



Cancer Education Project

Human Papillomavirus (HPV) and Cancer

Overview:

This series of lessons, summarized in the table below, centers on content related to HPV and cervical cancer. This content includes, but is not limited to, topics such as immune responses to pathogens and vaccines, virus life cycle, the Pap test, clinical testing for cancer, and the ethical, legal, and social implications of mandatory vaccination policies for the HPV vaccine, Gardasil. These activities are not meant to be a complete curriculum on these topics, but rather to complement a teacher's already-existing units.

The lessons in this series may be used as "stand-alone" activities, or sequenced in any way the teacher judges to be instructionally meaningful for her/his students and curriculum. The parts of the series shown in the table below represent one possible sequence of lessons based on the 5-E Lesson Cycle Model. The table provides a brief description of each lesson, an estimate of the number of 40-minute classes it might take to complete that lesson, a reference to the 5-E model, and a list of student products produced during each lesson.

#	Title	Description	# of 40-minute classes	5 E Model	Student Products
1	"One Less" and "Tell Someone"	Short PBL script based on Gardasil TV Commercials	1	Engage	Chart of facts and student questions about Gardasil
2	HPV Vaccine and the Immune System	U of R TV Commercial and 13-Slide PPT from NCI on viral cancer and the immune response	1	Explain	PowerPoint Notes
3	HPV Vaccine and Cervical Cancer	Jigsaw strategy using readings from a variety of Internet resources	2	Explain Elaborate	Options: - Q and A Pamphlet - 3-D (clay) model - Script for play for 4 th graders - Concept Map

4	The Pap Test	"Save the Last Word for Me" reading/discussion cooperative learning strategy	1	Explain Elaborate	5"x8" card with notes from reading on one side and student response on the other side
5	Cancer Detection: A Laboratory Simulation	Simulation wet lab for visual, radiation, and chemical detection of cancer	2	Explore	Lab report
6	Why Not the Boys?	Ethical Decision-Making Process on proposed law to vaccinate all middle school kids	1	Elaborate Evaluate	8-step decision-making handout (6 steps in groups, 2 steps individually)

Part 1: “One Less” and “Tell Someone”

Introduction

This activity is meant as an introductory “hook” for the HPV lesson series. It is a short Problem Based Learning (PBL) activity based on the Merck Pharmaceutical Company television commercials about Gardasil, the HPV vaccine. The commercials are titled “One Less” and “Tell Someone.”

Students first brainstorm a list of diseases against which they have been vaccinated, and then the teacher shows the video as an example of a new vaccine. The video is the stimulus for student teams who use the PBL model to create charts of Facts and Questions about Gardasil. The teacher provides packages of printed handouts from the websites below (or access to the Internet) so students can research answers to their questions. Students report out to their fellow team members the information they obtained from their research, and then individually turn in one question they still have about the virus, the vaccine, or ELSI (ethical, legal, and social implication) issues related to the vaccine.

Objectives:

Students will provide evidence that they:

- can work cooperatively in the PBL strategy to create relevant facts and questions
- can conduct research to answer selected questions about HPV and the vaccine
- know what the acronym HPV means
- identify modes of transmission of HPV
- associate genital warts and cervical cancer with different kinds of HPV
- understand that 75% of new cases of HPV infection occur in people ages 15-24

Teacher Preparation:

1. Set up AV equipment to show the Gardasil commercials (Resource CD or website: <http://www.gardasil.com/tv-commercial-for-gardasil>)
2. On front board or overhead, write the questions: What vaccines have you been given? What other vaccines are available?
3. Have poster paper, markers, and a 3x5 card available for each student team.
4. Run off copies of Human Papillomavirus (HPV) and Gardasil Facts and Question sheet for each team.
5. If Internet access is not available, run off copies of articles about HPV and Gardasil for each team. Articles can be found at a variety of sites by Google-ing “HPV” or “Gardasil.” Some sample sites are given here:

<http://www.fda.gov/bbs/topics/NEWS/2006/NEW01385.html>

<http://www.nytimes.com/2006/06/08/health/07cnd-vaccine.html>

http://coolnurse.healthology.com/main/article_print.aspx?content_id=190

http://coolnurse.com/cervical_cancer2.htm

<http://www.fda.gov/bbs/topics/NEWS/2006/NEW01385.html>

<http://webmd.com/content/article/123/115099.htm>

Lesson Plan Checklist:

- ___ 1. Do all copying in preparation for class.
- ___ 2. Write questions on front board, SmartBoard™, or overhead transparency.
- ___ 3. Have students think about vaccines they have received. (1 minute)
- ___ 4. Do whole-class brainstorm to collect examples of vaccines. (3 minutes)
- ___ 5. State the objectives and purposes for class in terms of learning about HPV and the new cancer vaccine, Gardasil. (1-2 minutes)
- ___ 6. Form students into PBL teams (of 3 or 4), and distribute one Facts and Questions sheet to each team. Explain directions for completing the Facts and Questions sheets based on the information to be seen in the video. (4 minutes)
- ___ 7. Show the video commercial(s) for Gardasil (see link above). (1 minute)
- ___ 8. Allow students time to complete Facts and Question sheets and to select one or two questions per person to research from the group's list. (10 minutes)
- ___ 9. Distribute the information packages (one per team) or have students log on and begin Internet search on HPV and Gardasil. (2 minutes)
- ___ 10. Allow time for research; distribute 3x5 card to each students during this time. (12 minutes)
- ___ 11. Give the direction to students to write one question on the 3x5 card that they still have about HPV or Gardasil (or that they think most teenagers... or parents... might have about the virus or the vaccine). (4 minutes)
- ___ 12. Collect the 3x5 cards as a Ticket to Leave as a formative assessment. The information from the Ticket to Leave can become the basis for future classroom discussion. (1 minute)

Human Papillomavirus (HPV) and Gardasil

Team Member's Names: _____ Period _____

FACTS

What facts about HPV and/or the vaccine are found in the video?

QUESTIONS

What questions do you have, or do you think others might have about HPV or the vaccine?

Part 2: HPV Vaccine and the Immune System

Introduction:

This activity provides some of the science behind how HPV causes cancer and how the HPV vaccine works to prevent cancer. It involves student “making notes” by creating answers to questions on a 12-slide PowerPoint presentation. The PowerPoint comes from the National Cancer Institute website: *Understanding Cancer and Related Topics*. Permission to use the PowerPoint slides for teaching purposes has been given by its authors.

Class starts with a viewing of the short TV commercial made by the University of Rochester’s Wilmot Cancer Center about their research that led to the discovery of Gardasil.

The two student pages accompany the PowerPoint. They are designed in a “making notes” format (as opposed to “taking notes” format) that allows students space “on the left” to answer science content questions related to the slides, and space “on the right” for students to take additional notes, write questions, or make drawings or doodles to help them understand the material.

Class ends with a 3-2-1 Reflection activity.

