Science Olympiad 2010
Disease Detectives

You will be presented with 3 different case studies. Please fill in the answer sheet. Non-programmable calculators are allowed. No other resources are permitted. Time allotted to event: 50 minutes.

Case #1: Infectious Disease Outbreak

On May 20, 1996, the following article appeared on the front page of the Toronto Sun:

Exotic Parasite Sickens Canadian Businessmen

By Xavier Onnasis

TORONTO – Public health officials today confirmed that three Canadian businessmen, two from Toronto and one from Ottawa, were diagnosed with cyclosporiasis, a parasitic disease seen only in tropical countries and overseas travelers. The three men, who had recently traveled to the United States, became seriously ill with diarrhea over the weekend (May 16-18). One of the men was hospitalized at Princess Margaret Hospital when he collapsed due to severe dehydration.

Dr. Richard Schabas, Ontario's Chief Medical Officer, reported that cyclosporiasis was exceedingly rare in North American and that much was still unknown about this disease. Cyclosporiasis is caused by the microorganism *Cyclospora cayetanensis*. *Cyclospora* infects the small bowel and usually causes watery diarrhea, with frequent, sometimes explosive, bowel movements. Symptoms can include bloating, increased gas, stomach cramps, nausea, loss of appetite, and profound weight loss. The illness is diagnosed by examining stool specimens in the laboratory.

Dr. Schabas declined to identify a source of infection for the three businessmen but indicated that the parasite is transmitted through contaminated food or water but not by direct person-to-person spread. The time between exposure to the parasite and becoming sick is usually about 7 days.

Dr. Schabas reported that all three men had attended a meeting in Texas on May 9-10. He said Ontario Health Department staff would be investigating leads locally and in Texas.

Additional information about Cyclospora:
Cyclospora is spread by ingesting something that has been contaminated with stool containing the parasite (i.e., the **fecal-oral route**). Cyclospora **needs time** (days or weeks), however, after being passed in a bowel movement **to become infectious**. (The parasite, which is passed in the stool as an "oocyst," must change forms and "sporulate" to become infectious.). As a result, food or water contaminated with unsporulated oocysts shortly before consumption should not cause infection. In addition, exposure of the parasite to temperatures less than –20°C for 24 hours or above 60°C for 1 hour inactivates the oocysts. No documented outbreaks have been associated with cooked or commercially frozen foods.

Additional information about this outbreak investigation:
The chief medical officer of the Ontario Health Department notified the Texas Department of Health (TDH) about the *Cyclospora* infections in the three Canadian businessmen. The businessmen had attended a meeting at a private club in Houston, Texas on May 9-10.

A total of 28 people had attended the Houston business meeting. Participants came from three U.S. states and Canada. Meals served during the meeting were prepared at the restaurant operated by the private club. Rumors among restaurant staff suggested that other attendees at the meeting had also become ill.

TDH, the Houston Health & Human Services Department, and the Centers of Disease Control and Prevention (CDC) initiated an epidemiologic investigation to identify the source of the cyclosporiasis outbreak.

Information collected during the epidemiologic investigation:
Of the 27 meeting attendees who were interviewed, 16 (59%) met the case definition for cyclosporiasis. Onsets of illness occurred from May 14 through May 19.

Patient #	Date of onset of illness
1	5/14
2	5/15
3	5/15
4	5/16
5	5/16
6	5/16
7	5/16
8	5/16
9	5/16
10	5/16
11	5/16
12	5/17
13	5/17
14	5/17
15	5/18
16	5/19

Investigators questioned both ill and well meeting attendees about travel history and food and water exposures during the meeting.

Twenty-four meeting attendees provided information on foods eaten during the meeting. (Four attendees, including three cases, did not provide the information.) Investigators examined the occurrence of illness among people who ate different food items.

Twelve (92%) of 13 attendees who ate the berry dessert became ill. Only one (9%) of 11 attendees who did not eat the berry dessert became ill. The relative risk for eating berries was 10.2 (p-value <0.0001). No other exposures were associated with illness.

Case #2 Environmental Risks to Health

Leading poisoning is the most common heavy metal poisoning caused by environmental factors (see box 1). "Cottage" industries in developing countries frequently involve some aspect of lead exposure (battery recycling, type-printing, cutlery tempering, pottery). These industries are frequently home-based, exposing household members to lead contamination. A high prevalence of elevated blood lead levels has been previously reported among workers in small backyard battery repair workshops.

