Disease Detectives KEY

2017 Golden Gate Science Olympiad Invitational Disease Detectives Test

Time limit: 60 Minutes

Names:_____

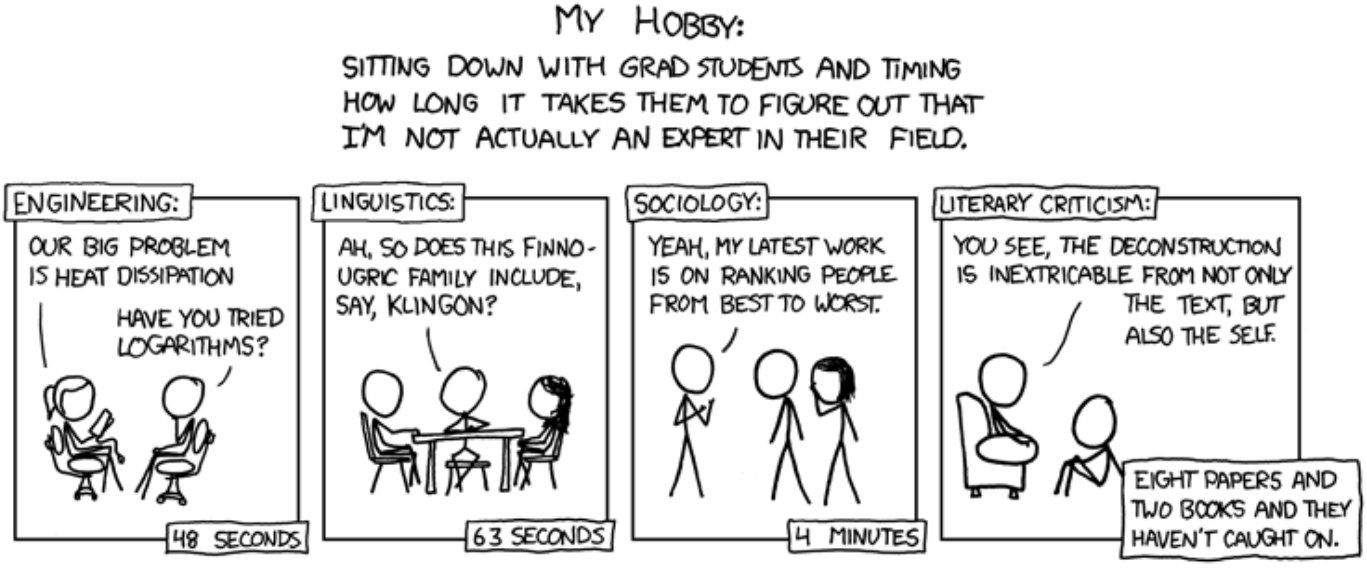
Team Number:_____

School:_____

(***For Grader's Use Only)***

Score: / 264

Rank:



Part One (66 points)

(1 point each, 66 points total) (Each term will be used only once)

Active Immunity	Acute Exposure	Agent	Antigen	Secondary Attack Rate	Information Bias	Selection Bias
Crude Birth Rate	Index Case	Necessary Cause	Class Interval	Comparison Value	Confounding	Delayed Health Effect
Detection Limit	Dose-Response Relationship	Efficacy	Efficiency	Endemic Level	Epidemiologic Trial	Analytic Epidemiology
Applied Epidemiology	Descriptive Epidemiology	Exposure-Dose Reconstruction	Fomite	Health Promotion	Healthy Worker Effect	Host Factor
Active Immunity	Herd Immunity	Passive Immunity	Incidence	Incubation Period	In Vitro	In Vivo
Crude Mortality Rate	Infant Mortality Rate	Neonatal Mortality Rate	Postneonatal Mortality Rate	Normal Distribution	Odds Ratio	Outbreak
Common-Source Outbreak	Point-Source Outbreak	Propagated Outbreak	Pandemic	Prevalence	Reservoir	Risk Communication
Random Sample	Representative Sample	Standard Deviation	Analytic Study	Case-Control Study	Cohort Study	Experimental Study
Observational Study	Medical Surveillance	Passive Surveillance	Sentinel Surveillance	Synergistic Effect	Teratogen	Airborne Transmission
Vectorborne Transmissions	Vehicleborne Transmissions	Virulency				

