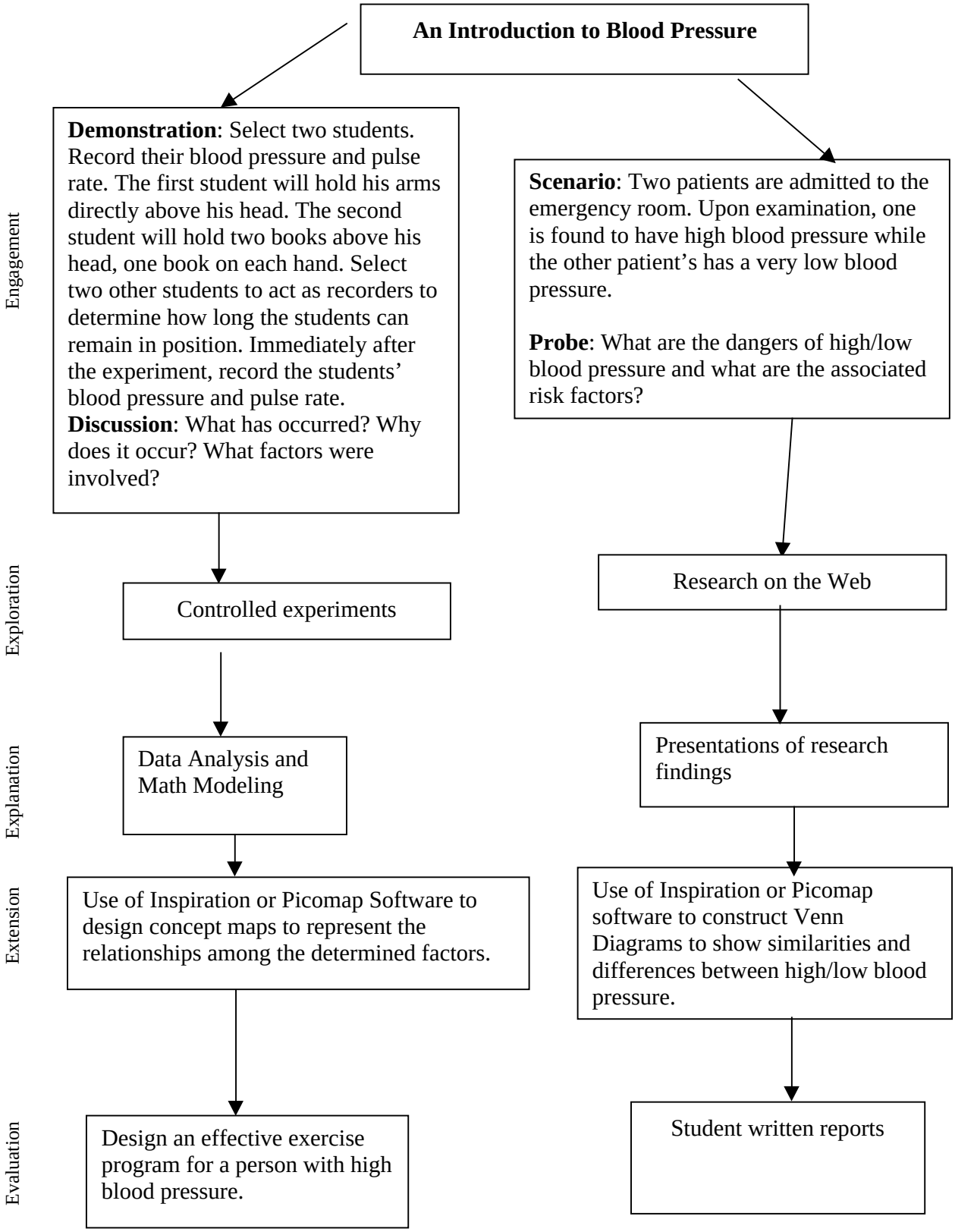

An Introduction to Blood Pressure
Engagement
Demonstration: Select two students. Record their blood pressure and pulse rate. The first student will hold his arms directly above his head. The second student will hold two books above his head, one book on each hand. Select two other students to act as recorders to determine how long the students can remain in position. Immediately after the experiment, record the students' blood pressure and pulse rate.
Discussion: What has occurred? Why does it occur? What factors were involved?
Scenario: Two patients are admitted to the emergency room. Upon examination, one is found to have high blood pressure while the other patient's has a very low blood pressure.
Probe: What are the dangers of high/low blood pressure and what are the associated risk factors?
Exploration
Controlled experiments
Research on the Web
Explanation
Data Analysis and Math Modeling
Presentations of research findings
Extension
Use of Inspiration or Picomap Software to design concept maps to represent the relationships among the determined factors.
Use of Inspiration or Picomap software to construct Venn Diagrams to show similarities and differences between high/low blood pressure.
Evaluation
Design an effective exercise program for a person with high blood pressure.
Student written reports

UNIT TITLE: *BLOOD PRESSURE AND PULSE RATE*

UNIT GOALS: To understand the role that blood pressure and pulse rate play in human health by:

- Forming and testing hypotheses about the effects of physical activity, cold stimulus, and caffeine on blood pressure and pulse rate.
- Explaining the mathematical relationship between blood pressure and pulse rate fluctuation with variables such as cardiac output, stroke volume, and peripheral resistance.
- Determining the causes of fluctuation in blood pressure and pulse rate and possible treatments for high blood pressure using information obtained from electronic sources.