An important question is whether such home-based work with lead causes lead poisoning to members of the household where battery repair occurs; to neighbours living close to the repair shops; or to family members of workers who are employed in these operations but who live in homes some distance away from the sites of battery repair.

According to lead surveillance information kept by the Ministry of Health, 19 of 22 children recently hospitalised for lead poisoning at the main hospital in your region lived near battery repair shops. Knowing that there are approximately 50 shops involved in the same activity throughout your health district, you decide to investigate lead exposures in household members.

Box 1

Essential Facts on Lead Poisoning

Sources:	air	• motor vehicle exhaust/leaded gasoline • industrial sources; • smelters, lead manufacturing industries
	water	• lead - soldered water pipes
	food/ingestion	• use of lead glazed cookware • ingestion of lead paint, herbal remedies
Health effects:		• nervous system acute encephalopathy intellectual deficits in children damage to nerves in arms and legs • kidney disease • anemia • reproductive disorders
Biological monitoring		• Blood lead • Blood zinc protoporphoryin (ZPP) measures haemoglobin synthesis by-product • Bone lead - research method

In this investigation, 24 "exposed households" were surveyed. There were three categories: all households located near a BBRS, who had at least one family member employed in the BBRS (n=5); all households located near a BBRS, but had no household members employed at the BBRS (n=12); and 7 of 12 households not located near BBRS, but with at least one family member employed at a BBRS.

For each address where an exposed household was located, one control household ("unexposed household") was selected as the first household identified on the same street (moving in a randomly selected direction from the exposed address) that met the following criteria: (1) it was at least 50 metres from the exposed address; (2) a responsible adult was at home and agreed to participate; and (3) if the exposed household had a child six months to six years of age, the control household had a child in the same age group.

For both "exposed" and "non-exposed" households, venous blood samples were obtained from available household members over the age of six months.

Results are described on the next page. "BBRS/worker" refers to the group living near a BBRS with a person working at the BBRS living in the home. "BBRS" refers to people living near a BBRS but not having a worker in the home. "Worker" refers to the group living away from a BBRS and having a person who works at a BBRS living in the home. "Control" refers to people living away from a BBRS and not having a person who works at a BBRS living in the home. Controls lived in the same block as those in the "worker" group.

Figure 1. Distribution of Blood Lead Levels in Children 11 years and Under, According to Type of Household