A. The systematic assessment of people exposed or potentially exposed to health hazards. Medical Surveillance

B. Manipulation of the association between an exposure and a health outcome by a third variable that is related to both. Confounding

C. The immunity that results from the production of antibodies by the immune system in response to the presence of an antigen. Active Immunity

D. The number of deaths of children from birth up to, but not including, 28 days per 1,000 live births. Neonatal Mortality Rate

E. Contact with a substance that occurs once or for only a short time. Acute Exposure

F. A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses. Analytic Study

G. Selected reporting units, with a high probability of seeing cases of the disease in question, good laboratory facilities and experienced well-qualified staff, identify and notify on certain diseases. Sentinel Surveillance

H. A toxin or other foreign substance that induces an immune response in the body, especially the production of antibodies. Antigen

I. The probability that infection occurs among susceptible persons within a reasonable incubation period following known contact with an infectious person or another infectious source. Secondary Attack Rate

J. Bias arising from measurement error. Information Bias

K. The choice of individuals, groups or data for analysis in such a way that proper randomization is not

achieved. Selection Bias

L. Gathers disease data from all potential reporting health care workers without prompting. Passive Surveillance

M. The number of live births occurring among the population of a given geographical area during a given year, per 1,000 mid-year total population of the given geographical area during the same year. Crude Birth Rate

N. A measure that is used to quantify the amount of variation of a set of data values. Standard Deviation

O. The initial patient in the population of an epidemiological investigation, or more generally, the first case of a condition or syndrome to be described in the medical literature. Index Case

P. A study that samples a group of people who share a defining characteristic, typically who experienced a common event in a selected period. Cohort Study

Q. A factor that must be present for a disease to occur. Necessary Cause

R. A factor (e.g., a microorganism or chemical substance) or form of energy whose presence, excessive presence, or in the case of deficiency diseases, relative absence is essential for the occurrence of a disease or other adverse health outcome. Agent

S. The size of each class into which a range of a variable is divided, as represented by the divisions of a histogram or bar chart. Class Interval

T. Refers to the degree of damage caused by a microbe to its host. Virulency

U. Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful health effects in exposed people. Comparison Value

V. An outbreak in which persons are exposed to the same source over a brief time, such as through a single meal or at an event. The number of cases rises rapidly to a peak and falls gradually. Point-Source Outbreak

W. A study that compares exposures of people who have a disease or condition with people who do not have the disease or condition. Case-Control Study

X. A disease or an injury that happens as a result of exposures that might have occurred in the past. Delayed Health Effect

Y. The lowest concentration of a chemical that can reliably be distinguished from a zero concentration. Detection Limit

Z. The relationship between the amount of exposure to a substance and the resulting changes in body function or health. Dose-Response Relationship

AA. The ability of an intervention or program to produce the intended or expected results under ideal conditions. Efficacy

BB. The ability of an intervention or program to produce the intended or expected results with a minimum expenditure of time and resources. Efficiency

CC. The amount of a particular disease that is usually present in a community. Endemic Level

DD. Consists of an external agent, a host and an environment in which host and agent are brought together, causing the disease to occur in the host. Epidemiologic Triad

EE. The study of epidemiology that is concerned with the search for causes and effects, or the why and the how. Analytic Epidemiology

FF. An outbreak which results from transmission from one person to another. Propagated Outbreak

GG. Putting epidemiological research methods to use in public health practice. Applied Epidemiology

HH. The study of the amount and distribution of a disease in a specified population by person, place, and time. Descriptive Epidemiology