GRADE LEVEL (K –16): Grades 10 – 14

GENERAL SUBJECT AREAS: Biology

MINIMUM TIME REQUIRED FOR THE UNIT: 4 hours

CONCEPTS LEARNED ACROSS ALL UNIT MODULES:

- Physical and chemical changes in the body affect blood pressure and pulse rate.
- A variety of diseases, drugs, emotional conditions, and genetic factors are associated with abnormal blood pressure readings and pulse rates.

STANDARDS ADDRESSED BY UNIT MODULES:

Maryland State Department of Education School Performance Program: High School Science Core Learning Goals (www.mdk12.org)

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.2.1	The student will identify meaningful, answerable scientific questions.
1.2.2	The student will pose meaningful, answerable scientific questions.
1.2.3	The student will formulate a working hypothesis
1.2.4	The student will test a working hypothesis.
1.2.5	The student will select appropriate instruments and materials to conduct an investigation.
1.2.6	The student will identify appropriate methods for conducting an investigation and affirm the need for proper controls in an experiment.
1.2.7	The student will use relationships discovered in the lab to explain phenomena observed outside the laboratory.
1.2.8	The student will defend the need for verifiable data.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.3.1	The student will develop and demonstrate skills in using lab and field equipment to perform investigative techniques.
1.3.2	The student will recognize safe laboratory procedures.
1.3.3	The student will demonstrate safe handling of the chemicals and materials of science.
1.3.4	The student will learn the use of new instruments and equipment by following instructions in a manual or from oral directions.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.4.1	The student will organize data appropriately using techniques such as tables, graphs, and webs.
1.4.2	The student will analyze data to make predictions, decisions, or draw conclusions.
1.4.3	The student will use experimental data from various investigators to validate results.
1.4.4	The student will determine the relationship between quantities and develop the mathematical model that describes these relationships.
1.4.5	The student will check graphs to determine that they do not misrepresent results
1.4.6	The student will describe trends revealed by data
1.4.7	The student will determine the sources of error that limits the accuracy or precision of experimental results.
1.4.8	The student will use models and computer simulations to extend his/her understanding of scientific concepts.
1.4.9	The student will use analyzed data to confirm, modify, or reject an hypothesis.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.5.1	The student will demonstrate the ability to summarize data.
1.5.2	The student will explain scientific concepts and processes through drawing, writing, and/or oral communication.
1.5.3	The student will use computers and /or graphing calculators to produce the visual materials that will be used for communication results.
1.5.4	The student will create and interpret graphics.
1.5.5	The student will use computers and/or graphing calculators to produce tables, graphs, and spreadsheet calculations.
1.5.6	The student will read a technical selection and interpret it appropriately
1.5.8	The student will describe similarities and differences when explaining concepts and/or principles.
1.5.9	The student will communicate conclusions derived through a synthesis of ideas.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.6.1	The student will use ratios and proportion in appropriate situations to solve problems.
1.6.2	The student will computers and/or graphing calculators to perform calculations for tables, graphs, or spreadsheets.
1.6.3	The student will express and/or compare small and large quantities.
1.6.4	The student will manipulate quantities and/or numerical values in algebraic equations
1.6.5	The student will judge the reasonableness of an answer.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.7.1	The student will apply the skills, processes, and concepts of biology, chemistry, physics, and earth science to societal issues.
1.7.4	The student will recognize mathematics as an integral part of the scientific process.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
3.6.1	The student will analyze the consequences and/or trade-offs between technological changes and their effect o the individual society and the environment.
3.6.2	The student will investigate a biological issue and be able to defend their position.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
5.1.1	The student will use analytical techniques appropriate to the study of physics. For example, selecting appropriate equipment for measuring and investigating., using appropriate units and applying dimensional analysis, manipulating equations.

TECHNOLOGY NEEDED IN UNIT MODULES:

Graphical Analysis computer software, Inspiration or Picomap software, Internet Access. Graphing Calculators, Blood Pressure Cuff, Stethoscope

TECHNOLOGY - ENHANCED INSTRUCTIONAL STRATEGIES EMPLOYED:

- Information Collection and Analysis (Information Exchanges) with other teachers andstudents to determine the variance of data collected and information retrieved from implementation of activities.
- Problem Solving (Information Searches) to answer specific questions relating to blood pressure and pulse rate, their relationship to diet, diseases associated with blood pressure and treatments.
- Problem Solving (Social Action Projects) to design safe physical activities for persons with high blood pressure.

TITLE OF MODULE 1: Blood Pressure and Pulse Rate: Exploration of Five Scientific Hypotheses Through Physical Activities

TITLE OF MODULE 2: Blood Pressure and Pulse Rate: Factors Associated With High and Low Blood Pressure

UNIT CULMINATING ACTIVITY: As a culminating unit activity, students will write a one page paper that shows the interdependence of our daily physical activities, environment, diet and genetics on blood pressure measurements.