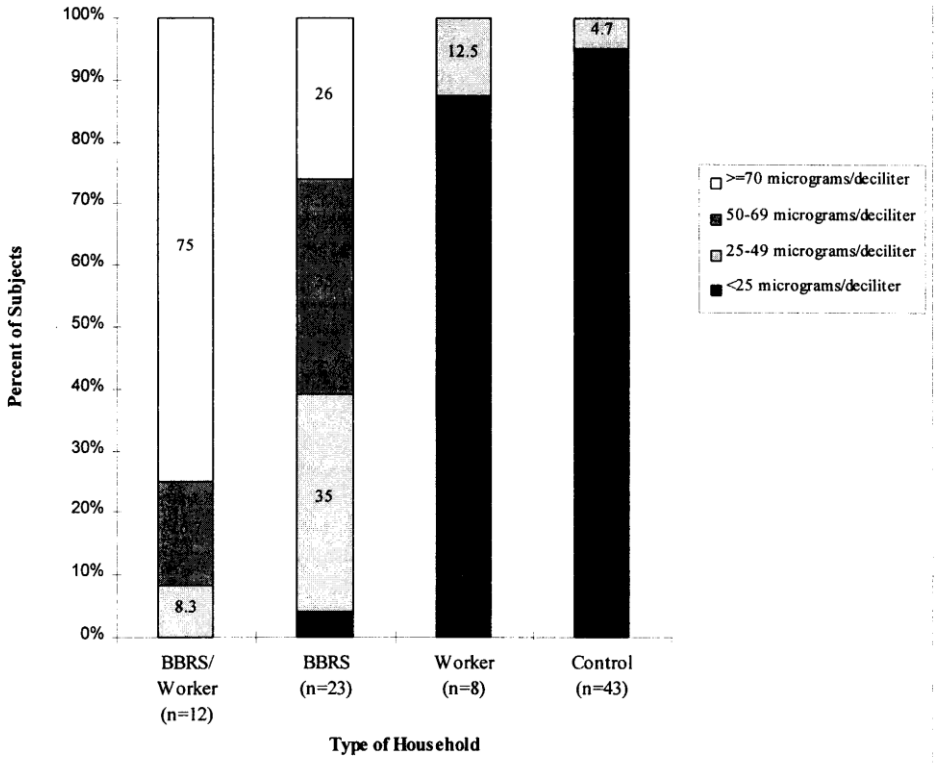
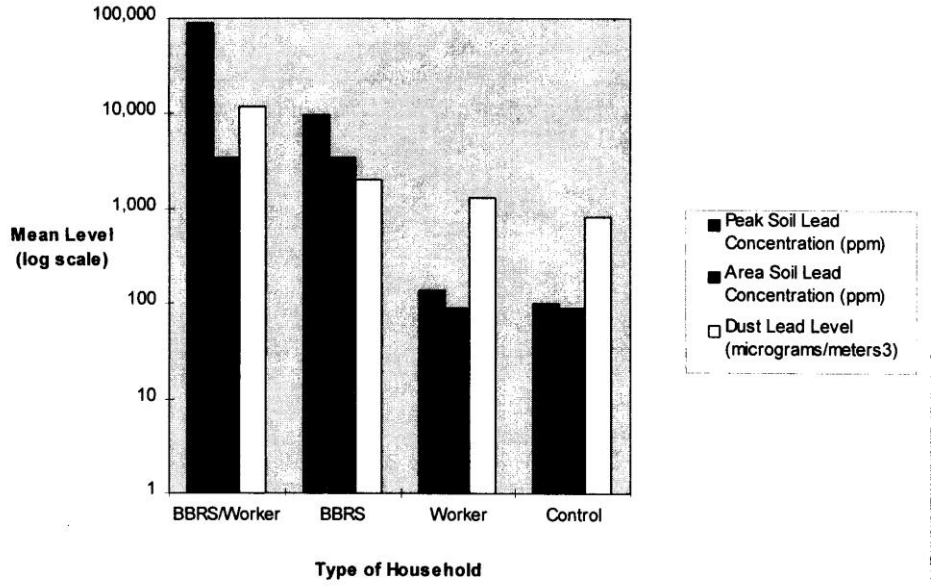


Figure 2. Soil and Dust Lead concentrations (Geometric Means) by Type of Household



Based on a report by **Matte, T.A.** et al. Lead poisoning among household members exposed to lead-acid battery repair shops in Kingston, Jamaica. *International journal of epidemiology*, 1989, **18**(4): 874-881.

The case is modified from a case prepared by Nancy V. Hicks, PhD and revised by Steven Markowitz, MD, 1991; revised 1997.

Case #3 – Nutrition challenges in a resource-limited world

As the world's population increases, adequate nutrition for all will become an even greater challenge than it is today. Today, nutritional challenges are common in some areas of the world, and are of great concern in refugee settlements such as the Bhutanese settlements in Nepal. The World Food Program of Nepal reported recently on the nutritional status of children in these refugee camps. Note the information in the table on malnutrition and micronutrient deficiencies.

TABLE. Number and percentage of Bhutanese refugee children aged 6–59 months with malnutrition or micronutrient deficiencies, by age group — Nepal, 2007

	Age group (mos)						Total		
	6–11		12–23		24–59				
Malnutrition/Deficiency	No. (n = 52)	(%)	No. (n = 117)	(%)	No. (n = 328)	(%)	No. (N = 497)	(%)	(95% CI*)
Acute malnutrition (wt for ht z-score)†	1	(1.9)	7	(6.0)	13	(3.9)	21	(4.2)	(2.8–6.4)
Severe§	*0*	*(0)*	*0*	*(0)*	*1*	*(0.3)*	*1*	*(0.2)*	*(0.0–1.1)*
Chronic malnutrition (ht for age z-score)¶	5	(9.6)	27	(23.1)	102	(31.1)	134	(26.9)	(23.2–31.0)
*Severe***	*0*	*(0)*	*5*	*(4.3)*	*16*	*(4.9)*	*21*	*(4.2)*	*(2.8–6.4)*
Underweight (wt for age z-score)¶	4	(7.7)	25	(21.4)	96	(29.3)	125	(25.1)	(21.5–29.1)
*Severe***	*3*	*(5.8)*	*3*	*(2.6)*	*18*	*(5.5)*	*24*	*(4.8)*	*(3.3–7.1)*
Anemia	41	(78.8)	80	(68.4)	94	(28.7)	215	(43.3)	(39.0–47.7)
Angular stomatitis	1	(1.0)	4	(3.4)	51	(15.5)	56	(11.3)	(8.8–14.3)
Diarrhea	27	(51.9)	54	(46.2)	68	(20.7)	149	(30.0)	(26.2–34.2)
Acute respiratory illness	23	(44.2)	45	(38.5)	75	(22.9)	143	(28.8)	(25.0–32.9)