II. A method of estimating the amount of people's past exposure to hazardous substances. Exposure-Dose Reconstruction

JJ. Any nonliving object or substance capable of carrying infectious organisms, such as germs or parasites, and hence transferring them from one individual to another. Fomite

KK. A study where the researcher observes and systematically collects information, but does not try to change the people. Observational Study

LL. The process of enabling people to increase control over, and to improve, their health. Health Promotion

MM. A phenomenon where workers usually exhibit lower overall death rates than the general population because the severely ill and chronically disabled are ordinarily excluded from employment. Healthy Worker Effect

NN. A biologic response to multiple substances where one substance worsens the effect of another substance. Synergistic Effect

OO. Refers to the traits of an individual person or animal that affect susceptibility to disease, especially in comparison to other individuals. Host Factor

PP. The immunity that results from the production of antibodies by the immune system in response to the presence of an antigen. Active Immunity

QQ. A sample whose characteristics correspond to those of the original population or reference population. Representative Sample

RR. The immunity to a pathogen in a population based on the acquired immunity to it by a high proportion of members over time. Herd Immunity

SS. A study where the researcher intervenes to change something (e.g., gives some patients a drug) and then observes what happens. Experimental Study

TT. The short-term immunity that results from the introduction of antibodies from another person or animal. Passive Immunity

UU. The number of new cases of disease in a defined population over a specific time period. Incidence

VV. The period between exposure and onset of clinical symptoms. Incubation Period

WW. The exchange of information to increase understanding of health risks. Risk Communication

XX. In an artificial environment outside a living organism or body. In Vitro

YY. Infections transmitted by the bite of infected arthropod species. Vectorborne Transmissions

ZZ. Within a living organism or body. In Vivo

AAA. The mortality rate from all causes of death for a population during a specified time period. Crude Mortality Rate

BBB. The habitat in which an infectious agent normally lives, grows and multiplies. Reservoir

CCC. The number of deaths of infants under one year old per 1,000 live births. Infant Mortality Rate

DDD. A substance that causes defects in development between conception and birth. Teratogen

EEE. A set of items that have been drawn from a population in such a way that each time an item was selected, every item in the population had an equal opportunity to appear in the sample. Random Sample

FFF. The number of deaths of children from 28 days up to, but not including, one year per 1,000 live births. Postneonatal Mortality Rate

GGG. A function that represents the distribution as a symmetrical bell-shaped graph. Normal Distribution

HHH. Infections transmitted by an inanimate object or material. Vehicleborne Transmissions

III. A measure of association between an exposure and an outcome. Odds Ratio or Cross-Product Ratio

JJJ. A sudden increase in occurrences of a disease in a particular time and place. Outbreak

KKK. An outbreak in which a group of persons are all exposed to an infectious agent or a toxin from the same source. Common-Source Outbreak

LLL. An epidemic of infectious disease that has spread through human populations across a large region. Pandemic

MMM. When bacteria or viruses travel on dust particles or on small respiratory droplets that may become aerosolized when people sneeze, cough, laugh, or exhale. Airborne Transmission

NNN. The number of existing disease cases in a defined population during a specific time period. Prevalence

Part Two (28 points)

Half of the students living in Berkeley's Adams, James, and Jefferson dorms eat in the President's Dining Hall for their meals, and the other half eat in a dining facility close by. About 700 students live in Adams, 1000 in James, and 850 in Jefferson. Dinner is served from 5:00PM to 7:00PM everyday. Typical meals at the dining hall include burgers, pizza, and french fries, but on special occasions, the dining hall serves the students good food from

restaurants in the surrounding community. On November 10th, 2016, some of the delicacies served were a soft cheese similar to brie, grilled steak with truffle mashed potatoes, and braised rosemary chicken breast. You can assume that all the students who ate at the dining hall ate all of the food provided. After their delicious meal, the Berkeley students returned to their dorms, studied for their classes, and went to bed. Around 8:00AM on November 11th, 30 students in Adams, 55 in James, and 40 in Jefferson came down with symptoms of nausea, diarrhea, fever, and muscle aches. All of these students ate at the President's Dining Hall. Of the students who ate at the other dining facility, which did not have this special dinner, 15 in total came down with these same symptoms. These students visited the University Health Services Center, and were told by the nurses to stay in bed and limit contact with uninfected students. Based on this situation, answer the following questions:

(1) Which food-borne organism **AND** illness do you believe these students were infected with? Support your claim with evidence from the above scenario. (4 points)

Organism: Listeria Monocytogenes (Just Listeria acceptable) (1 point)

Illness: Listeriosis (1 point)

Evidence: The **soft cheese** similar to brie OR the **mashed potatoes** (1 point). The symptoms of nausea, diarrhea, fever, and muscle aches (1 point). The symptoms arising approx. **15-17 hours** later (1 point). (No further explanation needed) (Max. 2 points)

(2) Name two food-borne illnesses that you could have ruled out from evidence provided above. Explain how you were able to rule them out. (4 points) **TIEBREAKER 6**

Hemorrhagic colitis or E. coli O157:H7 infection from the steak (1 point), but the symptoms and incubation time are off. (1 point)

Hemorrhagic colitis or E. coli O157:H7 infection from the mashed potatoes from unpasteurized butter/milk (1 point), but the symptoms and incubation are off (1 point).

Campylobacteriosis from the chicken (1 point), but the incubation and symptoms are off (1 point).

Salmonellosis from any of the foods (1 point), but the symptoms are off (1 point).

GRADING: Two illnesses and their evidence must be correctly paired together to gain all 4 points.

(3) Explain why the advice the nurses gave the students at the University Health Services Center does or does not make sense. (3 points)

The advice not to come into contact with uninfected students does not make sense because Listeriosis is **not a contagious illness** and the only way it would be able to spread is if the **food with that specific bacteria is eaten** by a student. (3 points)

(4) Calculate the risk ratio for the scenario above. Show the work you did to get to your answer. (6 points)

	Infected	Not Infected
Ate at President's Dining Hall	125 (A)	1150 (B)
Did not eat at President's Dining Hall	15 (C)	1260 (D)

Risk Ratio: (A/(A+B)) / (C/(C+D)) = (125/(125+1150)) / (15/(15+1260)) = .098 / .012 = **8.167**

(3 points for work, 3 points for the correct answer. If a simple calculation error was made leading to the wrong answer, but the formula AND process were still correct, give 3 points.)

(5) Interpret the risk ratio you calculated. (3 points)

Because the **risk ratio is so high** (8.167), or RR > 1, it can be seen that those who **ate at the President's Dining Hall** were at a much **greater risk** to be infected with the illness than those who did not eat at the hall. (3 points)

By coincidence, it happened that a free lamaze class for low income pregnant women was being held in a nearby Berkeley gymnasium from 3:00PM to 5:00PM the same day. About 400 women from around the area attended the class and they were all in their third trimester of pregnancy. When the class ended, every woman was given a free pass to Berkeley's President's Dining Hall for a free dinner that day only. 300 of the women went to dinner that day and ate all of the selections provided. About two and a half weeks later, 150 of these women started to develop flu-like symptoms, but only mild fever and vomiting, akin to morning sickness. Two weeks after these symptoms arose, 50 of these women had sudden miscarriages.

