# Forensic Toxicology

***Course***
*Forensic Science*

***Unit XI***
*Forensic Toxicology*

***Essential Question***
*What is a toxic substance?*

***TEKS***
*§130.295(c)*
*(1)(A)(B)*
*(2)(F)(G)(H)*
*(3)(A)(D)(E)(F)*
*(6)(A)(B)(C)(D)*
*(10)(A)(B)(C)(D)*

***Prior Student Learning***
- *Difference between physical and chemical properties*
- *Characteristics of acids and bases*

***Estimated Time***
*3½ hours total*
- *2¼ hour lecture*
- *45 min. Chromatography Lab*
- *30 min. Assessment*

**Rationale**
The role of a forensic toxicologist is extremely important in our society due to the rampant use of drugs, including alcohol. Toxicologists must detect and identify drugs, and even poisons, that are present in bodily fluids, tissues, and organs. Although forensic toxicologists are limited to matters that pertain to violations of criminal law, they may find themselves working in a wide variety of areas such as crime labs, medical examiners' offices, and hospital labs.

**Objectives**
The student will be able to:
1. Analyze physical and chemical properties of evidence collected from a crime scene.
2. Identify and explore toxicology lab procedures, such as blood alcohol concentrations.

**Engage**
Do an Internet search for the following article: Coroner Attributes Michael Jackson's Death to Propofol by Ashley Surdin. Use article and the following questions for a class discussion. Use the Discussion Rubric for assessment.
- At age 50, the news of the drug-related death of Michael Jackson rocked the world. Is Dr. Conrad Murray responsible?
- Does the demise of a superstar lie in the hands of his doctor?
- What did the toxicologist(s) find?

**Key Points**
I. Role of Forensic Toxicology
   A. Toxicology is the study of drugs and poisons, and their interactions and effects on the body
   B. A drug is a natural or synthetic substance that is used to produce physiological or psychological effects
   C. Forensic Toxicology is the application of toxicology to the law, including
      1. Workplace or forensic drug testing
      2. Postmortem toxicology
      3. Human performance testing

II. Toxicology of Alcohol
   A. Approximately 40% of traffic deaths in the U.S. are alcohol-related (Flinn, 2012)
   B. Toxicologists have had to develop specific procedures for measuring degrees of alcohol intoxication
   C. Methods for diagnosis must be defendable within the framework of the legal system
   D. Metabolism involves the body's ability to break down chemicals.

There are three steps:

1. Absorption
    a) Alcohol appears in the blood minutes after consumption
    b) Alcohol slowly enters the body's bloodstream and is carried to all parts of the body
2. Distribution
    a) When absorption is complete, alcohol becomes distributed uniformly throughout the "watery" parts of the body
    b) Factors affecting absorption and distribution are
        (1) Speed of consumption
        (2) Percentage of alcohol content
        (3) Quantity of alcohol consumed
        (4) Quantity and type of food present in the stomach
3. Elimination
    a) The body begins to eliminate alcohol as it is circulated through the bloodstream
    b) There are two mechanisms for elimination
        (1) Oxidation, which occurs in the liver
        (2) Excretion through breath, urine, and perspiration

E. To determine blood alcohol level, analyzing brain tissue would be best. However, brain tissue is not available from a living individual, so blood alcohol concentrations are used. Blood and brain concentrations are directly proportional
F. Measuring the quantity of alcohol consumed can be done by analyzing either blood or breath
G. Testing for Intoxication
    1. Breath testing
        a) The most widespread method
        b) The Breathalyzer measures alcohol content in alveolar breath (deep within the lungs)
        c) It requires no less than 1.1 to 1.5 liters of breath to ensure that "deep-lung" breath is measured
        d) For accuracy, avoid "mouth alcohol" such as from belching, regurgitation, or recent mouthwash
    2. Field Sobriety
        a) The preliminary test performed to ascertain the degree of a suspect's physical impairment, and whether further tests are justified
        b) Psychophysical tests
            (1) Horizontal-gaze nystagmus
            (2) Walk and turn
            (3) One-leg stand
        c) Preliminary Breath Test
            (1) A handheld breath tester that uses a fuel cell to measure alcohol content
            (2) Should establish probable cause for requiring more

thorough breath or blood tests

H. Blood Analysis
    1. Calculated with a high degree of accuracy by use of gas chromatography which separates alcohol from any other chemicals
    2. Collection and preservation of blood
        a) Before the penetration of the needle, the area must be cleaned with a non-alcoholic disinfectant
        b) Refrigerate the blood until it is delivered to the lab
        c) Effects on collected blood
            (1) Storage temperature
            (2) Presence of a preservative, such as sodium fluoride
            (3) Amount of time in storage
        d) Postmortem blood should be collected from a variety of bodily sites, if it is available at all