* Confidence interval.
† Defined as a z-score <-2.0 standard deviations from the reference median or presence of edema. (World Health Organization Expert Committee on Physical Status. Physical status: the use and interpretation of anthropometry. World Health Organ Tech Rep Ser 1995;854).
§ Defined as a z-score <-3.0 standard deviations from the reference median or presence of edema.
¶ Defined as a z-score <-2.0 standard deviations from the reference median.
** Defined as a z-score <-3.0 standard deviations from the reference median.

Exploring the World of Science

Disease Detectives

2010 Science Olympiad
UW-Oshkosh Regional Tournament
March 6, 2010
Division C

Team #_____
School: _____
Student 1 Name: _____
Student 2 Name: _____

Hosted by Science Outreach

Disease Detectives Regional 2010 – Division C Exam

Directions: Read the following scenarios and answer the questions that follow. Questions are matching, multiple choice, or short answer. The number in parenthesis indicates the point value for each question.

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1. Match the following terms on the left with the definitions on the right. Each term will have only one answer. (15)

A. Relative risk	**n**	a) An animate, living insect or animal that is involved with transmission of the disease agent.
B. Attack rate	**g**	b) Disease or infectious agent that is habitually present in a community, geographic area, or population group.
C. Odds ratio	**j**	c) More cases of a particular disease than expected in a given area or among a specialized group of people over a particular period of time.
D. Line list	**h**	d) Occurrence of a disease clearly in excess of normal expectancy.
E. Epidemic curve	**l**	e) An inanimate object that is laden with disease-causing agents.
F. Vector	**a**	f) Study that follows a group of subjects who received a specific exposure in order to examine the differences in incidence of a specific disease or other outcome of interest.
G. Fomite	**e**	g) The rate that a group experienced an outcome or illness.
H. Cohort	**f**	h) Chart of information about each case.
I. Case-control	**m**	i) An epidemic that spans a wide geographic area.
J. Endemic	**b**	j) Measure of association between frequency of exposure and frequency of outcome (formula is AD/BC).
K. Outbreak	**c**	k) Occurrence of an illness or illnesses in a population.
L. Epidemic	**d**	l) A histogram showing the course of a disease or outbreak.
M. Pandemic	**i**	m) Study that compares individuals who have a disease with individuals who do not have the disease in order to examine differences in exposures or risk factors for the disease
N. Mortality	**o**	n) Ratio of the risk of disease or death among the exposed to the risk among the unexposed.
O. Morbidity	**k**	o) Occurrence of death in a population.

2. In 1965, 400 soldiers were exposed to radiation from a bomb explosion. A total of 50 solders were 25 yards away, 100 solders were 1000 yards away, 200 solders were 2000 yards away, and 75 soldiers were 5000 yards away when the bomb exploded. A disease detective wants to determine the effect of this radiation exposure and these soldiers developing cancer. What data analysis would you perform? (1)
   a. Odds ratio
   b. Attack rate
   c. Relative risk
   d. Risk ratio
   e. Incidence rate

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A disease detective is examining the relationship between consuming alcohol within 2 hours of driving a car and having a car accident.

3. Complete Table 1 using the following data from the study. Of the people in this study, a total of 150 people did not drink and were not involved in a car accident. 40 people did consume alcohol, but did not get into a car accident. 80 people drank alcohol and got into a car accident, and 90 people did not consume alcohol, but did get into a car accident. Note, all shaded boxes must be completed for full credit. (9)

Table 1: Car accident and alcohol consumption.