UNIT AUTHOR: Nicholas Eke

UNIT CONTRIBUTORS: George Morse, Heather Pollock, Susan Ragan, and Dr. Janice Keyser

MODULE #1

MODULE TITLE: BLOOD PRESSURE AND PULSE RATE: EXPLORATION OF FIVE SCIENTIFIC HYPOTHESES THROUGH PHYSICAL ACTIVITIES

ESTIMATED TIME: 2 HOURS

MODULE OBJECTIVES:

- Form and test hypotheses about the effects of physical activity, cold stimulus, and caffeine on blood pressure and pulse rate.
- Explain the mathematical relationship between blood pressure and pulse rate fluctuation with variables such as cardiac output, stroke volume, and peripheral resistance.
- Construct concept maps to represent relationships and design an appropriate exercise regimen for someone with high blood pressure.

CONCEPTS LEARNED IN THIS MODULE:

- Use of the scientific method to test hypotheses.
- Use of mathematics and graphical analysis to model relationships among variables.

STANDARDS ADDRESSED IN THIS MODULE:

Maryland State Department of Education School Performance Program: High School Science Core Learning Goals (www.mdk12.org)

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.2.1	The student will identify meaningful, answerable scientific questions.
1.2.2	The student will pose meaningful, answerable scientific questions.
1.2.3	The student will formulate a working hypothesis
1.2.4	The student will test a working hypothesis.
1.2.5	The student will select appropriate instruments and materials to conduct an investigation.
1.2.6	The student will identify appropriate methods for conducting an investigation and affirm the need for proper controls in an experiment.
1.2.7	The student will use relationships discovered in the lab to explain phenomena observed outside the laboratory.
1.2.8	The student will defend the need for verifiable data.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.3.1	The student will develop and demonstrate skills in using lab and field equipment to perform investigative techniques.
1.3.2	The student will recognize safe laboratory procedures.
1.3.3	The student will demonstrate safe handling of the chemicals and materials of science.
1.3.4	The student will learn the use of new instruments and equipment by following instructions in a manual or from oral directions.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.4.1	The student will organize data appropriately using techniques such as tables, graphs, and webs..
1.4.2	The student will analyze data to make predictions, decisions, or draw conclusions.
1.4.3	The student will use experimental data from various investigators to validate results.
1.4.4	The student will determine the relationship between quantities and develop the mathematical model that describes these relationships.
1.4.5	The student will check graphs to determine that they do not misrepresent results
1.4.6	The student will describe trends revealed by data
1.4.7	The student will determine the sources of error that limits the accuracy or precision of experimental results.
1.4.8	The student will use models and computer simulations to extend his/her understanding of scientific concepts.
1.4.9	The student will use analyzed data to confirm, modify, or reject an hypothesis.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.5.1	The student will demonstrate the ability to summarize data.
1.5.2	The student will explain scientific concepts and processes through drawing, writing, and/or oral communication.
1.5.3	The student will use computers and /or graphing calculators to produce the visual materials that will be used for communication results.
1.5.4	The student will create and interpret graphics.
1.5.5	The student will use computers and/or graphing calculators to produce tables, graphs, and spreadsheet calculations.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.6.1	The student will use ratios and proportion in appropriate situations to solve problems.
1.6.2	The student will computers and/or graphing calculators to perform calculations for tables, graphs, or spreadsheets.
1.6.4	The student will manipulate quantities and/or numerical values in algebraic equations
1.6.5	The student will judge the reasonableness of an answer.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.7.4	The student will recognize mathematics as an integral part of the scientific process.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
3.6.2	The student will investigate a biological issue and be able to defend their position.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
5.1.1	The student will use analytical techniques appropriate to the study of physics. For example, selecting appropriate equipment for measuring and investigating., using appropriate units and applying dimensional analysis, manipulating equations.

TECHNOLOGY – ENHANCED INSTRUCTIONAL STRATEGIES UTILIZED IN THIS MODULE:

- Information Collection and Analysis (Information Exchanges) with other teachers and students to determine the variance of data collected and information retrieved from implementation of activities.
- Problem Solving (Social Action Projects) to design safe physical activities for a person with high blood pressure.

EXPECTED MODULE OUTCOMES: The students will understand the effects of certain physical activities on blood pressure and pulse rate. They will be able to determine the mathematical relationships that exist among blood pressure, resistance, cardiac output and stroke volume.

PERFORMANCE BASED ASSESSMENT OF MODULE OUTCOMES: Students will collect data and use the data to determine the rate of change of blood pressure as numerous variables are manipulated.They will design an exercise regimen for someone with high blood pressure.