I. Blood Alcohol Laws (Morgan, 2012)
    1. The Department of Transportation recommends that states adopt .08% blood alcohol concentration as the legal measure for drunk driving
    2. This percentage has been adopted by all 50 states
    3. .08% only applies to noncommercial drivers; for commercial drivers it is .04%
    4. An implied consent law is used to prevent a person from refusing to take a blood or breath test based on self-incrimination rights

III. Role of the Toxicologist
    A. Studies bodily fluid, tissue, and organs for drugs and/or poisons
    B. May conduct postmortem pathological examination, or examination of personal effects and empty containers, etc.
    C. May have extremely minute quantities to test
    D. Must detect, identify, quantify, and assess the toxicity

IV. Collecting and Preserving Toxicological Evidence
    A. When possible, collect both blood and urine
        1. Collect two voids (samples) of urine in separate specimen containers
        2. Collect a sample of blood if a physician or registered nurse (RN) is available (the amount depends upon the type of test to be conducted)

V. Techniques in Toxicology
    A. Drugs are chemicals that are categorized as either acids or bases
        1. An acid is a compound that donates hydrogen ions
        2. A base is a compound that accepts hydrogen ions
        3. The pH scale measures the strength of acids and bases
            a) The scale measures from 0 – 14

b) 7 is neutral; the farther the number is away from 7, the stronger the acid or base
c) Acids are below 7, and bases are above 7

B. Screening Tests
1. **Thin Layer Chromatography** (TLC)
a) Separates out molecules that move up a thin coated plate
b) This test has both a solid and a liquid phase
c) The distance each component travels is based on the characteristics of that substance
d) It is then compared to known samples
2. **Gas chromatography** uses the same process as TLC except it has a moving liquid and a moving gas phase
3. **Immunoassay** is based upon specific drug-antibody reactions; this is the best method for detecting low drug levels

C. Confirmation Test
1. Gas chromatography/mass spectrometry
a) The gas chromatography is completed first
b) Each separated component then enters the mass spectrometer, where the sample is broken into fragments for identification

D. Detecting Drugs in Hair
1. Drugs remain in the
a) Bloodstream up to 24 hours
b) Urine up to 72 hours
2. Drugs can become permanently entrapped in a hair's hardening protein
3. As hair grows, the drug's location on the hair shaft becomes a marker for the time of drug intake
4. Some drugs may enter a hair's surface from environmental exposure or sweat. This can cause a problem with the accuracy of the test

E. Detecting Non-Drug Poisons
1. Heavy metals, such as arsenic and mercury, may be detected
2. Carbon monoxide is one of the most commonly encountered poisons

F. Significance of Toxicological Findings – once a drug is identified, the toxicologist must assess its influence on the behavior of the individual

**Activities**

1. Chromatography Lab. Have students visualize the process of thin layer chromatography with markers, and calculate Rf values by completing the Chromatography Lab. Use the Chromatography Lab Key and the Individual Work Rubric for assessment.

*Notes: materials for this lab are for a single group. The number of groups and students per group is to be determined by the instructor.*

*This lab can easily be extended into a forensic mystery activity. To do that, use one of the markers to create enough strips for each group. Label one of the markers "Crime Scene." Distribute one strip to each lab group at the beginning of the lab. Upon completion of their lab, they will compare the crime scene strip to the ones that they tested.*

2. Blood Alcohol Determination. Have students work individually to complete this worksheet. Use the Blood Alcohol Determination Worksheet for the activity and the Blood Alcohol Determination Worksheet Key for assessment.