		Car Accident: YES	Car Accident: NO	
Drinking Alcohol	YES	**80**	**40**	**120**
	NO	**90**	**150**	**240**
		170	**190**	**360**

4. Which of the following type of study would you conduct to examine this relationship? (1)
   - **a. Case control**
   - b. Cohort
   - c. Ecologic
   - d. Quasi-experimental
   - e. Cross-sectional

5. Using the data in Table 1, calculate the measure of association for consumption of alcohol within 2 hours of driving a car and having an accident. (2)

_____ **OR = (80*150)/(40*90) = 3.3**

On the morning of Thursday, March 4th, the local hospital emergency room reports that several patients were seen in the emergency room with gastroenteritis. All the patients attended a birthday party (held Tuesday, March 2nd) hosted by a mutual friend at their home. A total of 55 guests attended the birthday party dinner; however only 35 guests became sick. Dates of onset in these cases ranged from March 3rd to March 5th. Onset of illness in all cases was characterized chiefly by abdominal pain and nausea. Some patients experienced diarrhea and/or vomiting. At least one ill person reported a fever >99.5º (37.5ºC).

6. Is this an outbreak? (1)
   - a. Yes, because the guests are all related and only 35 reported symptoms.
   - **b. Yes, because the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food constitutes an outbreak.**
   - c. Yes, because the guests experienced different symptoms.
   - d. No, because the guests are all related.
   - e. No, because the guests experienced different symptoms.

7. Assuming that exposure took place during the birthday party held at 5pm on March 2nd, give the range of incubation periods for these 35 cases. (3)
   - a. Shortest Incubation Period_____ **March 2nd-March 3rd = <1 day**
   - b. Longest Incubation Period_____ **March 2nd – March 5th = 3 days**
   - c. Incubation Range_____ **Less than 1 day to 3 days**

8. What are the components that make a good case definition? (1)
   - a. Person, place and time
   - b. Clinical criteria, place, and time
   - c. Identifying information, clinical criteria, time, person, place, and risk factors
   - **d. Clinical criteria, person, place, and time**
   - e. Person, place, time, and possible cause

A local catering company catered the birthday party, however guests did bring the cut fruit tray and the cake. The various foods consumed at the dinner party appear in Table 2.

9. In Table 2, complete the shaded squares. Each square is worth 0.5 points. (15)

Table 2: Food consumption information of guests from the birthday dinner party held March 2nd.

Food / Drinks	Persons who ATE Foods				Persons who did NOT eat foods				Odds Ratio
	Ill	Well	Total	% Ill	Ill	Well	Total	% Ill	
Hot turkey	12	6	18	**67**	3	14	17	**18**	**9.3**
Hot beef	7	9	16	**44**	8	11	19	42	**1.1**
Buns	13	12	25	**52**	2	8	10	**20**	**4.3**
Veggies	9	9	18	**50**	6	11	17	**35**	**1.8**
Dips	8	7	15	53	7	13	20	**35**	**2.1**
Baked beans	6	8	14	**43**	9	12	21	**43**	**1**
Chips	11	10	21	**52**	4	10	14	**29**	**2.8**
Pickles	8	6	14	**57**	7	14	21	**33**	**2.7**
Cut fruits	11	7	18	**61**	4	13	17	**24**	**5**
Tuna noodle salad	7	4	11	**64**	8	16	24	**33**	3.5
Cake	8	16	14	**57**	7	14	21	**33**	**2.7**

10. Refer to Table 2. What food is most likely the source of the illness experienced? (1)
    - **a. Hot turkey**
    - b. Tuna noodle salad
    - c. Cut fruits
    - d. Cake
    - e. Hot beef

11. Refer to Table 2. Which of the following food items had the greatest percentage of people getting sick? (1)
    - a. Chips
    - b. Pickles
    - c. Dips
    - d. Hot beef
    - **e. Cake**

12. Stool specimen from ill birthday party attendees were submitted to the state lab. Four specimen tested positive for Norovirus and negative for enteric bacteria. The stool specimen from the catering food worker was negative for both Norovirus and enteric bacteria. What intervention measure would you suggest? (1)
    - a. Wear gloves only when handling raw meat
    - b. Never wear gloves
    - **c. Use good personal hygiene during food preparations**
    - d. Use the same cutting board and knife for raw meats and vegetables
    - e. Thaw raw meat on the counter at room temperature