(6) Based on your earlier identification of the food-borne illness, what happened to these pregnant women that had miscarriages? (4 points)

The illness Listeriosis is known to have severe effects on pregnant women because of the **less efficient immune system during pregnancy**. The illness will cause only **mild flu-like symptoms in the mother**, but the **baby is at great risk to die** in the womb. (4 points)

That week was also homecoming week for UC Berkeley and alumni from across the country were coming to revisit their alma mater. The Berkeley Class of 1958's reunion was being held at the reception hall near the President's Dining Hall and their food was being catered by that dining hall the same day as the special dinner, November 10th. The alumni ate all of the food that was catered and several hundred of them had similar symptoms as the students, fever, nausea, muscle aches, diarrhea, and also a stiff neck and sensitivity to light. About 2 months later, a six dozen of these alumni who had these symptoms die.

(7) Based on the above information, what was the likely cause of their death? Provide evidence that supports your claim. (4 points) **TIEBREAKER 4**

These alumni likely died of **Meningitis** (**Bacteremia** is also an acceptable cause). Listeriosis in the elderly can lead to Meningitis if symptoms such as a **stiff neck or sensitivity to light** are observed. (4 points: 2 points case, 2 points for evidence)

Part Three (55 points)

(1) List the 13 steps of an Epidemiologic Outbreak Investigation. Do your best to put the steps in order, but it is not required. (13 points) **Tiebreaker 5**

1-Prepare for field work

2-Establish the existence of an outbreak

3-Verify the Diagnosis

4-Construct a working case definition

5-Find cases systematically and record information

6-Perform descriptive epidemiology

7-Develop hypotheses

8-Evaluate hypotheses

9-As necessary, reconsider, refine, and re-evaluate hypotheses

10-Compare and reconcile with laboratory and/or environmental studies

11-Implement control and prevention measures

12-Initiate or maintain surveillance

13-Communicate Findings

(1 point each, 13 points max)

(2) When identifying a specific case, what are the three different categories of a case definition that allow for uncertainty, and how do you define each of these categories? (6 points)

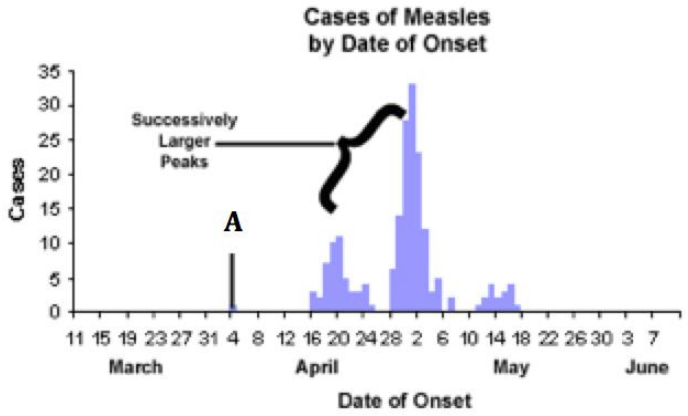
Confirmed-have diagnosis with case definition and lab verification

Probable-typical clinical features, but no lab verification

Possible/Suspect-fewer clinical features than probable, no lab verification

(1 point each category, 1 point for correct definition, 6 points max)

(3) Descriptive Epidemiology is the process of characterizing an outbreak by time, place, and person. (2 points)



(4) What type of graph is shown above? (2 points)

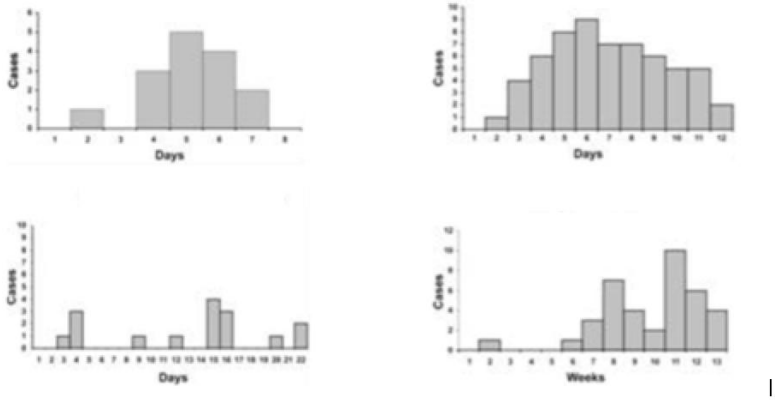
Epi Curve/Epidemic Curve

(5) On this graph above, what does A indicate? (2 points)