**Assessments**
Forensic Toxicology Exam and Key
Chromatography Lab Key
Blood Alcohol Determination Worksheet Key
Discussion Rubric
Individual Work Rubric
Writing Rubric

**Materials**
Forensic Toxicology computer-based presentation
*Chromatography Lab*
- Chromatography Lab handout
- 3 different brands of black marker or pen
- Coffee filters or chromatography paper
- Pencil
- Tape
- Water or acetone
- 1 beaker (200-500 ml)
- Ruler
- Goggles
- Gloves
- Calculator

Blood Alcohol Determination Worksheet

**Resources**
Saferstein, Richard. *Forensic Science: An Introduction.* New Jersey: Pearson Prentice Hall, 2008
Saferstein, Richard. *Forensic Science: An Introduction.* 2nd ed. New Jersey: Pearson Prentice Hall, 2011
Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science.* 8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004
http://en.wikipedia.org/wiki/Entomotoxicology
http://www.brad21.org/bac_charts.html
Do an Internet search for the following:

- Coroner Attributes Michael Jackson's Death to Propofol by Ashley Surdin
- Statistics on Alcohol Related Deaths by Mary Flinn
- Alcohol and Driving Laws by Lee Morgan
- drunkdrivingdefense general bac

**Accommodations for Learning Differences**
For reinforcement, students will compare a specific dosage given to an adult with the same does given to a child. *(Note: all chemicals, natural or man-made, are considered toxic. Paracelsus, considered to be the Father of Modern Toxicology, once said, "The dose makes the poison.")*

Fill a 200ml beaker with water, which will represent the "adult." Next fill a 100ml beaker with water to represent a "child." Add 2 drops of a food coloring to each beaker to represent a chemical substance. Stir each beaker.

Have the students discuss how, although the beakers have the same "dosage," the child's appears to be much more concentrated. This proves an adult dosage can be devastating to a child. Have students hypothesize in a journal entry. Use the Discussion Rubric and/or the Writing Rubric for assessment.

For enrichment, students will compare the relationship of Toxicology and Entomology by reading the following article:
http://en.wikipedia.org/wiki/Entomotoxicology.
After reading, students should write key points about how the toxicology of a decedent can greatly affect the post mortem interval by influencing the life cycles and activities of certain insects. Use the Individual Work Rubric for assessment.

**State Education Standards**
Texas Essential Knowledge and Skills for Career and Technical Education
§130.295. Forensic Science (One Credit).

(1) The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:
  (A) demonstrate safe practices during laboratory and field investigations; and
  (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) The student uses scientific methods and equipment during

laboratory and field investigations. The student is expected to:

(F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, meter sticks, and models, diagrams, or samples of biological specimens or structures;

(G) analyze, evaluate, make inferences, and predict trends from data; and

(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(D) evaluate the impact of scientific research on society and the environment;

(E) evaluate models according to their limitations in representing biological objects or events; and

(F) research and describe the history of science and contributions of scientists.

(6) The student analyzes the evidence collected from a crime scene using scientific methods. The student is expected to:

(A) demonstrate conversions of measurements between English and International System (SI) of units;

(B) distinguish between physical and chemical properties of matter using the periodic table;

(C) determine the elements within a compound or mixture;

(D) identify the four types of chemical reactions;

(10) The student explores toxicology laboratory procedures in forensic science. The student is expected to:

(A) explain the absorption, distribution, and elimination of alcohol through the human body;

(B) describe the blood alcohol laboratory procedures as they

relate to blood alcohol concentration;

(C) explain the levels of tolerance and impairment due to alcohol consumption; and

(D) explain the precautions necessary in the forensic laboratory for proper preservation of blood samples.

College and Career Readiness Standards

Mathematics Standards

VIII. Problem Solving and Reasoning

A. Mathematical problem solving

1. Analyze given information.
2. Formulate a plan or strategy.
3. Determine a solution.
4. Justify the solution.
5. Evaluate the problem-solving process.

Name_____Date_____

# Forensic Toxicology Exam

**Choose the best answer.**

____1. Which of the following categories of tests would thin layer chromatography be an example of?
   A. Screening
   B. Confirmation

____2. The current percentage of blood alcohol concentration necessary to consider a person intoxicated is
   A. .10%
   B. .80%
   C. .08%
   D. 8%

____3. Which of the following is NOT a psychophysical test which a police officer may give to an individual suspected of being under the influence of alcohol?
   A. Walk and turn test
   B. Field urine test
   C. Horizontal-gaze nystagmus
   D. One-leg stand test

____4. The role of the forensic toxicologist involves matters that pertain to violations of the law.
   A. True
   B. False

____5. A breath test, used to measure alcohol, reflects the alcohol concentrated in the pulmonary vein.
   A. True
   B. False

