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

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Funded by the American Association of Immunologists
High School Teachers Summer Research Program

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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
- SC.912.N.1.1: Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:
  - Conduct systematic observations.
  - Use tools to gather, analyze, and interpret data
- HE.912.C.13: Evaluate how environment and personal health are interrelated
- HE.912.C.1.4: Analyze how heredity and family history can impact personal health
- HE.912.C.1.8: Analyze strategies for prevention, detection, and treatment of communicable and chronic diseases

II. Unit Goals

This unit will:

- Introduce students to the role of microbiologists.
- Introduce students to the role of immunologists.
- Educate students on the importance of proper experimental protocol.
- Introduce and reinforce aseptic technique that is used in a microbiology laboratory.
- To acquire the skill of aseptic technique in the field of Microbiology.
  - Aseptic technique requires students to:
    - Prevent contamination of cultures and media from microbes in the environment.
    - Transfer cultures from one medium by inoculating another medium.
    - Prevent lab microorganisms from being spread in the environment and/or infecting the investigator.

Recommended Placement

This unit can be used to:

- Reinforce a human body immune system unit in a general biology course.
- Acquire and practice microbial laboratory techniques.
- Introduce and reinforce aseptic technique, cell plating, and counting in a Biotechnology Course.

III. Science Background

The Immune System and Cancer

The immune system is the human body's defense against invading pathogens. It is a complex network of cells, tissues, and organs that work cohesively to protect the body from foreign cells. A healthy immune system is something that can easily be taken for granted. Typically, when the human body is compromised due to a foreign cell or pathogen, the immune system reacts to destroy the invader. Cancer cells, however, present a special challenge for the immune system. Cancer cells are the body's own cells that have been transformed. The morphology of a cancerous cell is unlike a normal cell. Cancer cells also consistently show an abnormal number of chromosomes, called aneuploidy. Aneuploidy contributes to the rapid spread of cancer cells and the development of tumors. How could this happen among the body's own cells?

It was once believed that cancer developed as a result of immune deficiency. Today, it is apparent that cancers arise when the controls that normally regulate cell growth and division are not functioning properly. A single cell begins to divide uncontrollably, which can often develop into a tumor. Some tumors are benign and do not result in cancer. Malignant tumors, however, invade and destroy surrounding healthy tissue in the body. Recently, new clues about how cancer cells work have identified an impressive network of communication signals. In addition to exponential growth, cancer cells relay signals that prevent the body's healthy cells from developing and functioning normally.

Over time, cancer cells spread and disrupt the body's homeostasis, resulting in illness. Cancer cells use many tactics to deceive the human immune system. The immune system, however, should not be underestimated, as it has the capacity to recognize cancer cells as foreign and work to destroy the transformed cells.

IV. Student Outcomes

Students will:

- Study the role of the immune system in the human body.
- Understand how immune cells work together to form varying degrees of defense against invading pathogens.
- Explore how cancer cells develop.
- Learn and apply aseptic technique in the classroom laboratory.
    - Aseptic Technique is a method used to prevent the spread of contamination and is one of the primary methods used to control pathogens.

- 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.

- Prevent lab microorganisms from being spread in the environment and/or infecting the investigator.

Materials

- WARD'S Gram Staining and Bacterial Morphology Lab Activity
- Pre-Post Assessment
- Microscopic Investigation of Bacterial Cultures Worksheet

Pre/Post Lab Activity Questions

1. What is the definition of Aseptic Technique?

   Aseptic technique employs the proper use of specific practices and procedures under carefully controlled conditions.

2. What is the importance of utilizing aseptic technique?

   Proper aseptic technique minimizes contamination by pathogens.

3. What is a laminar air flow hood? What the importance of this equipment?

   Laminar air flow hoods are used for the purpose of cleansing the air when aseptic (sterile) techniques and a sterile environment are required.

4. What is the most appropriate disinfectant for cleaning a laminar air flow hood?

   75% Ethanol

5. What is the appropriate way to clean a spill in the laboratory according to aseptic technique?

   All spills should be reported and cleaned immediately with 10% bleach solution.

6. Define inoculating loop. What is the purpose of the inoculating loop?

   An inoculating loop is a sterile loop, used to collect a sample of bacteria and to streak a petri dish to culture a colony.