Index Case

(6) What type of spread is indicated above? (2 points)

Propagated Source



(7) Identify each of these graphs for different types of spread: (4 points)

Upper Left: Common Point Source

Upper Right: Common Persistent Source

Lower Left: Common Intermittent Source

Lower Right: Propagated Source

(8) Name and describe the two types of cohort studies: (4 points)

Retrospective Cohort: Starts at exposure in past and moves forward to outcome.

Prospective Cohort: Starts at present exposure and moves forward to outcome.

(1 point each, 1 point each correct description, 4 points max)

Brunch'd is a popular brunch destination in downtown Palo Alto, and only a 15 minute bike ride from the Stanford

campus! Frequents of the restaurant are university students as well as Palo Alto community members. In October, 394 people was diagnosed with Salmonellosis and Brunch'd is suspected to be the source. 274 went to Brunch'd and 120 people did not. In addition to the 394 people diagnosed, 612 similar disease-free people were contacted to see if they ate at Brunch'd. 241 people ate at Brunch'd and 371 did not.

(9) What is the type of study you will perform with the information provided? (2 points)

Case-Control Study

(10) What is the primary fallback from the type of study you listed above? (2 points)

It is **difficult to select the control group** for this type of study because it is **impossible to make the groups similar** in every way, increasing the possibility of confounding variables.

(11) Create a 2x2 table below: (5 points)

	Case Patients	Controls	Total
Ate at Brunch'd	274 (A)	241 (B)	515
Did not eat at Brunch'd	120 (C)	371 (D)	491
Total	394	612	

(1 point for each data point in the correct place, 1 point for the correct assembly of the table, 5 points max)

(12) Calculate the odds ratio for the above scenario. Show the work you did to get to your answer. (4 points)
TIEBREAKER 3

AD/BC = (274*371) / (241*120) = 101654/28920 = 3.52

(2 points for work, 2 points for the correct answer. If a simple calculation error was made leading to the wrong answer, but the formula AND process were still correct, give 2 points.)

(13) Interpret the odds ratio you calculated. (2 points)

The odds ratio is 3.52. People who ate at Brunch'd were 3.52 times as likely to contract Salonellosis than those who did not.

(14) Name three symptoms of Salmonellosis and the typical range of incubation period. (5 points)

Diarrhea, Fever, Abdominal Cramps, Vomiting. (1 point each, max 3 points)

Incubation Period: 6-48 hours. (6±2, 48±4 acceptable, 2 points)

Part Four (61 points)

Name the following famous epidemiologists (2 points each):

(1) British phyiscian who developed a critical theory regarding Cholera Transmission and lead to the adoption of anesthesia.

John Snow

(2) The scientist who was credited with developing the Smallpox Vaccine.

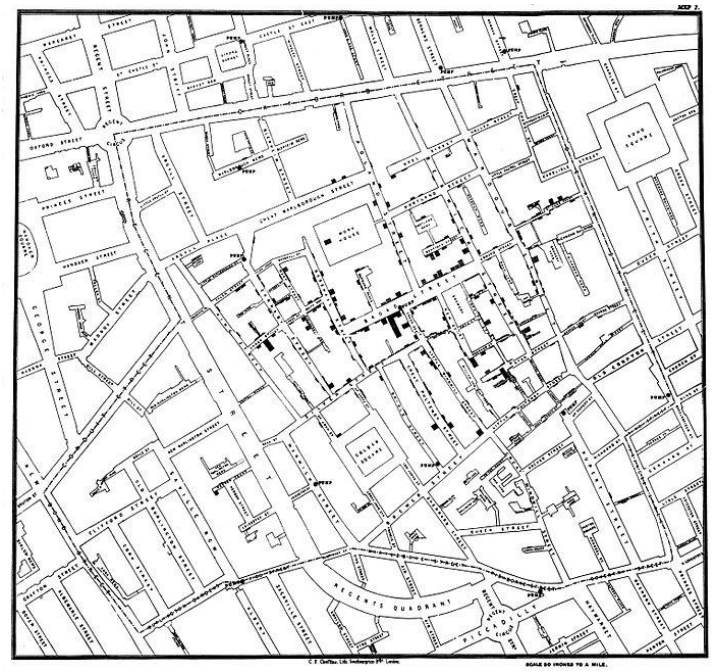
Edward Jenner

(3) The scientist who developed the vaccine that eradicated polio.

Jonas Salk

(4) British epidemiologist, regarded as the founder of medical statistics.

William Farr



(5) Name the type of map shown above as well as what significant disease outbreak it depicts. (4 points)
TIEBREAKER 2

Dot Distribution Map and Cholera Outbreak

(6) Clearly circle on the map above the source of this outbreak. (2 points)

Circle should be at the black T in the center-right of the map.

(7) Describe the significance of the discovery of this outbreak. (3 points)

John Snow discovered the Cholera outbreak in London in 1854 and this had many important impacts in the world of epidemiology. His discovery was based upon the **dot distribution map**, which has been an extremely useful tool in modern epidemiology for **discovering the source of an outbreak**. He also discovered that Cholera was **transmitted through contaminated food or water.**

(3 points for either explanation, or another insightful explanation)

(8) Previously, this disease had a debate over the mode of transmission. Explain what this debate was and how the discovery this epidemiologist made ended this debate. (6 points)

Before the discovery of this Cholera outbreak, there was a debate on how it was transmitted. The debate was between transmitting over the **inhalation of infected air** or the **ingestion of contaminated food or water.** John Snow discovered that the source of this Cholera outbreak was **a water pump** on Broad Street that caused deaths in the adjacent area. This infected water from the water pump proved that this was how Cholera was being transmitted from to each person instead of person to person through the air. (3 points for debate, 3 points for explanation of discovery)

(9) Below is a table of various diseases, modes of transmission, and symptoms of the disease. Fill in the blank spaces. (1 point each, 23 points total) **TIEBREAKER 1**

Disease	Transmission	Symptoms	B/V/P
Colorado Tick Fever	Tick	Fever, Chills, Headache	V
Yellow Fever	Mosquito	Flu-like, liver damage, jaundice	V
Tularemia	Zoonosis (Rodens, Rabbits, Insect)	Flu, Pneumonia	B
Hepatitis C	Blood	Fever, Fatigue, Poor Appetite	V
Psittacosis (Parrot Fever)	Zoonosis (Bird bite/air)	Typhoid	B
Pertussis	Coughing	Cough	B
Diphtheria	Direct Contact/Droplet	Throat/Respiratory	B
Tetanus	Puncture Wound Colonization	Muscle spasms, Jaw stiffness	B
Kuru	Food	Spongy Degeneration in Brain	P
Anthrax	Ingestion, Handling, Airborne	Pulmonary, Gastroenteric	B
Impetigo	Direct Contact	Skin	B
Measles	Droplet	Fever, Cough, Red Eyes, Rash	V
SARS	Close Contact/Droplet	Flu-like, Shortness of Breath	V
Legionellosis	Aerosol from Infected Water	Pneumonia	B
Lyme Disease	Tick	Circular Rash, Headache, Fatigue	B

(23 points in total, 1 point for each blank. Only one symptom or mode of transmission is needed for each disease)

(10) Determine if each disease in the above table is from a Bacteria, Virus, or Prion. Write your answer for each disease in the fourth column. (15 points)

Part Five (54 points)

Bias inherently exists in all Epidemiologic studies, and it is important for scientists to identify these sources of bias

and attempt to correct them.