____6. After a screening test has been used to determine the identity of an abused drug, the confirmation test of choice is
   A. Gas chromatography
   B. Gas chromatography/mass spectrometry
   C. Thin layer chromatography
   D. Immunoassay

____7. Carbon monoxide is one of the most common poisons encountered in a forensic lab.
   A. True
   B. False

____8. Hair can serve as a historical marker for determining drug intake.
A. True
B. False

____9. A chemical that is known as a hydrogen acceptor is a(n)
A. Acid
B. Base

___10. A chemical with a pH of 2 would be a
A. Strong acid
B. Weak acid
C. Strong base
D. Weak base

___11. Which of the following is NOT true of blood evidence?
A. Blood should be kept refrigerated
B. When collecting blood, clean the area with a nonalcoholic disinfectant
C. Utilize a preservative when possible
D. Collect postmortem blood from one specific site on the body

___12. A chemical that is known as a hydrogen donor is a(n)
A. Acid
B. Base

___13. There are 3 stages in the process of metabolism. Which involves the process of oxidizing alcohol in the liver and excreting alcohol in urine, breath, and perspiration?
A. Absorption
B. Distribution
C. Elimination

___14. The Breathalyzer requires a very small amount of breath.
A. True
B. False

___15. The test that is based on specific drug-antibody reactions, that is best for detecting low drug levels is called
A. Gas chromatography/mass spectrometry
B. Gas spectrometry
C. Immunoassay
D. Thin layer chromatography

___16. Because of the known characteristics of alcohol and its effects on the body, it is possible to prescribe uniform standards that would yield reliable alcohol intoxication levels.
A. True
B. False

___17. The concentration of a drug present in urine is an excellent indicator of how extensively an individual's behavior or state is influenced by the drug.
A. True
B. False

___18. Which of the following tests uses both a moving liquid and a solid phase?
A. Thin layer chromatography
B. Gas chromatography
C. Immunoassay

___19. A chemical with a pH of 7 is considered
A. An acid
B. A base
C. Neutral

___20. Drugs remain in the bloodstream for up to 72 hours.
A. True
B. False

# Forensic Toxicology Exam Key

1. A
2. C
3. B
4. A
5. B
6. B
7. A
8. A
9. A
10. A
11. D
12. B
13. C
14. B
15. C
16. B
17. B
18. A
19. C
20. B

Name_____ Date_____

# Chromatography Lab

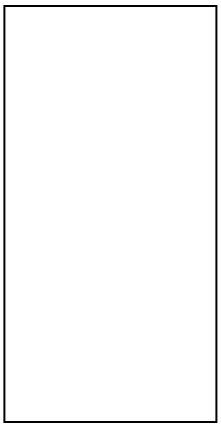
**Rationale:**
This activity is used to demonstrate the process of thin-layer chromatography. Different types of ink will be substituted for different types of drugs, and will show their various components.

**Materials:**
- 3 different brands of black marker or pen
- Coffee filters or chromatography paper
- Pencil
- Tape
- Water or acetone
- 1 beaker (200-500 ml)
- Ruler
- Goggles
- Gloves
- Calculator

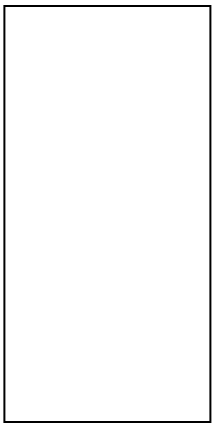
**Procedure:**
1. Cut 3 (2cm x 10cm) strips, making a "v" shape on one end of each to create a point. Save the remaining coffee filters for the other lab groups
3. In pencil, draw a horizontal line across each strip that is approximately 1cm from the pointed end
4. Also in pencil, lightly indicate which pen each strip represents on the top of the strip
5. Using a marker, place one dot at the center of the pencil line on the appropriate strip
6. Fill the beaker with enough acetone to cover the bottom of the beaker. *Note: the instructor will indicate whether or not water can be substituted for the acetone*
7. Tape each strip to the pencil horizontally with the point toward the bottom and suspend it over the opening of the beaker, or just hold them. The level of the liquid should not be deeper than the pencil line. The solution of either water or acetone represents the solvent and the "dot" represents the solute. When the strips are placed in the liquid, the solvent will travel up the strip. As it moves past the dot, the solute(s) will begin to separate and move up the strip as well
8. When the solvent nears the top, remove the strips from the beaker and lay them flat to dry
9. Sketch/color the strips in the appropriate boxes
10. Calculate the Rf value for each solute of each pen and record it in Data Table 1:

$$*\text{Rf (Rate of flow)} = \frac{\text{distance the solute traveled from the original line}}{\text{distance traveled by the solvent}}$$