MODULE OVERVIEW

Component	Brief Description of Module Activities	Student Grouping	Materials/Technology
Engagement	Demonstration: Select two students. Record their blood pressure and pulse rate. The first student will hold his arms directly above his head. The second student will hold two books above his head, one book on each hand. Select two other students to act as recorders to determine how long the students can remain in position. Immediately after the experiment, record the students' blood pressure and pulse rate. **Discussion**: What has occurred? Why does it occur? What factors were involved?	Whole Class	Sphygmomanometer, Stop Watch, Books
Exploration	Controlled experiments to test hypothesis	Small Groups	Sphymomanometer, Graphing Calculator, Step Stool, Stop Watch
Explanation	Data Analysis and math modeling to augment ideas	Small Groups	Graphing Calculator, Graphical Analysis Software
Extension/ Elaboration	Design of concept maps to represent relationships amongst factors influencing experimental observation and to clarify new information	Small Groups	Information generated from experiment and observation. Inspiration or Picomap software.
Evaluation	Design an appropriate exercise regimen for a person with high blood pressure.	Small Groups	Information generated from specifics about the beneficiary of the exercise regimen

MODULE 2

MODULE TITLE: BLOOD PRESSURE AND PULSE RATE: FACTORS ASSOCIATED WITH HIGH AND LOW BLOOD PRESSURE.

ESTIMATED TIME: 2 Hours

MODULE OBJECTIVES:

- Determine the causes of fluctuation in blood pressure and pulse rate and possible treatments for high blood pressure using information obtained from electronic sources.
- Represent similarities and differences between low and high blood pressure using Venn diagrams.
- Produce a written report analyzing and synthesizing the information about blood pressure and its associated factors.

CONCEPTS LEARNED IN THIS MODULE:

- Use of the World Wide Web as a research tool.
- Understanding of the wide range of factors which influence blood pressure.
- Understanding of the relationship between diseases and blood pressure.

STANDARDS ADDRESSED IN THIS MODULE:

Maryland State Department of Education Maryland School Performance Program: High School Science Core Learning Goals (www.mdk12.org)

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.2.1	The student will identify meaningful, answerable scientific questions.
1.2.2	The student will pose meaningful, answerable scientific questions.
1.2.5	The student will select appropriate instruments and materials to conduct an investigation.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.5.2	The student will explain scientific concepts and processes through drawing, writing, and/oral communication.
1.5.6	The student will read a technical selection and interpret it appropriately
1.5.8	The student will describe similarities and differences when explaining concepts and/or principles.
1.5.9	The student will communicate conclusions derived through a synthesis of ideas.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
1.7.1	The student will apply the skills, processes, and concepts of biology, chemistry, physics, and earth science to societal issues.

Goal/Expectation Number	Goal/Expectation/Indicator Statement
3.6.1	The student will analyze the consequences and/or trade-offs between technological changes and their effect o the individual society and the environment.
3.6.2	The student will investigate a biological issue and be able to defend their position.

TECHNOLOGY – ENHANCED INSTRUCTIONAL STRATEGIES UTILIZED IN THIS MODULE:

- Problem Solving (Information Searches) to answer specific questions relating the effects of physical activities and diet on blood pressure and pulse rate.
- Identify diseases associated with blood pressure and treatments using electronic resources.

MODULE OVERVIEW

Component	Brief Description of Module Activities	Student Grouping	Materials/ Technology
Engagement	Scenario: Two patients are admitted to the emergency room. Upon examination, one is found to have high blood pressure while the other patient's blood pressure has very low. blood pressure. **Probe**: What are the dangers of high/low blood pressure and what are the associated risk factors?	Whole Class	Stethoscope
Exploration	Research sources on the World Wide Web in order to collect information	Small Groups	Internet
Explanation	Presentation of research findings, analysis, explanation and discussion	Small Groups	N/A
Extension	Construction of Venn diagrams to show similarities & differences between high/low blood pressure	Small Groups	Inspiration or Picomap software
Evaluation	Student and group written reports	Small Groups	N/A

EXPECTED MODULE OUTCOMES: The students will understand the role of disease, drugs, emotions, and genetic factors in determining blood pressure and pulse rates.

PERFORMANCE BASED ASSESSMENT OF MODULE OUTCOMES: Students will write content-specific reports based on research and scored based on rubrics developed for this module.

Module #1 Engagement

Demonstration: Select two students. Record their blood pressure and Pulse rate. The first student will hold his arms directly above his head. The second student will hold two books above his head, one book in each hand.
Select two other students to act as recorders to determine how long the students can remain in position. Immediately after the experiment, record the students' pressure and pulse rate.

Discussion: What has occurred? Why does it occur? What factors were involved?

