel on?
4. What do you need to wear to view your gel on this light table?
5. What were the size fragments you observed and reported on this lab activity?
   * + bp
     + bp
     + bp
6. What does bp mean?
7. Do you believe you could run you own real life experiment after viewing this virtual lab? Why or why not? Be detailed:

**Linked Cooperative Activity 3:**

Webpage Creation Activity:

Create a webpage on [Mr. Taylor’s Web Page](http://mathandsciencewithmrtaylor.weebly.com/henrietta-lacks-web-page-assignment1.html) (Hosted on [www.weebly.com](file:///C:\Documents%20and%20Settings\gtaylor3514\Desktop\Wash%20U%20Bio%20Masters\Wash%20U%20Spring%202010\Case%20Study%20Assignment\www.weebly.com)) that will be attached as an archive of student work. The ethical issues and research you have done to this point should serve to make this a quick and easy exercise using the web creation skills we have achieved throughout the year.

The guidelines are as follows and are outlined in the website on the template page. You do not need to navigate the site to find the template as the [Mr. Taylor’s Web Page](http://mathandsciencewithmrtaylor.weebly.com/henrietta-lacks-web-page-assignment1.html) link (a direct link) provided will put you right to the desired page.

1. One page only per group (2 students) containing:
2. Three ethical points from your collective activities.
3. Three URL sources (Direct Links) to support each point…mandatory minimum.
4. At least one relevant Photo with a thoughtfully composed caption.

This activity will culminate with the class viewing each other’s web page, initially from a Smart Board presentation, as each pair of Web Masters give a guided tour of their page and links with explanation and thoughts as necessary to yield insight into the web design process.

Afterward there will be a short student exploration time to enjoy the creative process of their peers. After which we will blog about the strengths and insights we gained from each other’s presentations on

[Mr. Taylor’s Biology Blog](http://mathandsciencewithmrtaylor.weebly.com/henrietta-lacks-website-creation-blog.html).