7. Define micropipette. What is this equipment used for in the laboratory?

   A micropipette is an instrument used to measure out small volumes in a laboratory between µ1L and 1mL

Procedures:

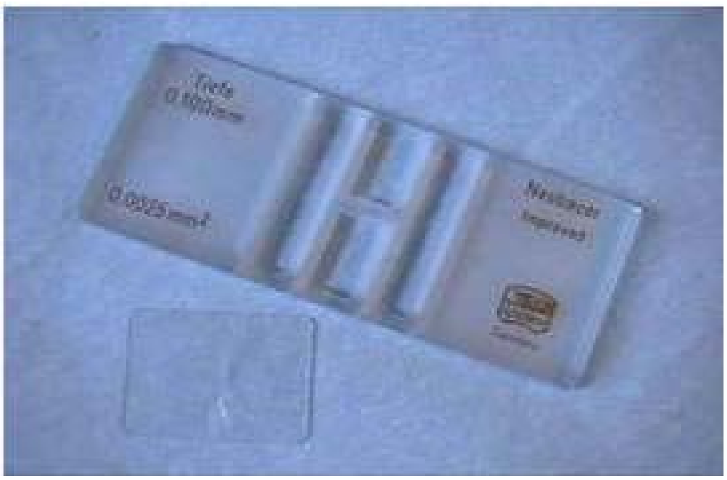
Aseptic Technique Laboratory Activity Procedure

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-contaminated. Allow the loop to cool a few seconds to avoid killing the inoculum.
4) Partially lift the lid of the plate culture and open it just enough to insert the inoculation loop. Do not completely open the lid and expose the surface to the air.
5) Touch the loop to an area of the agar with no growth in order to cool down the loop.
6) Choose an isolated colony and scrape off a very small amount of culture with the loop. Be careful not to gouge into the agar with the loop as you pick up the organisms.
7) Close the lid immediately once you have picked up the organisms, and turn the plate upside down on the work surface.
8) Pick up the tube of sterile nutrient broth with your free hand, carefully remove the cap (cotton plug) with your little finger of the hand holding the loop, and move the mouth of the tube through the flame.
9) Insert the loop into the sterile broth and inoculate it by gently moving the loop back and forth in order to disperse the cells.
10) Remove the loop from the tube and move the mouth of the tube through the flame again.
11) Replace the cap on the tube and place it on the rack.
12) Sterilize the loop by passing it at an angle through the flame.
13) Incubate the culture you just inoculated at 37°C for 24-48 hours.

IX: Lesson 2: Cell Counting: An Introduction to the Hemocytometer Virtual Laboratory

Introduction:

In this lesson, students will become acquainted with cell counting and the use of a hemocytometer. The Hemocytometer was invented by Louis-Charles Malassez, and it is a device with two chambers that is used to determine the number of cells per unit volume of a cell culture suspension in each counting chamber



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Dimensions	Area	Volume at 0.1mm depth
1 x 1 mm	1 mm^2	100 nl
0.25 x 0.25 mm (1/16)	0.0625 mm^2	6.25 nl
0.25 x 0.20 mm (1/20)	0.05 mm^2	5 nl
0.20 x 0.20 mm (1/25)	0.04 mm^2	4 nl
0.05 x 0.05 mm (1/400)	0.0025 mm^2	0.25 nl

Table 2012 © Amrita Labs 2012

Class Time:

One 90 minute Class Session
In 2 Parts: 45 minute Sessions

Objectives:

Students will use a virtual laboratory Hemocytometer to determine the number of cells per unit volume of a cell culture suspension

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 count other types of cells and other microscopic particles.
7. The hemocytometer was invented by Louis-Charles Malassez.
8. The hemocytometer is a special type of microscopic slide, which consists of two chambers.
9. The slide consists of rectangular indentations that create an H Shape.
10. Before a sample can be loaded into either chamber the hemocytometer must be covered with a glass coverslip.
11. A dye is used to distinguish between viable and non-viable cells.
12. Trypan blue differentiates live cells form dead cells by entering the cytoplasm of dead cells; which take up the stain.
13. The counting chamber must be cleaned with 75% ethanol.
14. An inverted microscope is used to illuminate the counting grid on the hemocytometer.

X. Lesson 3: Contagion: Micro-Immunology and Investigating the Spread of Infectious Diseases

Introduction:

In this lesson, student will review articles and complete laboratory exercises to explore micro-immunology and the mechanisms of infection. Students will also view the movie Contagion. The film focuses on public health, immunology, virology, and epidemiology. They will learn more about the nature of disease and how infection spreads.

Class Time:

Two 90 minute Class Session
Contagion Movie Length 1:20

Warm-up:

Introduce students to the CDC website and highlight important areas of the website..

Pre-viewing Contagion:

Read the article "The Cough That Launched Movie"

- Write the terms: infectious, virus, quarantine, vaccine and immunity on the board. Have students write what they think each terms means.
- Give students the **Cornell Notes Organizer**
  Have students:
  In column 1, draft questions that they may have about the article while reading or questions that the article did not answer.
  In column 2, take notes
  In the bottom Summary section, students must write a brief summary of the article.
- Following this activity, lead a class discussion with students and allow students to share their synopses with the class.

Post Viewing Contagion:

-Lead a discussion of infectious diseases and have students complete the following question:

1. What is the movie about?
2. Define the terms. (infectious, virus, quarantine, vaccine and immunity)
3. What emotions did you feel as you viewed the film?
4. Which elements seemed realistic? Did any of the elements seem dramatized for the sake of the story?