TEACHER NOTES

Blood pressure is an important indicator of cardiovascular health. It is determined by evaluating the force per unit area that blood exerts against blood vessel walls. Its unit of measurement is millimeters of mercury (mm Hg). Blood pressure is essential for the proper functioning of the vital organs in the body. Its measurement provides valuable information regarding the functional state of some of the essential organs in the human system. Blood pressure is determined by reading the ***systolic pressure*** (ventricular contraction or the force that blood exerts on the walls of the artery as the heart contracts to pump blood out) over the ***diastolic pressure*** (ventricular relaxation or the force that blood exerts on the walls of the artery as the heart relaxes to allow the blood to flow into the heart). Normal values fall in the range of 120/80 and 130/85 mm Hg (Systolic/Diastolic). (http://www3.healthgate.com/hic/wcon/wcon-14.asp or http://noah.cuny.edu/wellconn/hiblodpres.html)

An instrument often used to obtain blood pressure by the auscultatory method is a ***Sphygmomanometer.*** The Sphygmomanometer consists of an inflatable cuff with an attached pressure gauge. The auscultatory method (http://www.physio.mcgill.ca/vlabonline/cardiolab/auscult.htm) involves placing the cuff around the arm and inflating to a pressure higher than systolic pressure to occlude circulation to the forearm. As the cuff pressure is gradually released, the examiner listens with a stethoscope for characteristic sounds called the sounds of **Korotkoff**, which indicate the resumption of blood flow into the forearm. The pressure at which the first soft tapping sounds can be detected is recorded as the ***systolic pressure***. As the pressure is reduced further, blood flow becomes more turbulent and the sound becomes louder. However, when the artery is no longer constricted, blood flows freely and the sound can no longer be heard. The pressure at which the heart sounds disappear is recorded as the ***diastolic pressure***.

Pulse is the alternating surges of pressure in an artery that occur with each contraction and relaxation of the left ventricle. The pulse may be felt easily on any superficial artery when the artery is compressed over a bone or firm tissue. It can be taken at the back of the neck, around the back of the knee or at the lateral aspect of the wrist, above the thumb. To record the pulse pressure from the lateral aspect of the wrist, place your fingertips over the artery and count the radial pulse for one minute. The value obtained in one minute is the pulse rate.

Module #1 Exploration

Note: Students with health problems or heart problems should be exempted from these activities.

Start by having the class brainstorm physical activities and the effects they believe the activities will have on blood pressure and pulse rate. Have them write down their hypotheses in the form of: "If I do ..., then my blood pressure will ... and my pulse rate will ..."

Divide the class into randomly selected groups of four. Depending on the time available, each group may do all five activities described below or each group may do a single activity. In either case, results should be shared among the groups.

Prior to the start of each activity, blood pressure and pulse rate measurements should be taken using the blood pressure cuff and the procedure outlined for measuring pulse pressure.

POSTURE: Activity 1

1. Write a hypothesis predicting what will happen to blood pressure and pulse rate after 3 minutes of being in a reclining position.
2. Measure the pulse rate and blood pressure of the participant before he or she assumes the reclining position. This will be the baseline measurement. After the participant has been in the reclining position for 3 minutes, take blood pressure and pulse rate readings and record these values in the table below.
3. How did the blood pressure and pulse rate change?
4. What factors could have contributed to the change in blood pressure and pulse rate?

POSTURE: Activity 2

1. Write a hypothesis predicting what will happen to blood pressure and pulse rate upon standing up after being in a reclining position for 3 minutes.
2. After the participant has been in the reclining position for about 3 minutes, have the participant stand up and immediately take blood pressure and pulse rate readings.
3. How did the blood pressure and pulse rate change?
4. Why would there be a difference in these readings compared to the readings when reclining.

==========

POSTURE

Activity 1	**Blood pressure (mm Hg)** (Trial 1)	**Pulse (beats/min)**
Before reclining	_____	
Reclining (After 3 min)	_____	
Activity 2		
Immediately on standing from the reclining position	_____	

EXERCISE: **Activity 3**

1. Write a hypothesis predicting what will happen to blood pressure and pulse rate after 5 minutes of vigorous exercise.

2. The exercise can vary from stepping on and off a step stool or some simple sprints up and down a confined area. If using the step stool, have each participant conduct the activity over a period of 5 minutes. Take blood pressure and pulse rate readings and record these values in the table below.

3. How did the blood pressure and pulse rate change?

4. What factors could have contributed to the change in blood pressure and pulse rate?

==========

EXERCISE

Activity 3	**Blood pressure (mm Hg)** (Trial 1)	**Pulse (beats/min)**
Before Using step stool for 5 minutes		
Immediately after using step stool for 5 minutes.		

***COLD STIMULUS*: Activity 4**

1. Write a hypothesis predicting what will happen to blood pressure and pulse rate after 6 minutes of cold exposure.

2. Measure the blood pressure and pulse rate of the participant as he or she sits quietly. Obtain a basin and thermometer. Fill the basin with ice cubes and add some water. When the temperature of the ice bath reaches 5^{o} C, immerse the subject's other hand (the non - cuffed limb) in ice water. With the hand still immersed, take blood pressure and pulse readings at 2-minute intervals for a period of 6 minutes. Record the values in the table below.

3. How did the blood pressure and pulse rate change?

4. What factors could have contributed to the change in blood pressure and pulse rate?

==========

COLD STIMULUS

Activity 4	**Blood pressure (mm Hg)** (Trial 1)	**Pulse (beats/min)**
Before inserting hand in cold water		
2 minutes after inserting hand		
4 minutes after inserting hand		
6 minutes after inserting hand		

CAFFEINE: **Activity 5 (optional)**

1. Write a hypothesis predicting what will happen to blood pressure and pulse rate after drinking a caffeinated soda.

2. Take a baseline blood pressure and pulse of the participant before he or she drinks the Mountain Dew. After the participant has consumed the drink, take measurements at intervals of 2 minutes for 6 minutes. Record the values in the table below.