13. Match the following infectious diseases with the causative type of biological agent. Each disease will have only one answer, but some answers may be used more than once, while other answers may not be used at all. (8)

A. Cryptosporidiosis	**d**	a)	Bacteria
B. Encephalitis	**f**	b)	Viruses
C. Schistosomiasis	**e**	c)	Fungi
D. Strep throat	**a**	d)	Protozoa
E. Ringworm	**c**	e)	Helminths
F. Amebiasis	**d**	f)	Arthropods
G. Candidiasis	**c**		
H. Salmonellosis	**a**		

Table 3: Mortality by Selected Age Groups, Males and Females, United States, 2003.

Age	Males		Females		Total	
	Population	# Deaths	Population	# Deaths	Population	# Deaths
15-19	10,518,680	9,706	9,959,789	3,889	20,478,469	13,595
20-24	10,663,992	14,964	10,063,772	5,009	20,727,694	19,973
25-34	29,222,486	28,602	19,650,112	12,698	39,872,598	41,300

14. Using Table 3, calculate the age-specific death rates: (3)

a. 15-19 age group **13,595/20,478,469 x 100,000 = 66.39**

b. 20-24 age group **19,973/20,727,694 x 100,000 = 96.4**

c. 25-34 age group **41,300/39,872,598 x 100,000 = 103.6**

2. Using Table 3, calculate age and sex specific death rates: (6)

a. Males aged 15-19 **9,706/10,518,680 x 100,000 = 92.27**

b. Males aged 20-24 **14,964/10,663,992 x 100,000 = 140.3**

c. Males aged 25-34 **28,602/29,222,486 x 100,000 = 141.4**

d. Females aged 15-19 **3,889/9,959,789 x 100,000 = 39.05**

e. Females aged 20-24 **5,009/10,063,772 x 100,000 = 49.8**

f. Females aged 25-34 **12,698/19,650,112 x 100,000 = 64.6**

15. What can you infer from the age-specific death rates (calculated above)? (1)

a. Death rates decrease with age
b. Death rates increase with age
c. Death rates are based on population
d. Death rates are affected by smoking not age.
e. Death rates are not associated with age

16. For which gender group is the death rate highest? (1)

a. Male
b. Female
c. Male and Female are equal

17. Table 3 lists the 10 leading causes of death in 2007 and the leading causes of death in 1900. In 1900, chronic lower respiratory diseases, diabetes, Alzheimer's disease, and septicemia were not among the 10 leading causes of death. How do you account for these changes? (1)
    a. Chronic conditions have replaced acute infectious diseases
    b. Aging of the general population
    c. Changes in the fatal course of a disease
    d. A and B
    e. B and C

Table 3: Leading causes of death and rates for those causes in 2007 and 1900, United States.

Cause of Death	Rate per 100,000 Population	
	2007	1900
All Diseases	803.7	1,719.1
Disease of the heart	204.1	137.4
Malignant neoplasms	185.7	64.0
Cerebrovascular diseases	44.4	106.9
Chronic lower respiratory diseases	42.9	Not in top 10
Accidents	38.8	72.3
Alzheimer's disease	24.8	Not in top 10
Diabetes mellitus	23.5	Not in top 10
Influenza and pneumonia	17.5	202.2
Nephritis	15.3	81.0
Septicemia	11.6	Not in top 10

18. Among the 10 leading causes of death in 1900 were: influenza and pneumonia (202.2 per 100,000 – Rank 1), tuberculosis (194.4 per 100,000 – Rank 2), gastroenteritis (142.7 per 100,000 – Rank 3), and Diptheria (40.3 per 100,000 – Rank 10). (This data is not provided in Table 3). With the exception of influenza and pneumonia, these are no longer among the 10 leading causes of death. What is an explanation for this trend? (1)
    a. More food and water contamination events
    b. Preventative and curative practices
    c. Aging population
    d. Increased exposure to sunlight
    e. Increased number of hospitals

19. The population of Metroville was 3,187,463 on June 30, 2008. During the period January 1 through December 31, 2008, a total of 4,367 city residents were infected with HIV. During the same year, 768 new cases of HIV were reported, and 67 residents died as a result of HIV/AIDS. What is the prevalence per 100,000 population? (1)
    a. 2.1 per 100,000 population
    b. 5.7 per 100,000 population
    c. 24.1 per 100,000 population
    d. 137.0 per 100,000 population
    e. 161.1 per 100,000 population