Objectives:

Students will provide evidence that they can:

- tell what the acronyms HPV and VLP mean
- explain how HPV is transmitted
- describe or draw a flow chart to demonstrate a basic understanding of HPV replication in epithelial cells
- describe the pathway (steps) by which HPV disables suppressor genes in normal cervical tissue (i.e., how the virus causes cancer)
- compare and contrast HPV with the vaccine’s VLPs
- describe or diagram the role of antibodies in preventing HPV replication
- give a reason why Pap tests are still necessary after HPV vaccination
- reflect on the content and concerns associated with the HPV vaccine

Teacher Preparation: Prior to this class, the teacher should:

1. Print copies for each student of the two *Making Notes* pages that go along with the PowerPoint. Also print copies for each student of the *3-2-1 Reflection* sheet.
2. Load the video for projection. <http://www.stronghealth.com/services/cancer/hpvMedia.cfm>
3. Load the PowerPoint for projection. (<http://cancer.gov/cancertopics/understandingcancer/HPV-vaccine>). Click on Page Option’s last option: View/print PowerPoint

4. Make one teacher copy, and have available to read to students, of the Teacher Notes version of the PowerPoint.
5. Make one teacher copy for the *“Making Notes” Sample Student Answers* sheet.

Lesson Plan Checklist:

- ___ 1. Show the University of Rochester (Strong Health) video. If this lesson follows the introductory one, students should be very familiar with the topic and you can proceed with the lesson. If this is the first HPV lesson you are doing, allow some class time for students to discuss what they know about Gardasil. (A KWL or KTW chart is recommended for this discussion.) (2 minutes)
- ___ 2. Tell students the objectives and purpose for the day. The objectives are written above. The main purpose is for them to become familiar with the science behind the new vaccine for cervical cancer and to better help adults in their lives understand the science needed to make important medical decisions for pre-teen girls in their family. (5 minutes)
- ___ 3. Distribute the *Making Notes* pages to students and briefly describe the purpose of the left and right sides of the pages. (1 minute)
- ___ 4. Show the PowerPoint, reading the script (or providing similar information to students) and allowing time for students to respond to the *Making Notes* questions and tasks. (25 minutes)
- ___ 5. Distribute copies of the *3-2-1 Reflection* sheet, and allow time for students to complete the sheet. Have students turn in the sheets (for formal or informal assessment of the lesson). (7 minutes)

"Making Notes" pages from the HPV PowerPoint

Name _____

Period _____

PPT #	Title / Notes / Question	Notes, Comments, Drawings
1	<p><i>HPV Vaccine to Prevent Cervical Cancer</i></p> <p>Title Page (no questions)</p>	
2	<p>Common Infection:</p> <p>Two facts about HPV:</p> <ol style="list-style-type: none"> 1. 2. 	
3	<p>Infection is Sexually Transmitted:</p> <p>What might "the virus is silent" mean?</p>	
4	<p><i>Many Types of HPVs</i></p> <p>Name the 3 basic types of HPVs:</p> <ol style="list-style-type: none"> 1. 2. 3. 	
5	<p><i>Virus Penetrates Cervix</i></p> <p>What % of cervical cancers are linked to long-term infections with high-risk HPV? _____%</p>	
6	<p><i>Virus Uncoats</i></p> <p>What's the job of viral genes E6 and E7?</p>	

7	<p><i>Virus Disables Suppressors</i></p> <p>This is probably the most important slide in the whole PPT</p> <p>So, what's so bad (for the cell) about having defective "damage surveillance" suppressor proteins?</p>													
8A	<p><i>Virus-Like Particles</i></p> <p>What do the soccer ball-like structures made of L-1 proteins do once they get inside the cell?</p>													
8B	<table border="1"> <thead> <tr> <th data-bbox="289 1016 505 1058">VLPs</th> <th data-bbox="505 1016 721 1058">Comparison</th> <th data-bbox="721 1016 937 1058">Real HPVs</th> </tr> </thead> <tbody> <tr> <td data-bbox="289 1058 505 1100"></td> <td data-bbox="505 1058 721 1100"></td> <td data-bbox="721 1058 937 1100"></td> </tr> <tr> <td data-bbox="289 1100 505 1184"></td> <td data-bbox="505 1100 721 1184">One Similarity</td> <td data-bbox="721 1100 937 1184"></td> </tr> <tr> <td data-bbox="289 1184 505 1268"></td> <td data-bbox="505 1184 721 1268">One Difference</td> <td data-bbox="721 1184 937 1268"></td> </tr> </tbody> </table>	VLPs	Comparison	Real HPVs					One Similarity			One Difference		
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	One Similarity													
	One Difference													
9	<p><i>The Vaccination</i></p> <p>Put numbers next to the statement to represent its correct place in the immune response sequence:</p> <p>___ antibodies attack L1 proteins of HPV</p> <p>___ lots more antibodies are produced</p> <p>___ a person gets first vaccine (shot)</p> <p>___ immune response to VLPs begins</p>													
10	<p><i>Antibodies Prevent Infection</i></p> <p>What do those little Y-shaped antibodies actually do to attack HPV?</p>													

<p>11</p>	<p><i>Pap Test Still Necessary</i></p> <p>What tissue is collected during a Pap Test?</p> <p>When technicians examine the tissue collected for a Pap Test, what do they look for?</p> <p>Why should women who have been vaccinated continue to have Pap tests?</p>	
<p>12</p>	<p><i>More Work Ahead</i></p> <p>Based on the information on this slide, create another title (or headline), other than "More Work Ahead?"</p>	

3-2-1 Reflection

3-2-1 Reflection for HPV Vaccine PowerPoint

3. Different people take away different bits of learning from a presentation like we had in class today. Name three important bits of information you learned about the HPV vaccine today:

1.

2.

3.

2. Create two headlines that might be used for a newspaper article about what you learned in today's class.

1.

2.

1. Some people have serious concerns about the HPV vaccine. List 1 concern that you (or others) might have about this vaccine.

1.