3. How did the blood pressure and pulse rate change?

4. What factors could have contributed to the change in blood pressure and pulse rate?

==========

CAFFEINE:

Activity 5:	**Blood pressure (mm Hg)**	**Pulse (beats/min)**
Blood pressure And pulse rate before drinking caffeinated drink	_____	
2 minutes after drinking	_____	
4 minutes after drinking	_____	
6 minutes after drinking	_____	

Module #1 Explanation

After the groups have shared the results of their experiments, have them enter their data in a spreadsheet application for graphing and analysis. Ideally, there should be multiple trials of each experiment. Time should be entered as the independent variable and blood pressure and pulse rate will both be dependent variables. Engage the students in a discussion of the implications of their findings.

Introduce the formulas discussed below. Engage the students in a discussion of the impact of the physical activities on the variables in the formulas.

TEACHER NOTES

Blood pressure is affected by cardiac output, peripheral resistance and blood volume. Mathematically, there is a direct relationship between blood pressure (BP), cardiac output (CO) and peripheral resistance (PR). This relationship can be expressed as:

BP = CO x PR (where CO = SV x HR and SV = EDV - ESV)

Cardiac output (CO) is the volume of blood pumped out by each ventricle in one minute. It can be represented as the product of heart rate (HR) and stroke volume (SV). ***Heart rate*** is the number of times the heart beats each minute. It can be determined by taking one's pulse.

Stroke volume is defined as the volume of blood pumped out by a ventricle with each heartbeat. It can be expressed as the difference between the **end diastolic volume** (EDV)and **end systolic volume** (ESV). ***End diastolic volume*** is the volume of blood found in the ventricle at the end of diastole. This is the greatest amount of blood found in the ventricle during the cardiac cycle. ***End systolic volume*** is the amount of blood left in the ventricle at the end of systole. This is the smallest volume of blood in the ventricle during the cardiac cycle.

The difference between the systolic and diastolic pressure is ***pulse pressure***. It is often felt as a throbbing pulsation in an artery during systole. Because of the fluctuations in aortic pressure, mean atrial pressure (***MAP***) becomes significant. It is the pressure that propels the blood to the tissues through the cardiac cycle. Because of the longer lasting sequence of diastole, **MAP** is often represented as the diastolic pressure plus one-third the pulse pressure.

MAP = Diastolic Pressure + 1/3 Pulse Pressure

Peripheral resistance is the opposition to blood flow and is a measure of the amount of friction blood encounters as it passes through the blood vessels. Peripheral resistance is affected by (a) blood viscosity, (b) total blood vessel length and (c) blood vessel diameter.

Blood viscosity is the internal resistance to blood flow and is related to the thickness of a fluid. All liquids and gases exhibit this characteristic. Blood viscosity is fairly constant but an excessive number of red blood cells can increase blood viscosity, which ultimately increases blood pressure. Also, when the red blood cell number is low, blood can become less viscous which results in a decrease in peripheral resistance. ***Blood vessel length*** has a direct relationship with peripheral resistance. The longer the total vessel length, the greater the resistance.

Blood vessel diameter significantly affects peripheral resistance. The smaller the blood vessel diameter, the greater the resistance. Resistance varies inversely with the fourth power of the vessel radius (radius is half the diameter). Consequently, if the radius of a blood vessel is doubled, the resistance is one – sixteenth as much. Thus, the large arteries close to the heart contribute little to peripheral resistance whereas the smaller ones, which enlarge or constrict in response to neural and chemical controls, are major factors. Saturated or unsaturated fat within the blood vessel can substantially increase peripheral resistance.

Normal Blood Pressure for an Adult = 120 mm Hg/80 mm Hg
Normal Average Cardiac Output = 5250 ml/min ; Normal Heart Rate = 75 beats/min
Normal Stroke Volume = 70 ml/beat; Normal End Diastolic Volume = 120 ml/beat (For an Adult) ; Normal End Systolic Volume = 50 ml/beat (For an Adult)