-Give students the article "The Cough That Launched a Movie" after viewing the movie. How does the synopsis compare to the film? Compare and contrast the films elements and circumstances as it relates to the Guidelines for controlling infection. The CDC website can be used as a resource.

Contagion Lesson

Cornell Notes

Directions:

Questions	Notes

Summary

The Cough That Launched a Hit Movie

The New York Times

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 Disease Control and Prevention, gets off her plane in Minneapolis, that city has enough brewing cases to fill a couple 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 — all privacy immediately disappears. Likewise, a forced quarantine, the major tool for fighting contagious disease, sacrifices individual rights for the public good. Competing governmental agencies square off on turf and budget issues, while entire countries adopt aggressively misguided routines.

We see gigantic public mood swings, amplified by Internet scares. Some people become irrationally terrified, others irrationally fearless. Many succumb to the lure of unlikely patent medicines. Unscrupulous entrepreneurs quickly appear, like maggots, to feed these instincts and to feed off them.

We see selfish and selfless behavior, often in the same person. We see unexpected scientific setbacks ("It's mutated!") and slow steps to ultimate control. All unfold against the eerie visuals of quarantine, with uncollected garbage lining deserted streets, empty public spaces, masked faces, isolated clusters of families reduced to a primitive, almost tribal existence.

And indeed, from AIDS to SARS to the swine flu, pretty much all of this has actually happened somewhere in the world, if on a much smaller scale.

But for all the relentless realism, much of the real drama of epidemic disease never quite makes it to the screen.

First, nowhere but in Hollywood does medicine, even in its most catastrophic form, unfold with the sustained hysteria that requires the beat of this unnerving, tympanitic score.

The real horror of most disease is that it all moves so slowly, leaving everyone involved all too much time to think. The worse the illness, the more time seems to drag.

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	�
Conclusions	1. Summarizes data used to draw conclusions 2. Conclusions follow data (not wild guesses or leaps of logic), 3. Discusses applications or real world connections 4. Hypothesis is rejected or accepted based on the data.	3 of 4 of the "excellent" conditions is met	2 of 4 of the "excellent" conditions is met	1 of 4 of the "excellent" conditions is met	�
�**Format and Lab Protocols**	Lab report submitted as directed, and on time. Directions were followed, stations were cleaned. All safety protocols followed.	Most of the excellent conditions were met; possible minor errors in format or procedures	Some of the excellent conditions were met; directions were not followed, problems with lab stations, questionable safety	Student did not follow directions, practiced unsafe procedures, goofed around in the lab, left a mess or equipment lost	�
	Total (out of 20)				�

XII. Student Section

Student Worksheets

Contagion Lesson

Cornell Notes

Directions: Use the worksheet while reading the article “The Cough That Launched a Movie”

Questions	**Notes**

Summary

Name: ___________________

Date: _____________

Hemocytometer Virtual Laboratory Scavenger Hunt

Directions:

1. Define the term Hemocytometer.

2. What is the purpose of the Hemocytometer?

3. Identify the term used of a liquid media containing a cell sample.

4. ________________ and ___________________ use cell suspensions to determine the _________________________ of cells.
5. The ______________________ is the device used for determining the number of cells per unit volume of a __________________.
6. The hemocytometer was mainly designed for counting _______________. However, it is used to count other types of ____________ and ______________________________.
7. The hemocytometer was invented by ______________________________.
8. The hemocytometer is a _____________________________, which consists of two chambers.
9. The slide consists of ________________________ indentations that create an _______________________.
10. Before a sample can be loaded into either chamber the ___________________ must be covered _____________________.
11. A ______________ is used to distinguish between ___________________ and ___________________ cells.
12. ______________ blue differentiates live cells form dead cells by ________________ ______________________________.
13. The counting chamber must be cleaned with _____________________________.
14. An ________________________________ is used to illuminate the counting grid on the hemocytometer.

Name: ________________________

Date: _____________________

Class Period: __________

Micro-Immunology: Introduction to Aseptic Technique and Gram Staining

Pre/Post Lab Assessment Questions

1. What is the definition of Aseptic Technique?

2. What is the importance of utilizing aseptic technique?

3. What is a laminar air flow hood? What the importance of this equipment?

4. What is the most appropriate disinfectant for cleaning a laminar air flow hood?

5. What is the appropriate way to clean a spill in the laboratory according to aseptic technique?

6. Define inoculating loop. What is the purpose of the inoculating loop?

7. Define micropipette. What is this equipment used for in the laboratory?

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.

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But for all the relentless realism, much of the real drama of epidemic disease never quite makes it to the screen.

First, nowhere but in Hollywood does medicine, even in its most catastrophic form, unfold with the sustained hysteria that requires the beat of this unnerving, tympanitic score.

The real horror of most disease is that it all moves so slowly, leaving everyone involved all too much time to think. The worse the illness, the more time seems to drag.

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.

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