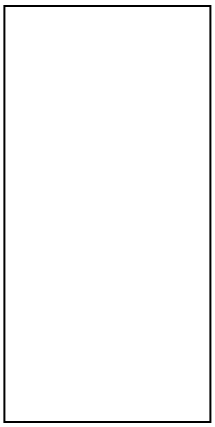
**Data:**



Pen_____



Pen_____



Pen_____

**DATA TABLE 1**

| Pen | Color & RF Value | Color & RF Value | Color & RF Value | Color & RF Value |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

*****If there are less than 4 colors for a pen, write N/A in the blank. If more than 4, stop at 4.

**Questions:**

1. Did each of the pens have more than one component?

2. Did any of the pens have the same colors? If so, were they in the same location on the strip?

3. How does this activity represent thin layer chromatography for drug testing?

# Choromatography Lab Key

1. Answers will vary depending on the markers you use

2. Answers will vary

3. This process allows one to visualize how one substance is actually made of many parts, much like that of drugs that consist of several components. It also indicates the amounts of certain substances within a compound.

Name_____Date_____

# Blood Alcohol Determination Worksheet

**Rationale:**
The purpose of this activity is to observe and understand the levels of tolerance and impairment due to alcohol consumption.

**Information:**
Blood Alcohol Concentration (BAC) is the amount of alcohol in the blood at any given time. A BAC of .10 means that a person's blood contains one part alcohol to 1000 parts blood. The only thing that can lower BAC is time. Factors that can affect BAC are gender, amount of alcohol ingested, weight, speed of consumption, metabolism, food in the stomach (how much and what type), and medications.

**TABLE 1: BAC INDICATING EFFECTS ON THE BODY**

| BAC | EFFECTS |
|---|---|
| **.02 - .03** | Some feel mildly relaxed, warm, sociable, talkative, and flushed |
| **.04 - .05** | Definite relaxation, very mellow, some impairment, ability to drive safely begins to be limited |
| **.06 - .07** | Judgment and driving somewhat impaired, pupils dilated, slightly uncoordinated, thickness of speech |
| **.08** | Judgment and driving impaired, the level of intoxication in most states, rapid eye movement, unstable exaggerated moods |
| **.09 - .10** | Loss of inhibition, clear deterioration of reaction time and control |
| **.11 - .13** | Possible vomiting, drowsiness, loss of critical judgment, impairment of memory and comprehension, impairment of vision |
| **.14 - .15** | Obviously drunk, staggering, irrational behavior, no coordination |
| **.16 - .30** | Very drunk, may lose consciousness |
| **>.30** | Comatose. Death may occur at .35 or higher. BAC's of .45 or higher are fatal to nearly all individuals |

**TABLE 2 – AVERAGE BAC% BASED ON WEIGHT AND NUMBER OF DRINKS**

| # OF DRINKS | BODY WEIGHT (LBS) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 240 |
| 1 | .06 | .04 | .03 | .03 | .03 | .03 | .02 | .02 |
| 2 | .12 | .09 | .07 | .06 | .05 | .05 | .04 | .04 |
| 3 | .18 | .14 | .11 | .10 | .08 | .07 | .06 | .06 |
| 4 | .25 | .19 | .15 | .13 | .11 | .10 | .09 | .07 |
| 5 | .31 | .23 | .20 | .17 | .14 | .13 | .11 | .09 |
| 6 | .37 | .27 | .23 | .20 | .17 | .14 | .14 | .10 |
| 7 | .43 | .37 | .31 | .28 | .23 | .21 | .19 | .14 |

Both tables 1 and 2 contain average data between males and females. Various factors, such as those listed in the Information section above, will affect BAC. When calculating BAC, you should subtract .015% for each hour of drinking. This data is not intended for legal purposes. The sources of this data are listed in the resource section of this lesson.

**Scenario 1:**
Marisa is a 120 pound female who attended a party where alcohol was being served. She began drinking at 9 pm. After finishing her 5th drink at midnight, she left, driving her own car. She was pulled over about a mile from the party location.

1) Based on the information provided, what is her blood alcohol percentage? Show your work.