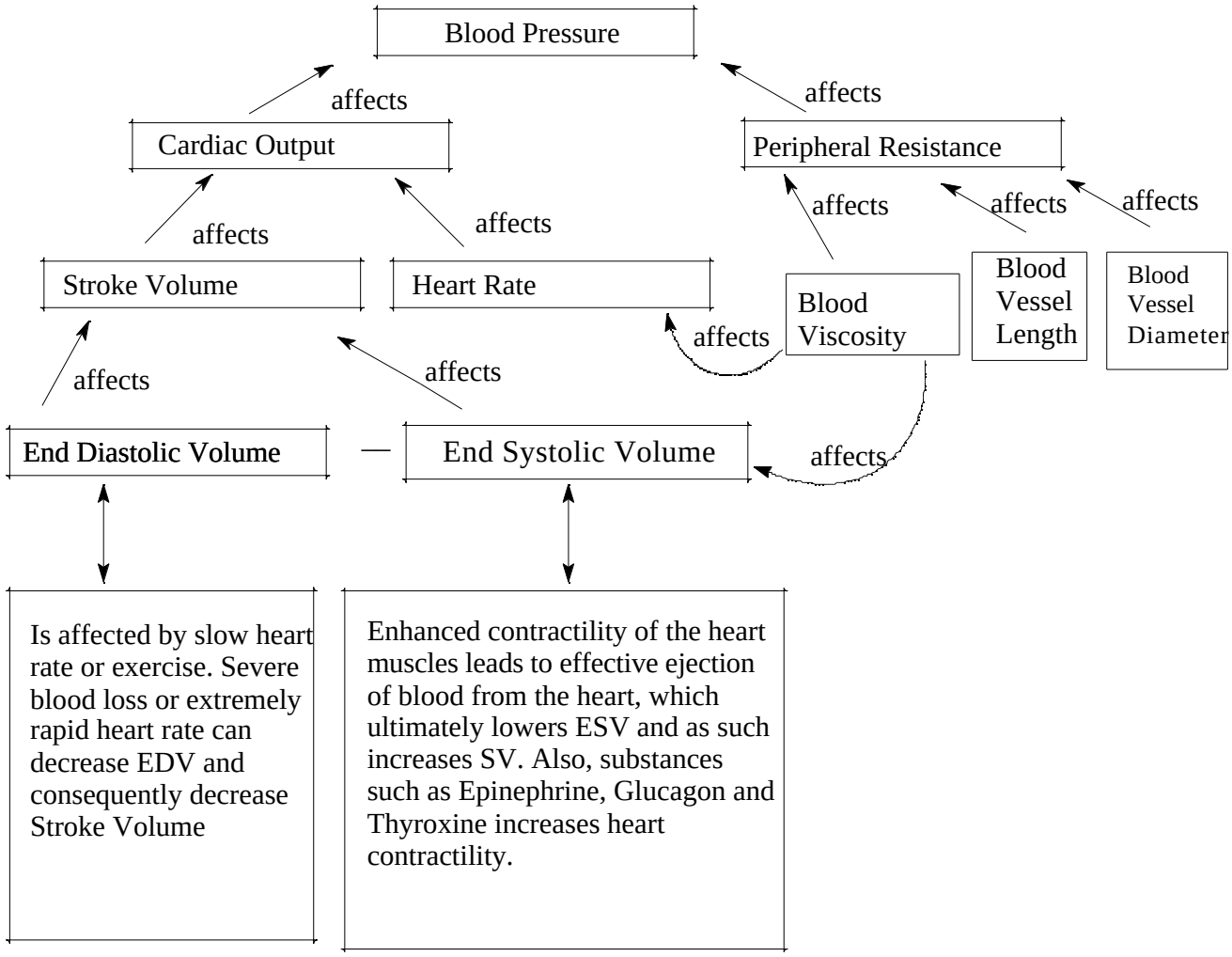
Module #1 Elaboration

Have the students create a concept map using Inspiration or Picomap software which incorporates the following terms:

blood pressure
blood vessel diameter
blood vessel length
blood viscosity
cardiac output
end diastolic volume
end systolic volume
heart rate
peripheral resistance
stroke volume

Have the students add one of the physical activities to their concept map, explaining which factors were affected by the activity.

SAMPLE CONCEPT MAP FOR BLOOD PRESSURE MODULE 1



Module #1 Evaluation

Group work will be evaluated based on the rubric on the next page.

Students will recommend an exercise program for a person with high blood pressure taking into consideration variables unique to that person and then justify their decisions.

Team Evaluation Format During Activities For Module 1

** The following was adapted from " Team Evaluation Through Observation by Janice Olexia Keyser, Ph.D.

TEAMS	MEMBERS	ACTIVELY PARTICIPATED IN GROUP ACTIVITIES ( ) points	MEMBERS FOLLOWED DIRECTIONS ( ) points	TEAM MEMBERS SOUGHT ASSISTANCE IF NEEDED ( ) points	TEAM MEMBERS WERE ON TASK ( ) points	TEACHER COMMENTS
TEAM 1	1. 2. 3. 4. 5.					
TEAM 2	1. 2. 3. 4. 5.					
TEAM 3	1. 2. 3. 4. 5.					
TEAM 4	1. 2. 3. 4. 5.					

Module #2 Exploration

Exploration

Students will work in groups of four. Each group will explore the World Wide Web for information regarding high/low blood pressure, risk factors, associated diseases and possible treatments.