“Making Notes” Sample Student Answers

Name _____

Period _____

PPT Slide #	Title / Notes / Question	Notes, Comments, Drawings
1	HPV Vaccine to Prevent Cervical Cancer	
2	<p style="text-align: center;">Common Infection:</p> <p>Two facts about HPV:</p> <ol style="list-style-type: none"> 1. most common STD 2. 70% of sexually active people get it 	
3	<p>Infection is Sexually Transmitted:</p> <p>What might “the virus is silent” mean?</p> <p>The virus may be inside someone and not cause any symptoms for a while (or a long time), but the person is still contagious if they have unprotected sex (or other skin-to-skin contact).</p>	
4	<p style="text-align: center;">Many Types of HPVs</p> <p>Name the 3 basic types of HPVs:</p> <ol style="list-style-type: none"> 1. Harmless 2. Warts-linked 3. Cancer-linked 	
5	<p style="text-align: center;">Virus Penetrates Cervix</p> <p>What % of cervical cancers are linked to long-term infections with high-risk HPV? _99_%</p>	
6	<p style="text-align: center;">Virus Uncoats</p> <p>What’s the job of viral genes E6 and E7?</p> <p>Those genes cause the infected cervical cells to make make virus proteins instead of normal cervical cell proteins.</p>	
7	<p style="text-align: center;">Virus Disables Suppressors</p> <p>This is probably the most important slide in the whole PPT.</p> <p>So, what’s so bad (for the cell) about having defective “damage surveillance” suppressor proteins?</p> <p>The virus’s E6 and E7 proteins affect the cell’s tumor suppressor genes (DNA). This causes a normal cell’s “damage surveillance” proteins to become defective. These defective proteins can no longer detect defects in the DNA responsible for normal cell growth. When this happens, the cells begin to grow abnormally and the resulting tumor of cells may become cancerous.</p>	

<p>8A</p>	<p align="center">Virus-Like Particles</p> <p>These soccer ball-like structures made of L-1 protein VLPs do what once they get inside a person?</p> <p>They fool the cell into thinking that it's been infected with HPV and the person's immune system starts to produce a strong antibody response so that if the real HPV shows up, the body is ready to fight it off.</p>												
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<p>10</p>	<p align="center">Antibodies Prevent Infection</p> <p>What do those little Y-shaped antibodies actually do to HPV?</p> <p>They attach to the outside of the L1 protein in the coat and prevent the genetic material inside from being escaping into the cell.</p>												

<p>11</p>	<p style="text-align: center;">Pap Test Still Necessary</p> <p>What tissue is collected during a Pap Test? Tissue from the cervix and uterine lining</p> <p>When technicians examine the tissue collected for a Pap Test, what do they look for? Irregularly shaped cells with large nuclei</p> <p>Why should women who have been vaccinated continue to have Pap tests? The vaccine is effective against only about 70% of the viruses that may cause the different forms of cervical cancer, Continued Pap tests are important to make sure that a woman has not been infected by viruses that may cause the other 30% of cancers</p>	
<p>12</p>	<p style="text-align: center;">More Work Ahead</p> <p>What might be another title (or headline) for this slide? Three's not enough!</p> <p>Long-term safety!</p> <p>Is it still good after 4 years?</p>	

Part 3: HPV Vaccine and Cervical Cancer

Introduction:

This activity provides copies for classroom reading of a sample of four Internet resources related to the HPV vaccine and cervical cancer topics. The resources are used in a Jigsaw cooperative learning strategy. Teams of 4 students (“home” groups) divide up the 4 reading resources so that each member of the team reads a different resource. During the individual reading time, students take notes to identify a minimum of 5 important facts and/or concepts that come from each reading. After the reading and 5-fact identification time, four large groups (“reading specialty” groups) are formed (Jigsaw I) that contain all the students from the smaller teams who did similar readings.

During Jigsaw I time, students in the specialty reading groups exchange information about their 5 important facts and make a list of what the group believes are the “Top 3 Facts.” These “top 3” will be brought back to the home groups during Jigsaw II. During Jigsaw II, students report back to their home groups, and each student shares his/her “top 3” facts from the reading specialty groups. Each member of the home group then completes a Personal Reflection about HPV and Cervical Cancer reflection sheet.

Objectives:

Students will provide evidence that they can:

- compare and contrast high risk and low risk HPV types
- discuss the relationship between genital warts and cervical cancer
- identify ways that HPV infection can occur
- describe how cervical cancer is diagnosed
- describe how virus-like particles (VLPs) in the HPV vaccine work
- select relevant information from medical readings
- work cooperatively in groups to prioritize important medical facts
- provide a personal reflection about the HPV and cancer vaccine readings

Teacher Preparation:

1. Print copies of the home group reading packages.
2. Print 2-sided copied for each student: One side will be *Student Notes from Home Group Jigsaw Readings*. On the back of this, print the *Top 3 Facts about HPV Vaccine and Cervical Center*.
3. Print copies of the *Personal Reflection* for each student.
4. Obtain poster paper, markers, and tape for each Specialty Group.

Lesson Plan Checklist:

- ___ 1. If students are already familiar with the Jigsaw strategy, tell students today's class will be a Jigsaw related to a specific form of cancer. If students are not familiar with the Jigsaw strategy, provide an overview of the strategy.
- ___ 2. Establish "home groups" of 4 students.
- ___ 3. Provide one set of the 4 different readings to each home group, and a copy of the Student Reading Notes / Top 3 Facts page to each student.
- ___ 3. Provide time for teams to decide which reading each will do and then time for students to do the reading.
- ___ 4. Monitor student progress during this reading time; keep the room quiet for reading and identification of important facts.
- ___ 5. Distribute the poster paper and markers to four different areas of the room. These areas will each represent one of the 4 different readings and will become the reading specialty areas for Jigsaw I.
- ___ 6. Break students out of their home groups and into the four different reading specialty groups.
- ___ 7. Give directions to these groups to brainstorm their list of important facts on the poster paper and to then decide on the "Top 3 (most important) Facts." Direct each of the 4 groups to write their "Top 3 Facts" on the back of their Student Reading Notes sheet.
- ___ 8. Return students to their home groups (Jigsaw II) to exchange information about "Top 3 Facts" with the other members of their home group.
- ___ 9. Distribute the Personal Reflection about HPV Vaccine and Cervical Cancer sheet, and have students complete this closure reflection as a ticket-to-leave (or as homework).

Home Group Jigsaw Reading Passages

Group 1: Center for Disease Control and Prevention: Genital HPV Infection fact sheet

<http://www.cdc.gov/std/hpv/stdfact-hpv.htm>

Group 2: Spreading the Word about HPV and Cervical Cancer

http://www1.umn.edu/umnnews/Feature_Stories/Spreading_the_word_about_HP_V_and_cervical_cancer.html#

Group 3: American Cancer Society: Overview – Cervical Cancer: Can Cancer of the Cervix Be Prevented?

http://www.cancer.org/docroot/CRI/content/CRI_2_2_2x_Can_Cancer_o_the_Cervix_Be_Prevented.asp?sitearea=

Group 4: Strong Health: Anti-Cancer Vaccine with Roots in Rochester Moves Forward

http://www.stronghealth.com/news/article.cfm?art_ID=736&servis

Student Notes from Home Group Jigsaw Readings

Name _____

Period _____

Student Reading Notes

Directions: Use the space below to take notes from the reading that you have been assigned in your team.

Top 3 Facts about HPV, the HPV Vaccine, and Cervical Cancer

Directions: From the notes that you took on the readings, select three concepts or facts from the notes that you feel are the most important or most interesting. Write those concepts or facts in the space below.

1.

2.

3.

Personal Reflection about the HPV Vaccine and Cervical Cancer

Name _____

Period _____

Directions: Based on the HPV Vaccine and Cervical Cancer readings and your team's exchange of the "Top 3 Facts," write your reactions to the following questions:

1. From all the information presented in class, what do you believe are the most important things that teenagers should know about the HPV vaccine and cervical cancer?