20. Using the information in the previous question, what is the incidence per 100,000 population? (1)
    a. 2.1 per 100,000 population
    b. 5.7 per 100,000 population
    c. 24.1 per 100,000 population
    d. 137.0 per 100,000 population
    e. 161.1 per 100,000 population

21. Match the following infectious diseases with the causative type of biological agent. Each disease will have only one answer, but some answers may be used more than once, while other answers may not be used at all. (7)

A. Cryptosporidiosis	**d**	a)	Bacteria
B. Encephalitis	**f**	b)	Viruses
C. Schistosomiasis	**e**	c)	Fungi
D. Strep throat	**a**	d)	Protozoa
E. Ringworm	**c**	e)	Helminths
F. Amebiasis	**d**	f)	Arthropods
G. Candidiasis	**c**		

Page Total _____

Lead is a common, potent, pervasive, environmental contaminant. Exposure to lead is a preventable risk in all areas of the United States. Lead exposure has been associated with decreased cognitive function, developmental delays, and behavior problems in children. The Centers for Disease Control and Prevention (CDC), has established a blood lead level (BLL) of 10 micrograms per deciliter *(µ*g/dL) as the threshold for action (further testing and monitoring, and removal of lead source). Lead toxicity has been well-established, with evidence of harmful effects found in children whose blood lead levels exceed 10 *µ*g/dL. A recent study suggested that a child is estimated to lose 2 IQ points for each 10 µg/dL increase in blood lead level.

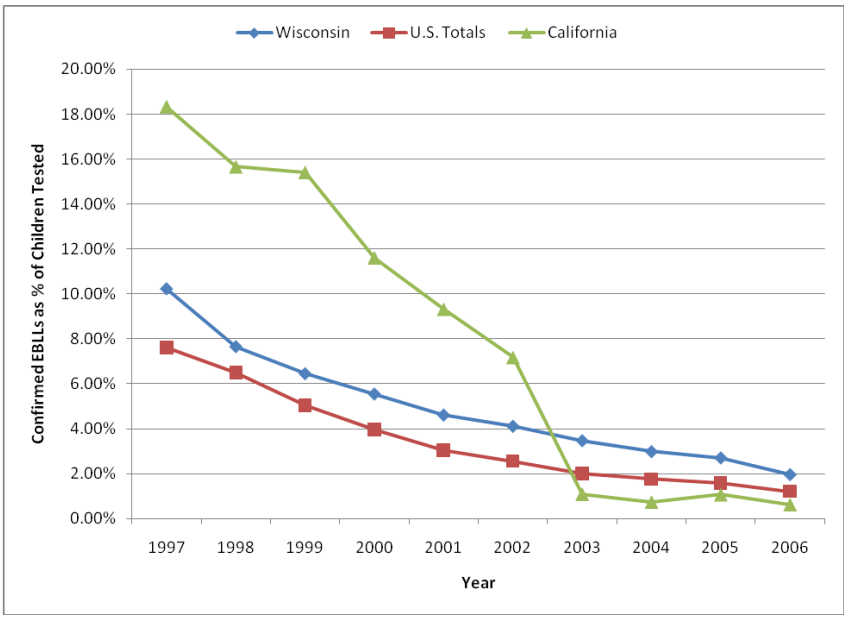

Figure 2: Data from the CDC indicate substantial yearly decreases in the percentage of children tested in the US with EBLLs

Eliminating elevated blood lead levels (EBLLs) among children is one of the 2010 US National health objectives. Data from the CDC indicate substantial yearly decreases in the percentage of children tested in the US with EBLLs is shown in Figure 2.