Internet Sites:

Causes of High Blood Pressure:
http://www.who.int/ncd/cvd/ht_guide.html
http://www.healthcentral.com/mhc/top/003082.cfm
http://www.ama-assn.org/insight/spec_con/bp/bp.htm
http://www.nhlbi.nih.gov
http://www.americanheart.org

Causes of Low Blood Pressure:
http://www.healthcentral.com/mhc/top/003083.cfm
http://www.bloodpressure.com

Blood Pressure information in the US
http://www.cdc.gov/nchs/data/nvs47_19.pdf

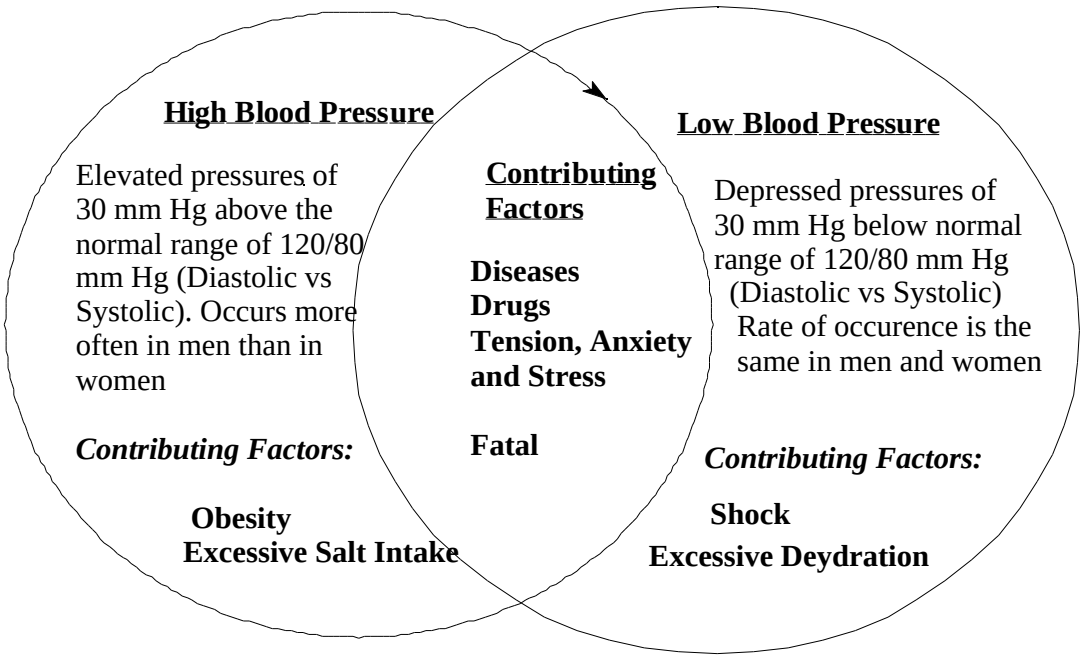
Module #2 Elaboration

Extension/ Elaboration

Students create a Venn diagram for High and low blood pressure

http://www.inspiration.com
http://www.picomap.org
http://www.poweroflogic.com/cgi-pol/menu.cgi
http://www.thomasleonard.com/teleclass/notes/class140

SAMPLE VENN DIAGRAM FOR HIGH BLOOD PRESSURE AND LOW BLOOD PRESSURE COMPARISON: MODULE 2



Module #2 Evaluation

Evaluation

GROUP REPORT SCORING FOR MODULE 2

CRITERIA	***POSSIBLE POINTS***	***SCORE***
1. Students followed directions for report	5	
2. Students defined high/low blood pressure and indicated units	5	
3. Students discussed the causes of high/low blood pressure	5	
4. Students discussed treatments for high/low blood pressure	5	
5. Students discussed diseases associated with blood pressure problems	5	
6. Students used the internet and other reference sources to gather information on high blood pressure statistics in the United States	5	
	Total Points 30	

Teacher Comments:

Web Site References

Below are some sites with information on some of the activities outlined.

1. Information on normal values for systolic/diastolic pressures and variations.
   http://www3.healthgate.com/hic/wcon/wcon-14.asp
   http://noah.cuny.edu/wellconn/hiblodpres.html
   http://www.who.int/ncd/cvd/ht_guide.html

2. Information on Sphygmomanometer and the auscultatory method
   http://www.physio.mcgill.ca/vlabonline/cardiolab/auscult.htm

3. Information on Venn Diagrams
   http://www.inspiration.com
   http://www.picomap.org
   http://www.poweroflogic.com/cgi-pol/menu.cgi
   http://www.thomasleonard.com/teleclass/notes/class140

4. Information on Concept Maps
   http://www.inspiration.com
   http://www.picomap.org
   http://geocities.com/athens/crete/2893/page2.html
   http://www.schoolnet.edu.mo/general/biology/temp/cmap/oxygen.html

5. Information on Blood Pressure
   Causes of High Blood Pressure:
   http://www.who.int/ncd/cvd/ht_guide.html
   http://www.healthcentral.com/mhc/top/003082.cfm
   http://www.ama-assn.org/insight/spec_con/bp/bp.htm
   http://www.nhlbi.nih.gov
   http://www.americanheart.org

   Causes of Low Blood Pressure:
   http://www.healthcentral.com/mhc/top/003083.cfm
   http://www.bloodpressure.com

   Blood Pressure mortality statistics in the US:
   http://www.cdc.gov/nchs/data/nvs47_19.pdf