2. There is a debate among adults about this vaccine. Some people think that the HPV vaccine should be a required immunization for all middle school girls. Some people believe that the vaccine should not be required. Identify one "pro" argument and one "con" argument that adults use in this debate.

Pro: The vaccine should be required because:

Con: The vaccine should not be required because:

3. If you were a parent of middle school girl, what would you decide about getting your daughter vaccinated with the HPV vaccine, and why would you decide that way? Use the back if necessary to complete your answer.

Part 4: The Pap Test

Introduction:

This activity provides details and medical background information about the Pap test (“Pap smear”) screening test for cervical cancer. The activity uses the cooperative learning discussion protocol known as “Save the Last Word for Me.” The reading gives information about Pap test procedures (smear or liquid transfer), recommended frequency of testing depending on age, risk factors for cervical cancer, and medical descriptions of 5 courses of action depending on the results. Each student selects one passage from the reading, one that gives him/her some new or significant information, and writes that passage on one side of a 5”x8” card. The student uses the other side of the card to write why they chose that particular passage or why they considered that passage to be significant.

Students are formed into groups, and the teacher acts as a timekeeper. One volunteer in each group then begins the cooperative learning part of the activity. The volunteer reads to the group the quotation from the reading that he/she selected (the front side of the card), but does not share why they chose that passage (the back side of the card.). Other members of the group then have one minute each to respond to the quotation, explaining what the quote means to them. The original volunteer then “has the last word,” and is given up to three minutes to share why the quote was selected by reading and explaining what he/she wrote on the back of the card. A second volunteer continues the pattern until everyone in the group has had a chance to “have the last word.”

Each student hands in his/her 5”x8” cards. Each team then completes and hands in *The Pap Test Review Sheet*.

Objectives:

Students will provide evidence that they can:

- critically read medical material provided for the general public (reading)
- select passages of interest from the reading (writing)
- work in groups to discuss medical information (listening & speaking)
- describe the Pap test procedure
- discuss the need for Pap test screening
- list risk factors for cervical cancer
- explain medical terms associated with normal and atypical Pap tests

Teacher Preparation: Prior to this class, the teacher should:

- Print copies of the Mayo Clinic Pap test reading passage:
<http://www.mayoclinic.com/health/pap-smear/HQ01177>
- Obtain 5”x8” index cards, one for each student.
- Obtain copies of, or have available the website for, histology images of normal and cancerous epithelial cells to show to students. These images, without the accompanying

explanations, may be used at the beginning of class to have students see if they can see differences in tissue areas, or at the end of class to show the difference between normal and dysplastic cells. Sample images may be found at the following sites:

<http://library.med.utah.edu/WebPath/FEMHTML/FEM008.html> and

<http://library.med.utah.edu/WebPath/FEMHTML/FEM009.html>

Lesson Plan Checklist:

- ___ 1. Give directions for the “Save the Last Word for Me” activity (see Introduction). (3 minutes)
- ___ 2. Distribute the Mayo Clinic reading passage and allow time for students to read silently, select their significant passage (new or significant information) to write on the front of the 5”x8” card, and to write their reaction on the back of the card. (10 minutes)
- ___ 3. Form students into teams of 3. (2 minutes)
- ___ 4. Keep time for student teams to go through the protocol (described in Introduction). Each team should allow a maximum of 5 minutes per person to complete the discussion exchange. (e.g., one minute for the volunteer to read his/her passage, one minute each for the other two members to react, and up to two minutes for the volunteer to “have the last word” by reading and explaining their reaction written on the back of the card.) (15 minutes)
- ___ 5. Collect the 5’x8” cards. (1 minute)
- ___ 6. Distribute and give teams time to complete *The Pap Test Review Sheet*. Collect the review sheets. (9 minutes)

The Pap Test Review Sheet

Team Names: _____

Period _____

1. Briefly describe the procedure used for a Pap test.

2. Identify two reasons why a Pap test is needed.

-
-

3. List 4 risk factors for cervical cancer

- | | |
|---|---|
| • | • |
| • | • |

4. Below are 4 phrases used to describe abnormal cells that may be found by Pap test results. Briefly describe what each phrase means.

- Atypical squamous cells of undetermined significance
- Squamous intraepithelial lesion
- Atypical glandular cells
- Squamous cancer or adenocarcinoma cells

Part 5: Cancer Detection: A Laboratory Simulation

Overview:

This goal of this activity is to have students mimic three kinds of cancer detection techniques by performing visual, radiation, and chemical tests on paper images of biopsy samples. Most of the cells in the tissue samples are normal, but some have been treated to test as abnormal (cancerous). At the end of the lab, students figure out a way to use data from the lab to predict the chances that a biopsy sample will be cancerous.

Overview of the Lab Activities:

- **Visual detection.** Students observe two images of biopsy samples and hypothesize how to tell abnormal ones from normal ones just by looking at them. The lab groups are polled for their list of possible hypotheses about normal and abnormal looking cells.
- **Radiation detection.** Students subject the images of both biopsy samples to ultra-violet radiation (black light) and observe that abnormal cells “glow.” Nuclei of abnormal cells have been pretreated with fluorescent ink. Students decide which class hypotheses are supported or rejected by the data from this radiation detection technique.
- **Chemical detection:** Students swab the membranes of the cells in both biopsy samples with an “antibody” and observe that abnormal cells (and some “normal” ones) produce a color change. Membranes of abnormal (and a few “normal” cells) have been pretreated with a color-change solution. Students are challenged to figure out ways to estimate the total number of abnormal biopsy samples in the whole population of biopsies tested by the class. Teams figure out a way to collect the class data needed to calculate the chances that a biopsy sample is cancerous.

Citations:

This activity is adapted from “Cancer Detectives: a class simulation” from The Chemical Heritage Foundation. The two cites below provide the teacher and student versions of the Chemical Heritage Foundation’s original activity.

- Teacher Version:
<http://www.chemicalheritage.org/educationalservices/pharm/tg/chemo/activity/detecting/htm#note>
- Student Version:
<http://www.chemicalheritage.org/educationalservices/pharm/chemo/activity/detecting.htm>

Teacher Instructions:Before Class

1. Print enough copies of the student version of the lab activity (*Cancer Detection: A Laboratory Simulation*), one for each team. Print enough copies of the *Cancer Detection Lab Report Sheet*, one for each student.
2. Prepare enough copies of images of “normal” and “abnormal” biopsy samples on yellow paper (see page 29) In the Chemical Heritage Foundation activity, the teacher version suggests that the “abnormal” range be between 30% and 40%. This range represents the possibility that a person will develop cancer in his/her lifetime. The chart below shows class sizes, number of “normal” biopsy images needed for that class, and the number of “abnormal” biopsy images needed for that class. The numbers are based on a calculation of 35% “abnormal” images. For each class, it might be good to copy a few more of each kind of image and have those copies in reserve.

Class Size (# of students)	Number of “Normal” Biopsy Images Needed	Number of “Abnormal” Biopsy Images Needed
15	20	11
20	26	14
25	33	18
30	39	21

3. Obtain a package of BiC™ *bright liner* yellow fluorescent pens (#91189)
4. Treat the 3 “abnormal” cells in the “abnormal” biopsy by applying a fluorescent spot to the nuclei. Yellow paper (OfficeMax #64) is used to mask the color of the fluorescent dye. Students should not be able to see the fluorescent spot with a naked eye observation; they will need to use the ultraviolet light to “see” the spot. Two to three applications of the fluorescent spot may be necessary.
5. Prepare a “membrane marker solution”, which is a 0.1M (approximate) solution of potassium thiocyanate (KSCN), by dissolving 0.97g of KSCN in 100 ml of water.
6. Apply the membrane marker solution to sections of the cell membrane on the 3 “abnormal” cells and on a few sections of the membrane of one or two “normal” cells. Adding the membrane marker solution to some apparently “normal” cells will introduce some (real-world) conflicting evidence and require that students make judgments about this evidence. The membrane marker solution is colorless, so students should not be able to see the solution with a naked-eye observation. Care should be taken not to apply so much membrane marker so that the biopsy image paper wrinkles, thus giving away the presence of the membrane marker.
7. Prepare enough bottles of “antibody” solution, which is a 0.3-0.5M iron (III) chloride solution (FeCl₃), for each team (see Materials List for purchasing information), and cotton swabs for each student. During the chemical detection section of the lab, students will use a cotton swab to lightly apply the “antibody” to the membranes of all the cells. The red color change that will occur is a result of the presence of the thiocyanato iron (III) ion

- (FeSCN²⁺). Be careful to keep the fluorescent spots away from the membrane marker areas so that the chemicals do not overlap each other.
8. Assemble class sets of biopsy samples of the number of “normal” cells and “abnormal” cells (treated with fluorescent ink and potassium thiocyanate). See chart (above) for the numbers of “normal” and “abnormal” cells needed.
 9. Prepare a “Radiation Center” in the class by deciding how the source of UV will be used by students. For safety purposes, it is recommended that teachers control the use of the light(s). The “Radiation Center” will depend on the teacher’s available source of UV light. If student teams have their own UV light source, this section of the lab will be completed more efficiently.
 10. For the collection of class data, have available poster paper and markers, or transparency sheets and markers, or black/white board markers so the class results can be made visible to students.
 11. Decide on how you will introduce the lab. One option is shown below, but other options are effective depending on the nature of your class and your laboratory program.

Conducting the Class

- ___ 1. **Introduction:** Engage students by first having student teams discuss, and then have a whole-class brainstorm responses to the following question: *What two science laboratory skills are most critical to a crime scene investigator (CSI)?* Reinforce the skills of observation and interpretation of data (evidence).
- ___ 2. Tell students the goal of this lab is to use those two skills to understand three important techniques that different medical professionals use to detect cancer when they are given a tissue sample (biopsy) for a person suspected of having cancer.
- ___ 3. Read the Introduction to the student version of the lab activity (*Cancer Detection: A Laboratory Simulation*). This may be done in a number of ways, depending on the ability and maturity level of the class. One suggestion is to have students first read by themselves the first four paragraphs, highlighting the three techniques and the three medical careers that are part of a cancer detection team. Students would then read by themselves the next three paragraphs and be able to explain to their lab team what they are about to do in the lab. Another suggestion is for the teacher to facilitate a whole-class discussion of the first four, and then the next three, paragraphs.
- ___ 4. Form students into teams and distribute one copy of the student version of the lab to each team.
- ___ 5. Distribute one copy of the *Cancer Detection Lab Report Sheet* to each student.
- ___ 6. Shuffle all the “normal” and “abnormal” biopsy images for a class of this size and have each student pick two images. You might also lay all the images upside down on a lab table and have each student select two images. Either of these procedures will randomly distribute the samples among the student teams.

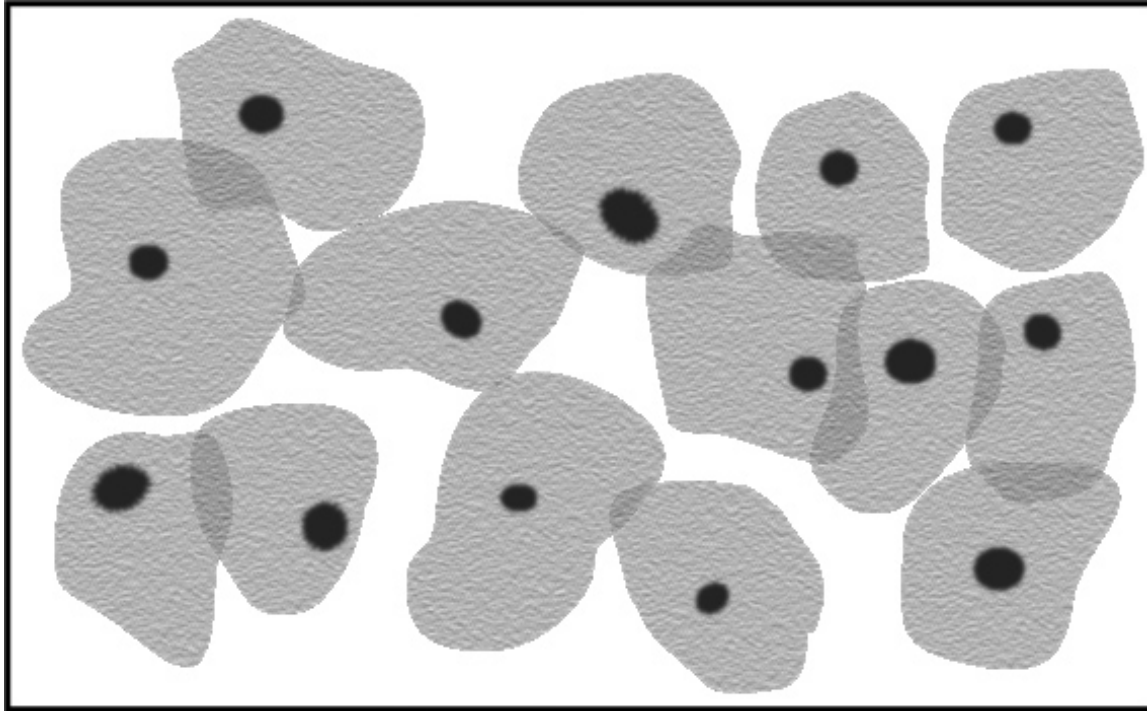
- ___ 7. **Visual Detection:** Allow time (approximately 5 minutes) for students to become pathologists by observing their two images and comparing their images with those of other team members. Have students use a pencil to mark each of their suspected “abnormal” cells (in both biopsy samples) with the letters “Ab.”
- ___ 8. Allow time (approximately 5 minutes) for student teams to create one or more hypotheses (**Question 1 on the lab report**) about the size, shape, and/or arrangements of cells (and cell parts) that would lead to a visual identification of “abnormal” cells in a tissue biopsy.
- ___ 9. Write different hypotheses on the front board (or poster or overhead transparency or SmartBoard™) so that students can copy the list (**Question 2**).
- ___ 10. **Radiation Detection:** Discuss with student the correct lab safety procedures involving the safe use of ultraviolet light. Warn students of the dangers of the light shining into someone’s eye.
- ___ 11. Direct students to use the “Radiation Center” to look for cells that fluoresce under UV light.
- ___ 12. Have students use a pencil to mark each fluorescent cell with the letters “UV” and to discuss the difference(s) between “normal” and “abnormal” cells subjected to UV light (**Question 3**).
- ___ 13. Allow students time to use the Radiation Detection evidence to accept or reject any of the Visual Detection hypotheses (**Question 4**).
- ___ 14. **Chemical Detection:** Discuss with students the correct lab safety procedures for using the “antibody” solution.
- ___ 15. Allow students time to add “antibody” to the cell membranes of both their biopsy samples, to describe their observations (**Question 5**), and to count the number of abnormal (cancerous) biopsy samples (not cells) among their team’s samples (**Question 6**).
- ___ 16. Assist the class in arriving at an operational definition of “abnormal” biopsy (**Question 7**).
- ___ 17. **Estimating Odds:** This is a more open-ended part of the lab. “Cookbook-style” directions are specifically **not** given to students to show them how to collect the class data needed to answer questions 7 and 8. Different teams of students may come up with different solutions to the problem posed by this section of the lab. The job of the teacher in this approach is to facilitate student thinking, not dictate how to solve the problem. Eventually, students will have to collect class data to compare the numbers of “normal” and “abnormal” biopsy samples. They first will have to agree on operational definitions of “normal” and “abnormal” based on the visual, radiation, and chemical evidence, and based on the how they make judgments about the apparent conflicting evidence from the Chemical Detection section of the lab (that some apparently “normal” cells will exhibit a small amount of fluorescence).

- ___ 17. Facilitate the class discussion needed to allow students to arrive at operational definitions and collect class data to estimate the odds that a biopsy sample will be cancerous (**Questions 8 and 9**).
- ___ 18. **Summary:** Explain the differences between the two options, “a” or “b,” for writing a summary for this lab.
- ___ 19. If time permits, allow time to complete the Summary at the end of the *Lab Report* sheet, or assign the Summary for homework.

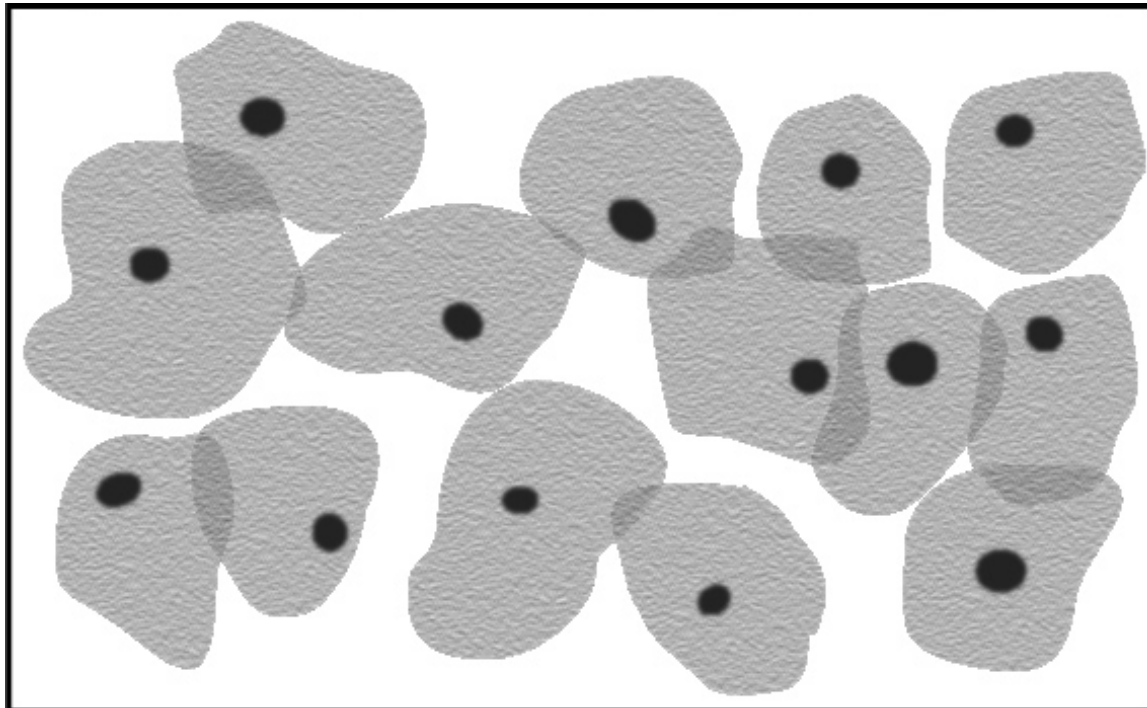
Materials List:

- Copies:
 - *Cancer Detection: A Laboratory Simulation* (student version) – 1 per team
 - *Cancer Detection: Lab Report Sheet* – 1 per student
 - “Normal” Biopsy Samples
 - “Abnormal” Biopsy Samples (treated with yellow fluorescent pen and FeCl₃)
- Source of UV radiation (black light): one for whole class or one for each team
(*Wards’s 2007 Catalog, pg. 596, 29W 3005, MiniLongwave UV Lamp, 4W*)
- BiC™ *brite liner* yellow fluorescent pens (#91189)
- 0.1M potassium thiocyanate, KSCN (as membrane marker)
(*Ward’s 2007 Catalog, pg. 930, 942W 5103, 0.1M QuickPrep Solution, Lab Grade*)
- 0.3-0.5M iron (III) chloride (dropping bottles or beakers for each team)
(*Wards 2007 Catalog, pg. 916, 970W 2603, 0.1M QuickPrep Solution, Lab Grade; change dilution directions to obtain the 0.3-0.5M concentration*)
- cotton swabs - one per student
- one beaker or dropping bottle of “antibody” (0.3-0.5M FeCl₃) per team

Abnormal Biopsy Sample (cut off these words on copies given to students)



Normal Biopsy Sample (cut off these words on copies given to students)



Correlation to New York State *Living Environment Core*:

Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design to pose questions, seek answers, and develop solutions.

Performance Indicator 1.1: Elaborate on basic and scientific and personal explanations of natural phenomenon, and develop extended visual models and mathematical formulations to represent one's thinking.

Performance Indicator 2-1: Devise ways of making observations to test proposed explanations.