2) Describe her characteristics.

3) Is she driving intoxicated according to Texas law? Explain.

**Scenario 2:**
David is a 240 pound male who met some friends for drinks at a club around 10:30 pm. The bar closed at 3:00 am, but David and his friends wanted to "beat the rush," so they finished their last drinks at 2:30 and left. Each person drank 6 drinks. When reaching their cars in the parking lot, David noticed that his friend Anthony was stumbling so badly that he decided he was too intoxicated to allow him to drive, so David drove Anthony home.

4) What is David's blood alcohol percentage? Show your work.

5) Describe his characteristics.

6) Should David be driving? Why or why not?

7) If Anthony had the same number of drinks during the same time, why is he more intoxicated?

# Blood Alcohol Determination Worksheet Key

## Scenario 1

1) Marisa drank 5 drinks. At 120 lbs, that puts her at .20%. However, you must subtract .015% for each hour that passes and she drank for 3 hours so .045% must be subtracted. .20% - .045 % = **.155%**

2) Obviously drunk, staggering, irrational behavior, no coordination

3) Yes, she is driving intoxicated because Texas' legal limit is .08% and she is above that.

## Scenario 2

4) David drank 6 drinks. At 240 lbs, he is at .10%. However, subtracting .060% (.015% per hour x 4 hours) gives a BAC of **.04%**

5) Relaxed, mellow, may show slight signs of impairment

6) David is okay to drive at .04% according to Texas law. However, the effects of alcohol can vary greatly for many reasons.

7) Even though Anthony drank the same amount during the same amount of time, several factors could cause Anthony's BAC to be higher than David's, thus making him "more drunk." The following questions could play a role in the determination:
   - How much does Anthony weigh?
   - Did he eat before drinking and what?
   - Did the men drink the same kinds of drinks?
   - Is Anthony taking any other medications?

Name_____ Date_____

## Discussion Rubric

| Objectives | 4 pts. Excellent | 3 pts. Good | 2 pts. Needs Some Improvement | 1 pt. Needs Much Improvement | N/A | Pts. |
|---|---|---|---|---|---|---|
| Participates in group discussion | | | | | | |
| Encourages others to join the conversation | | | | | | |
| Keeps the discussion progressing to achieve goals | | | | | | |
| Shares thoughts actively while offering helpful recommendations to others | | | | | | |
| Gives credit to others for their ideas | | | | | | |
| Respects the opinions of others | | | | | | |
| Involves others by asking questions or requesting input | | | | | | |
| Expresses thoughts and ideas clearly and effectively | | | | | | |
| **Total Points (32 pts.)** | | | | | | |

Comments:

Name_____ Date_____

## Individual Work Rubric

| Objectives | 4 pts. Excellent | 3 pts. Good | 2 pts. Needs Some Improvement | 1 pt. Needs Much Improvement | N/A | Pts. |
|---|---|---|---|---|---|---|
| **Follows directions** Student completed the work as directed, following the directions given, in order and to the level of quality indicated | | | | | | |
| **Time management** Student used time wisely and remained on task 100% of the time | | | | | | |
| **Organization** Student kept notes and materials in a neat, legible, and organized manner. Information was readily retrieved | | | | | | |
| **Evidence of learning** Student documented information in his or her own words and can accurately answer questions related to the information retrieved | | | | | | |
| ***Research/Gathering information (if relevant)** Student used a variety of methods and sources to gather information. Student took notes while gathering information | | | | | | |
| **Total Points (20 pts.)** | | | | | | |

Comments:

Name:_____ Date:_____

## Writing Rubric

| Objectives | 4 pts. Excellent | 3 pts. Good | 2 pts. Needs Some Improvement | 1 pt. Needs Much Improvement | N/A | Pts. |
|---|---|---|---|---|---|---|
| The writing has all required parts from introduction to conclusion in smooth transition. | | | | | | |
| The writing is interesting, supportive, and complete. | | | | | | |
| The writing demonstrates that the writer comprehends the writing process. | | | | | | |
| Accurate spelling, grammar, and punctuation | | | | | | |
| The content of paragraphs emphasizes appropriate points. | | | | | | |
| The writer shows an understanding of sentence structure, paragraphing, and punctuation. | | | | | | |
| All sources and references are clearly and accurately documented. | | | | | | |
| **Total Points (28 pts.)** | | | | | | |

Comments: