How does infection spread?
The mechanisms of immunity:
An introduction to cancer and infectious diseases

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Abstract

Cancer is a disease that arises when abnormal cells divide exponentially in any part of the body resulting in tumorgenesis. My lab experience at The University of Miami School of Medicine exposed me to the IDO (indoleamine 2,3-dioxygenase) pathway and its relationship with cancer cells. This introduction to the 4T1 IDO deficient cell line inspired me to design an Immunology Unit aligned with Florida Biology Next Generation Sunshine State Standards (NGSSS). Students will be introduced to the immune system and the mechanisms of cancer. Students will learn the organization of the immune system. They will also gain an understanding that cancer has many aspects. Virtual inquiry and laboratory activities will provide students with an opportunity to practice aseptic technique, cell culture, and cell counting. A research component will require students to construct an explanation of how cancer develops. Students will also be required to identify some of the agents that cause cancer and differentiate between normal cells and cancer cells.

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I. Florida Next Generation Sunshine State Standards

- SC.912.L.14.6: Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health
- SC.912.L.14.52: Explain the basic functions of the human immune system, including the specific and nonspecific immune response, vaccines, and antibiotics
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III. Science Background

- Utilize a virtual Hemocytometer to count cells in a virtual culture. Cell counting with the Hemocytometer demonstrates the relationship between the immunity and technology.
- Learn cell proliferation and how cells grow in culture.

V. Learning Objectives

Observable and measurable

- Explain the basic functions of the human immune system, including the specific and nonspecific immune response, vaccines, and antibiotics.
- Define a problem based on knowledge of the immune system and cancer.
- Use tools to gather, analyze, and interpret data.
- Evaluate how a person's environment and personal health are interrelated.
- Analyze strategies for prevention, detection, and treatment of communicable and chronic diseases.
- Determine that the immune system response is used by researchers to study how infectious diseases work.
- Identify the varying levels of immune system and explain the process of infection.
- Hypothesize how cancer affects the human body.
- Learn and perform aseptic technique in the classroom laboratory.
- Use a virtual Hemocytometer to count cells in culture.

VI. Time Requirements

Time Requirements
3 Days of 90 Minute block periods

VI. Materials and Equipment

Per Group of 2-3 Students:

- Black Ink Pen
- Copy of Lab Procedure
- Labeling Tape (colored)

- Rehydrated bacterial samples
- Sterile inoculating loops (plastic or metal)
- Sterile petri dishes
- Test tubes and caps
- Test Tube racks
- Bunsen Burner
- Experimental Hood
- Incubator
- Safety equipment (goggles, aprons, etc.)
- Gloves
- Goggles
- Apron or Lab coat
- Experimental hood
- 70% Bleach solution
- 70% Lysol Solution
- 70% Ethanol Solution
- Bacterial Samples; Escheria Coli and Bacillus. Cereus

Estimated cost for materials:

- $61.75 (Cat #85 V 3983):
  - WARD'S Gram Staining and Bacterial Morphology Lab Activity
  - http://wardsci.com/product.asp_Q_pn_E_IG0009840_A_Gram+Staining+and+Bacterial+Morphology+Lab+Activity

VIII. Lesson 1: Introduction to Aseptic Technique

Introduction

Aseptic technique is a fundamental and important laboratory skill in the field of microbiology. Microbiologists use aseptic technique for a variety of procedures such as transferring cultures, inoculating media, isolating pure cultures, and performing microbiological tests. Proper aseptic technique prevents contamination of cultures from foreign bacteria inherent in the environment. For example, airborne microorganisms (including fungi), microbes on the researcher's body, lab bench-top, or other surfaces, microbes found in dust, and microbes found on unsterilized glassware and equipment may potentially contaminate cultures and interfere with results. Using proper aseptic technique, researchers greatly minimize or even eliminate the risk of culture contamination. In addition, aseptic technique is of utmost importance to maintain pure stock cultures while transferring cultures to new media. Aseptic technique is also essential to isolate a single species of microorganism from a mixed culture in order to obtain a pure culture. Furthermore, proper aseptic technique prevents microbes used in the laboratory from accidentally being released into the environment and/ or infecting people working in the laboratory.

Class Time:

Two 90 minute Class Session
Laboratory Exercise 90 minutes or 45 minute Sessions
Follow-up Activity Observations 90 minutes

Warm-up

ENGAGE
Show students Aseptic Technique video
http://amrita.vlab.co.in/?sub=3&brch=73&sim=212&cnt=1
Discuss the importance of Sterilization in a laboratory setting.
Introduce students to the Amrita Labs Aseptic Technique Virtual Lab
http://amrita.vlab.co.in/?sub=3&brch=73&sim=212&cnt=1

Objectives

Students will:

- Learn and perform aseptic technique in the classroom laboratory.
- Prevent contamination of cultures and media from microbes in the environment.
- Transfer cultures from one medium by inoculating another medium. (This is called sub-culturing.)
- Isolate a microorganism from a mixed culture to obtain a pure culture.

Procedures:

Aseptic Technique Laboratory Activity Procedure

1) Prepare your work space (Laminar Air Flow Cabinet) or lab bench by wiping down the area with disinfectant.
2) With a marking pen, label a tube of sterile nutrient broth with your initials, the organism's name and the date of inoculation. Place in the test tube rack.
3) Sterilize your wire inoculating loop by passing it at an angle through the flame of a Bunsen burner until the entire length of the wire becomes glowing red/orange from the heat. **Important:** Never lay the loop down once it is sterilized or it may become re-

emocytometer Virtual

unting and the use of a
es Malassez, and it is a device
unit volume of a cell culture

Labs 2012

the number of cells per unit

Directions: To complete this activity, visit
http://amrita.vlab.co.in/?sub=3&brch=188&sim=336&cnt=1

Materials:

Per Lab Group

1-2 Students

- 1 desktop computer with internet access
- 1 Hemocytometer Virtual Lab Scavenger Hunt Worksheet

Hemocytometer Virtual Laboratory Scavenger Hunt

Answer Key

1. Define the term Hemocytometer. Counting of cells
2. What is the purpose of the Hemocytometer?
   To determine the concentration of cells in a given sample
3. Identify the term used of a liquid media containing a cell sample. Cell suspension
4. Microbiologists and Cell Biologists use cell suspensions to determine the concentration of cells.
5. The counting chamber is the device used for determining the number of cells per unit volume of a suspension.
6. The hemocytometer was mainly designed for counting blood cells. However, it is used to

Contagion Lesson

Cornell Notes

Directions:

Questions	Notes

Summary

The Cough That Launched a Hit Movie

And that is not only for relatives sitting in waiting rooms. At every medical ground zero, doctors and nurses pace and dither and second-guess themselves, waiting for tests to be done and results to dribble back, cursing when the IV falls out and struggling forever to put it back in, counting days and doses, watching trends. Patients do nothing but wait for the next footfall outside their door. Waiting is where much of the real drama of contagion lies. But you cannot make a movie out of that.

Further, while medical heroics may abound these days, characters like Ms. Winslet's are vanishingly rare. Medicine has become a team sport and public health even more so. It rumbles forward like any bureaucracy, creating policy in a series of endless meetings — deadly for narrative purposes. So character-driven screenplays like this one become parables, with cardboard characters standing in for what is really a nuanced cast of thousands.

Finally, pandemics are never everywhere. Even in the midst of history's worst, ordinary life has always lurched on. Millions died from the flu in 1918, but many more millions were untouched. The early years of AIDS unfolded against a breathtakingly bland backdrop — the social equivalent of the crystalline blue sky on 9/11. Walk one block from hospitals on whose wards all hell is breaking loose and you would never know there is a problem.

The bizarre disconnect cocooning AIDS fueled an anger in affected communities that persists to this day. You cannot tell the story of AIDS without exploring the surrounding silence.

So artists seeking to represent the realities of epidemic disease have a difficult mission. The noise and action are only half the story. The rest is all very pedestrian and quiet.

The C.D.C.'s main spokeswoman during the 2009 H1N1 flu pandemic was Dr. Anne Schuchat, director of immunization and respiratory diseases. Dr. Schuchat, who has been with the agency for almost 25 years, has been involved with dozens of epidemics. She has the standard drills down cold — in fact, the creators of "Contagion" enlisted her to coach Ms. Winslet before filming began.

But in an essay published a few months ago in The American Journal of Obstetrics and Gynecology that reflected on the toll H1N1 took among pregnant women, Dr. Schuchat veered away from the usual story line.

"Pandemics are personal," Dr. Schuchat began, going on to tell the story of her great-aunt Bessie, who was killed during childbirth by the 1918 flu. Bessie's death resounded through generations of the Schuchat family, just one of the millions of quiet, necessary footnotes without which the big glitzy narratives are neither accurate nor complete.

XI. Assessment
Sample Lab Report Rubric

	Excellent (4 pts)	Good (3 pts)	Adequate (2 pts)	Needs Work (1 pt)	Not attempted (0)
Introduction	1. Includes the question to be answered by the lab 2. states hypothesis that is based on research and/or sound reasoning 3. title is relevant.	One of the "excellent" conditions is not met, two conditions met	Two of the "excellent" conditions is not met , one is met	Introduction present, no exemplary conditions met	
Methods	Description or step-by-step process is included, could be repeated by another scientist	Description included, some steps are vague or unclear	The description gives generalities, enough for reader to understand how the experiment was conducted	Would be difficult to repeat, reader must guess at how the data was gathered or experiment conducted	
Data and Analysis	Results and data are clearly recorded, organized so it is easy for the reader to see trends. All appropriate labels are included	Results are clear and labeled, trends are not obvious or there are minor errors in organization	Results are unclear, missing labels, trends are not obvious, disorganized, there is enough data to show the experiment was conducted	Results are disorganized or poorly recorded, do not make sense ; not enough data was taken to justify results	

XII. Student Section

Student Worksheets

Name: _____

Date: _____

Hemocytometer Virtual DntHemoc

Microscopic Investigation: Bacterial Cultures

Directions: In the circles below draw an image of what your bacterial sample looks like at 10x and 40x magnification. Use the squares to describe the bacteria and identify the bacteria's morphology and motility.

The Cough That Launched a Hit Movie

September 12, 2011

By ABIGAIL ZUGER, M.D.

When Hollywood turns to medicine, accuracy generally heads for the hills. But the creators of the new action thriller "Contagion" went to unprecedented lengths to fact-check their story of a destructive viral pandemic, retaining a panel of nationally renowned virologists and epidemiologists as consultants. The intent was to infuse the usual hyperbole with an extra frisson: This is the way it could really happen. Be very afraid.

You have to applaud the effort, for the movie does indeed offer a procession of dead-on accurate scenes that not only could happen but, in many cases, have already happened. Still, the whole thing is an improbable caricature, with 100 action-packed Hollywood minutes veering far from reality. You can still be very afraid if you want, if a contagious apocalypse happens to be your thing. But it's not going to happen this way.

"Contagion" begins modestly and realistically enough, with a cough. Gwyneth Paltrow, a midlevel executive for an international corporation, gets sick on her way home from a business trip. She coughs from Hong Kong through a layover in Chicago and on to Minneapolis, producing clouds of a deadly Asian virus and leaving infectious droplets on everything she touches. She is the pandemic's index case, and her napkins, used tissues, drinking glasses and three-ring binder are all vectors of disease.

Her infection is a fictional combination of influenza and brain infection caused by the exotic Nipah virus. Nipah (NEE-pa) is carried by fruit bats in South Asia: bats don't get sick from it, but their saliva and urine may infect pigs, which do. Sick pigs have transmitted Nipah to their human caretakers, and in the dozen small outbreaks described since 1999, sick humans sometimes passed it on to their own caretakers. The disease has never been seen outside a rural setting and has certainly never traveled on a plane. Still, Nipah, with its 50 to 75 percent mortality rate in humans, tops most lists of scary new animal-derived viruses.

The creators of "Contagion" scaled down the mortality rate of their "MEV-1" virus infection to 25 percent (for comparison, the mortality rate of SARS in 2003 was about 15 percent, and that of even the worst influenza substantially less). Then they jacked up the viral infectivity so that a few days into the fictional epidemic dozens of unrecognized cases already dot the globe. By the time Kate Winslet, who plays an epidemiologist at the Centers for

of football fields with hospital beds. A few weeks later, with disease exploding everywhere, the world's social fabric begins to dissolve.

What follows is a series of gruesome worst-case scenarios, crumpling together every conceivable social and ethical complication of epidemic disease, for what boils down to a giant in-your-face public-service advertisement for the world's beleaguered health agencies.

The medical details, including the rapid demise of several excellent actors (after some highly unrealistic foaming at the mouth) are the least of it.

We also experience, in short order, the downside of contact tracing, a time-honored epidemiologic term for figuring out who has touched whom —

And that is not only for relatives sitting in waiting rooms. At every medical ground zero, doctors and nurses pace and dither and second-guess themselves, waiting for tests to be done and results to dribble back, cursing when the IV falls out and struggling forever to put it back in, counting days and doses, watching trends. Patients do nothing but wait for the next footfall outside their door. Waiting is where much of the real drama of contagion lies. But you cannot make a movie out of that.

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