Performance Indicator 2.3: Develop and present proposals including formal hypotheses to test predictions; i.e., predict what should be observed under specific conditions if the explanation is true.

Standard 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science

Major Understandings concepts and topics:

- 1.2g cell membrane function
- 1.2j receptor molecules
- 2.2e genetics and health care
- 5.2i genes and cancer

Laboratory Process Skills: a student....

- states an appropriate
- analyzes results from observations / expressed data
- formulates an appropriate conclusion or generalizations from the results of an experiment
- recognizes assumptions and limitations of the experiment

Cancer Detection: A Laboratory Simulation

Introduction:

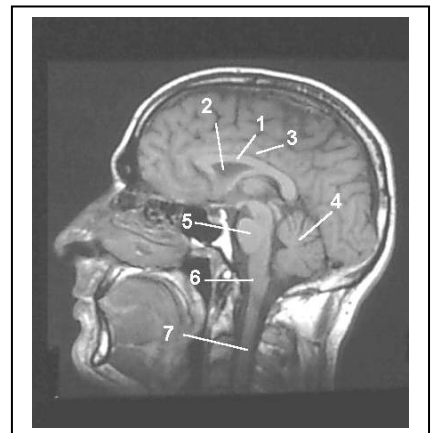
The fight against cancer involves the teamwork skills of many different medical and technical professionals who specialize in the detection of cancer cells. Early detection allows doctors to treat cancers before the cancerous cells metastasize (spread to other tissues in the body). Metastasis makes cancer treatments options more limited and more complicated.

As you read the next three paragraphs, underline or highlight the names of the medical professionals who detect cancer and the names of the three techniques for cancer detection.



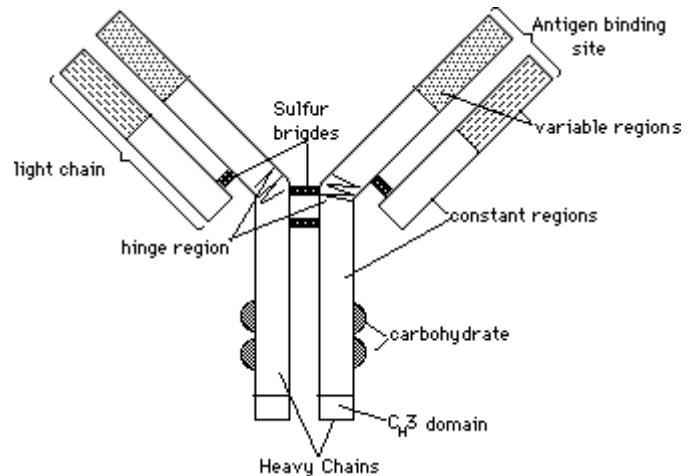
One member of a cancer detection team is a pathologist who observes stained tissue samples (from biopsies) under a microscope to look for cancerous cells. Cancerous cells are different in shape and arrangement from normal cells; these differences provide clues to the pathologist that these cells have become abnormal. People who observe biopsy samples in this way are using **visual detection** to observe cells.

Another member of a cancer detection team is a radiologist who uses some form of radiation (X-rays, CAT scans, MRI) to detect cancerous tissue. Cancerous cells and tissues respond differently to radiation than the surrounding cells and tissues that are normal (non-cancerous). Radiologists look at and interpret images of suspected tissues to determine if cancerous cells are present. People who observe and analyze cancerous cells in this way are using **radiation detection** to observe cells.



A third member of a cancer detection team is an immunologist who analyzes suspected cancer cells by treating them with labeled antibodies that bind to protein markers found on the surface of cancer cells, but not found on the surface of normal cells. Cancerous

cells have different kinds of proteins on their cell membranes and these proteins can be detected and identified by exposing suspected tissues to specific antibodies. People who use antibodies in this way are using **chemical detection** to find abnormal (cancerous) cells.



Directions:

Your team will study cancer in epithelial cells. Epithelial cells form sheets of tissues (called epithelium tissues) that become the lining of body organs such as those found in the digestive, reproductive, and excretory systems. Cancers of the mouth, large intestine, cervix, and urinary bladder are examples of cancers of epithelium tissues in these systems. Each member of your team will receive two simulated biopsy samples of epithelial tissues.

Your job as a team will be to:

- perform visual, radiation, and chemical testing on the simulated epithelium tissue biopsy samples given to your team to determine which ones are normal and which ones are abnormal (cancerous).
- combine your data with that of other teams to calculate the percentage of abnormal epithelium tissue in your class. This calculation will serve a rough estimate of the chances that an individual who goes for a biopsy will be diagnosed with cancer.

Activity 1 - Visual Detection:

Each member of your lab team will be given two copies of images of epithelial tissues that were obtained from biopsy samples (such as those that might come from Pap tests). Your two images may both represent images of normal tissues, or images of normal and abnormal (cancerous) tissues, or they may both represent abnormal (cancerous) tissues.

As soon as you get your samples, write your initials and the date on the sample (but not on the cells).

Look carefully at all the cells in the tissues of both images given to you, and then compare your images with those from your lab team. Try to find cells that look different from other cells; these may be the abnormal (cancerous) cells in that tissue.

With a pencil, write "Ab" (for "abnormal") in the cytoplasm of the cell(s) that you think may be abnormal (cancerous).

Record your answers to the **(bold type)** questions in this lab on the *Cancer Detection Lab Report Sheet*.

- 1. In your team, propose a hypothesis that you think could be used to tell the visual difference between the images of normal and abnormal (cancerous) epithelium cells.**
- 2. Contribute to the class discussion of possible hypotheses; record the ideas for visual detection from other teams.**

Activity 2 - Radiation Detection:

Abnormal (cancerous) tissues reflect or transmit radiation differently from normal tissues. For this part of the lab, you will use an ultraviolet light source (also known as a "black light") to detect the presence of abnormal cells in your team's tissue samples.

Follow the directions of your teacher to expose your biopsy samples to ultraviolet radiation by bringing your samples to the "radiation center" in your classroom.

Use a pencil to write "UV" in the cytoplasm of cells that appear different when exposed to ultraviolet radiation.

- 3. What difference did your team (or other teams) notice between normal and abnormal (cancerous) cells when they were exposed to ultraviolet radiation?**

- 4. Were any of the visual detection hypotheses supported by the results of the radiation detection? If so, which one?**

Activity 3 - Chemical Detection Using Antibodies:

Abnormal (cancerous) tissues react differently than normal tissues when treated with antibody. Sometimes, abnormal tissues are detected by the antibody method before the abnormal tissues are detected by radiation. For this part of the lab, you will use a simulated "antibody" to determine the total of number of cells in both samples that react with the "antibodies." You will use a cotton swab to spread a thin layer of "antibody" on the outside of all the cell membranes in both biopsy samples.

From your visual and radiation detection work, you already know that some cells are abnormal (cancerous). Test those cells first to see what happens when you add "antibody" to the outside of their cell membranes. Also test the membranes of (apparently) normal cells and note any differences in the reaction of these cells to the "antibody."