Below you will be given various scenarios and you will state the most specific type of bias that is present. Explain how this bias could have been prevented. (6 points each scenario, 42 points max)

(1) 500 supervisors are selected as a sample and they are questioned about the amount of work they give their employees. The survey is publicly available, with their individual responses identified. The result of the survey had the mass majority of supervisors respond that they give their employees little work.

The bias here is **nonresponse bias**. This could have been prevented by ensuring that the survey results were **private or made anonymous**, so the supervisors were not in fear of backlash from their response. (3 points for bias, 3 points for prevention)

(2) A case-control study is being performed among a group of people who ate a restaurant that likely served contaminated food. After eating at this restaurant, the people brought leftovers home. The control group selected are the family members of the sick people.

The bias here is **inclusion bias**. This could have been prevented by **selecting a better control group** that would have been less likely to be exposed. (3 points for bias, 3 points for prevention)

(3) A complete study is performed on California residents who have lung cancer. Biographical and medical information is collected as complete as possible, with 15 different categories per patient. When analyzing the data, it is decided that any patient with information missing in more than 5 categories will be thrown out of the study. About 2000 cases of 14000 ended up being thrown out.

The bias here is **missing information**. This could have been prevented by **not throwing out the cases that had missing categories**, and just including every information with as much information that each had. (3 points for bias, 3 points for prevention)

(4) A study is being performed where an interviewer is asking study participants questions about their eating habits. The morning of the study, the intended interviewer was sick and was not able to make it in, so the designer of the study decided to perform the interviews herself.

The bias here is **interviewer (information bias)**. This could have been prevented by **selecting an interviewer who had no idea what the goals of the study were.** The designer of the study has the most opportunity to incorporate bias into the study. (3 points for bias, 3 points for prevention)

(5) A study is being performed in which patients infected with Norovirus are asked about when they were exposed and what situations placed them at risk. During these interviews, the interviewer asked the patients about a specific location where they believe the Norovirus to have broken out, and many patients said they went to that location.
TIEBREAKER 7

The bias here is **recall bias**. This could have been prevented by the **interviewer not asking the leading question** about the location where the outbreak was believed to have started. (3 points for bias, 3 points for prevention)

(6) 1000 young college students are interviewed regarding their sexual health and history. One of the questions in the interview asked about their use of protection when engaging in sexual activities with partners. There ended up being an extremely high percentage of students that said they use protection, 85%, whereas the national average for college students is about 60%.

The bias here is **reporting bias**. This could have been prevented by having the students take an **online interview without an actual person asking the question**, taking away the students desire to give the "correct" answer. (3 points for bias, 3 points for prevention)

(7) A group of 45 high school students were exposed to whooping cough and contracted the disease. A group of epidemiologists came in from the CDC to investigate the outbreak and interviewed the students about their

interactions with other students in an attempt to find the source. Five researchers came in and each student went through five rounds of interviews.

The bias here is **the Panel Effect**. This could have been prevented by **reducing the number of interviews that each student went through**; this would relieve the students of the interview fatigue that several rounds of interviews can cause. (3 points for bias, 3 points for prevention)

(8) Name three ways confounding can be controlled in a study. Explain how each of these methods reduces an aspect of confounding. (12 points)

Restriction of the study group-One of the main issues with confounding is having a confounding factor distributed evenly among a study group, and this can be reduced by **maintaining the same factors in a studying group**. For example, keeping the age group the same and the gender the same.

Matching comparison groups-Instead of restriction, one could **match groups with a single confounding factor**, but similar other factors, such as age and gender. Good for controlling complex, multifaceted variables.

Randomization in clinical trials-If a **large number of subjects are allocated to treatment groups randomly**, then it is likely that these groups will have a similar distribution of age, gender, and other factors.

(2 points for each control of confounding, 2 points for each matching explanation, 12 points max)