22. Which of the following is/are commonly associated with childhood lead poisoning? (1)
    a. Newer housing
    b. Lead based paints
    c. Access to medical care
    d. All of the above
    e. None of the above

23. Lead has been found in which of the following? (1)
    a. Toys
    b. Pottery (homemade) pots and dishes
    c. Candy wrappers
    d. A and C only
    e. A, B and C

24. In Figure 2, the percentage of children tested in the US with EBLLs has decreased over the past 10 years. To what may this decrease be attributed to? (1)
    a. Increased screening and testing of at risk children
    b. Increased use of lead based paints in homes
    c. Increased access to health care
    d. Increased use of lead in candy wrappers
    e. Increased screening of children from other countries

25. In Figure 2, the 1997 percentage of children tested with EBLLs in California was much higher than the percentage of children in Wisconsin. A possible explanation for this is that: (1)
    a. California is more populated than Wisconsin
    b. California has a larger geographic area than Wisconsin
    c. California tested more children than Wisconsin
    d. California has a greater number of pre-1950 housing units than Wisconsin does
    e. California does not collect a blood sample by the capillary method, but Wisconsin does

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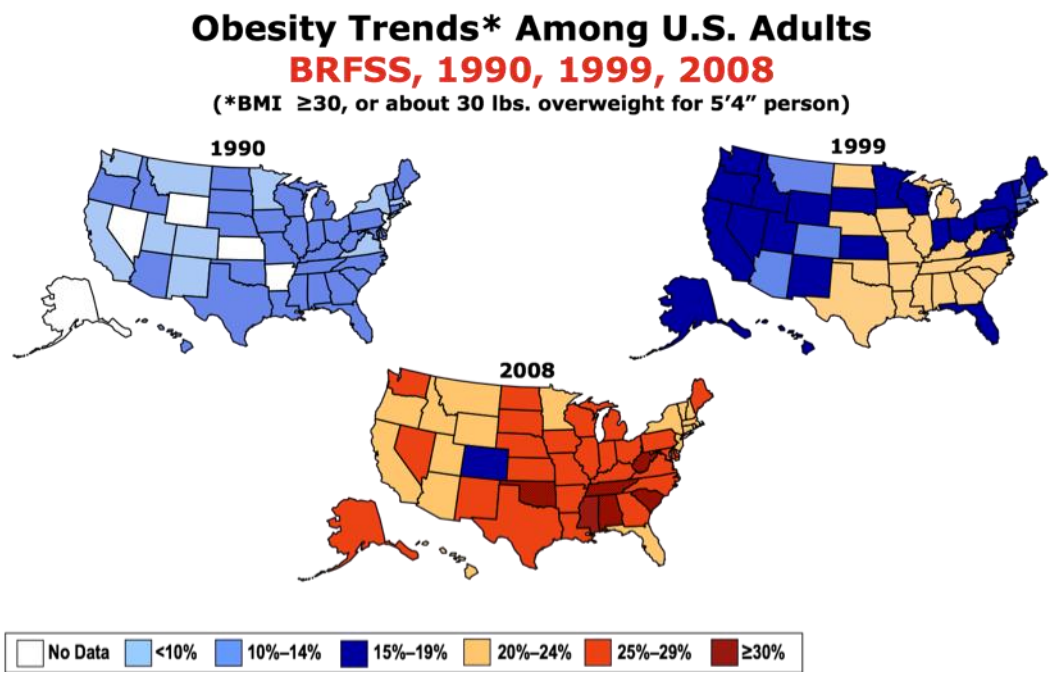
Obesity is defined as a body mass index (BMI) of 30 or greater. BMI is calculated from a person's weight and height and provides a reasonable indicator of body fatness and weight categories that may lead to health problems. Obesity is a major risk factor for cardiovascular disease, certain types of cancer, and type 2 diabetes. During the past 20 years there has been a dramatic increase in obesity in the United States. The following questions are based on the data shown in Figure 3.

Figure 3: Obesity trends among US adults 1990, 1999, and 2008. The data shown below were collected through the CDC's Behavioral Risk Factor Surveillance System (BRFSS).



26. In 1990, ten states had a prevalence of obesity less than 10%. Five of these states were: (5)

a. _____**Washington, New Mexico**
b. _____**California, Minnesota**
c. _____**Montana, New York**
d. _____**Utah, Virginia**
e. _____**Colorado, Massachusetts**

27. In 1999, there were three states with a prevalence of obesity less than 15%. They were: (3)

a. _____**Montana**
b. _____**Colorado**
c. _____**Arizona**

28. In 2008, six states had a prevalence of obesity equal to or greater than 30%. They were: (6)

a. _____**Alabama**
b. _____**Mississippi**
c. _____**Oklahoma**
d. _____**South Carolina**
e. _____**Tennessee**
f. _____**West Virginia**

Page Total _____