- 5. Describe your observations of the membranes of cells in your biopsy samples when you exposed the membranes to the labeled antibodies.**
- 6. As a result of your chemical, radiation, and visual detection, count and record the number of abnormal (cancerous) biopsy samples (not cells) in your team's biopsy samples.**

Estimating Odd of Developing Cancer:

It is possible from the data obtained from the chemical detection test to obtain a rough estimate of the odds that a tissue sample will be diagnosed as cancerous. There are a number of ways to obtain the numbers needed for the calculation of this estimate. Work with other teams to figure out a way to obtain the numbers that you need, and then do the calculations.

You will first need to agree on the (operational) definition of "a cancerous biopsy" based on the results of your visual, radiation, and chemical tests.

- 7. What is your definition of a cancerous biopsy?**
- 8. Describe what numbers your team will need to do the calculations.**

9. Estimate the odds (chances, percent possibility) that someone who is brought in for a biopsy will develop cancer. Show all the mathematical work you used to obtain this estimate.

Summary - Choose either "a" or "b" below:

- a. Write one sentence (or group of sentences) that summarize the main idea(s) behind this simulated cancer detection lab.
- b. Choose one vocabulary word (or main idea) from this lab and write a cinquain (5-line poem) to summarize this lab. Below you will see the "rules" for writing a cinquain and an example.

Rules of Writing a Cinquain:

Line 1	1 word*	Title
Line 2	2 words	Nouns or adjectives that describe Line 1
Line 3	3 words	"-ing" words that tell what Line 1 does
Line 4	4 words	Your personal, emotional reaction to Line 1
Line 5	1 word	Synonym for Line 1 (foreign words are OK)

*A word and its root or derivative may only be used once. For example, if you use the word "life," you cannot use words like "living" or "alive" in the rest of the cinquain.

Cancer
Abnormal Growth
Hiding, Dividing, Metastasizing
Should've Worn Enough Sunblock!
Tumor

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Cancer
 Abnormal Growth
 Hiding, Dividing, Metastasizing
 Should've Worm Enough Sunblock!
 Tumor

_____ _____

_____ _____ _____

_____ _____ _____ _____

Part 6: Why Not the Boys?

Introduction

This activity uses an 8-step ethical decision-making process to provide a forum for discussion about a gender bias question related to HPV and the HPV vaccine. Teams of students use the model to work through a fictitious scenario in which a local school board is considering a resolution to require a Gardasil vaccination for all students in middle school, both girls and boys. In the scenario, the school board invites comments from community members about the resolution prior to a school board vote on the resolution. The invitation comes to the community in the form of press release.

Students work as a whole class to identify the ethical dilemma(s) behind this resolution and the stakeholders involved in this dilemma(s). Students work in teams of 3 or 4 to brainstorm courses of action and consequences, identify risks and benefits, and determine the ethical principles and values involved in the different courses of action. Students then work individually to write a position paper about the dilemma, choosing one course of action and defending their choice based on the consequences, benefits, and risks. Students are told that their position statements will be given to the school board as part of community comments.

Students discover that this is a two-part dilemma. The first part is the decision by the school board to require the vaccination, similar to other vaccination requirements most school districts have for entrance into elementary school. The second part is the gender bias aspect (and relevant medical research) of requiring middle school males as well as females to be vaccinated.

Objectives:

Students will provide evidence that they can:

- state an ethical dilemma as a clash of ethical principles and/or values
- identify stakeholders and others involved in the dilemma
- work as a team to list courses of action, risks and benefits, and consequences
- write a position paper based on the decision-making model and recent decisions by some state governors and recent medical research related to the use of the HPV vaccine in males

Teacher Preparation:

1. Print copies of the *Ethical Decision-Making Process* sheets for each student.
2. Print copies of the *School Board Press Release*, one for each team.
3. Arrange for access to computers and the Internet for student teams.
4. Determine criteria for putting students into groups.

Lesson Plan Checklist:

- ___ 1. Establish student groups of 3 or 4 students per group.
- ___ 2. Distribute the handout packages to the teams. The package should contain one *School Board Press Release* per team and *Ethical Decision-Making Process* sheets for each student on the team.
- ___ 3. Provide time for student teams to read the press release and ask questions about the press release.
- ___ 4. Explain to students that they will use the 8-step ethical decision-making process to formulate a position statement that will be sent to the school board as part of the school boards public comment invitation.
- ___ 5. Facilitate the whole class discussion of steps 1-3 in the decision-making process.
- ___ 6. Provide time for teams to complete steps 4-6 in the process, including time for students to do Internet research. Background information is readily available with Internet searches for “Gardasil + governors” and for “Gardasil + males.”
- ___ 7. Assign the position statement for homework.

Internet Resources:

The following sites may be helpful if students have not done research for any of the other HPV activities and, therefore, need to know more about HPV and the vaccine:

<http://www.fda.gov/bbs/topics/NEWS/2006/NEW01385.html>

<http://www.nytimes.com/2006/06/08/health/07cnd-vaccine.html>

http://coolnurse.healthology.com/main/article_print.aspx?content_id=190

http://coolnurse.com/cervical_cancer2.htm

<http://www.fda.gov/bbs/topics/NEWS/2006/NEW01385.html>

<http://www.fda.gov/womens/getthefacts/hpv.html>

<http://www.cancer.gov/cancertopics/factsheet/Risk/HPV>

<http://tell-someone.hpv.com>

<http://hpv.com/hpv-resources.html>

<http://www.cancer.gov/cancertopics/understandingcancer/HPV-vaccine>

School Board Press Release

The district's mission statement includes the wording that all adults in the community take seriously our commitment for the intellectual, mental, and physical health of the children in our district. A recent medical advance has made it possible for us to protect our children from the virus that causes cervical cancer and genital warts.

The school board has approved a draft resolution that all middle school students, both males and females, be vaccinated with Gardasil, the Human Papillomavirus (HPV) vaccine. Prior to the school board vote on this resolution, we will hold a public forum session during which time members of the community will be invited to address the school board with written or verbal comments about the resolution.

The session will be held in the middle school auditorium beginning at 7:00 PM on Tuesday, June 1. Those wishing to make comments or submit a position statement in writing are asked to register with the superintendent's secretary by May 30.

Ethical Decision-Making Process

1. What is the ethical problem or dilemma?

2. Identify the stakeholders who may be affected by the problem.

3. List others who could assist or influence the stakeholders in making the decision?

4. Describe at least three possible courses of action and record these on the Ethical Decision-Making Process Chart on the next page.

5. Describe the benefits (pros) and risks (cons) of each course of action on the Ethical Decision-Making Process Chart on the next page.

6. Identify the ethical principles and values that support each course of action on the Ethical Decision-Making Process Chart on the next page. .

Ethical Decision-Making Process Chart

Course of Action	Pros (Benefits)	Cons (Risks)	Principles	Values

