

# STE(A)M IT INTEGRATED LESSON PLAN TEMPLATE

## Title

(Under) Pressure, pressure, pressure all around us

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## Summary

The aim of this learning scenario is for students to connect three important STEM subjects (Physics, Chemistry and Biology) through a common theme of “pressure”. This topic was chosen because pressure is an integral part of our everyday life, in many ways. It is everywhere, both in us and around us - in the atmosphere, in the water, in our bloodstream, in the Earth, in all living beings... With this scenario, we expect students to understand and become familiar with measuring of pressure, learn about the importance of pressure in cooking, learn about blood pressure and its importance to our health.

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## Subject (s)

STEM Subject 1 : Physics

STEM Subject 2 : Chemistry

STEM Subject 3 : Biology

STEM Subject 4 : Informatics (ICT)

Non STEM Subject 1: English language



## Real- life questions

- Atmospheric pressure on our daily life, weather and pressure,
- Connection between atmospheric pressure and cooking (pressure cookers)
- Pressure and health: impact of sudden changes in air pressure on health, the importance of blood pressure and the negative impact of high blood pressure on health, the importance of treating high blood pressure and adopting healthy living habits

## Aims of the lesson

By the end of the lesson student should be able to:

### Physics:

Explain what atmospheric pressure is, how it is measured, what is the connection between changes in atmospheric pressure and weather conditions

### Chemistry:

Explain the dependence of boiling water on altitude

### Biology:

Explain how blood pressure is measured, its importance for human health

### Informatics (ICT)

Use appropriate software for data processing and graphical display, making presentations

### English language

Students will present the results of their work and research in all three subjects in English and write a joint report

## Connection to STEM careers

- **Physicist:** design engineer, lab technician, physicist designer , meteorologist
- **Chemistry :** chemical engineer, Chemists (industrial and materials chemistry)
- **Biology:** pharmacologist , biotechnologist

## Age of students

14-15



## Time

**Preparation time:** Sharing ideas with colleagues to implement the activities (1 hour)

**Teaching time:**

**Preparation:**

- **Brainstorming and discussion** – 15 min (each subject)
  - **STEM Subject 1** Physics – 120 min
  - **STEM Subject 2** Chemistry – 120 min
  - **STEM Subject 3** Biology -120 min
  - **STEM Subject 4** ICT -45 min
  - **non-STEM subject** English language 45 min

## Teaching resources (material & online tools)

### Materials:

**Physics:** cartoon, drinking straws, rubber band, balloon, scissors, jar, color markers or colors pencils, tape, clear bottle, glass cup or beaker, ruler

**Chemistry:** Heater ,vessel, thermometer, distilled water

**Biology:** Stethoscope and asphygmomanometer

Student Worksheet

### Online tools:

Microsoft Office 365 tools (Word, PowerPoint, Excel)

Kahoot: <https://kahoot.com/>

<https://planetcalc.com/275/>

### Physics

Atmospheric Pressure (Science On line) <https://www.youtube.com/watch?v=xJHJsA7bYGc>

What is Air Pressure? | Don't Memorise <https://www.youtube.com/watch?v=28grZdfexT8>

Exploring Air & Air Pressure <https://www.youtube.com/watch?v=Grziaq-caVE>

The history of the barometer (and how it works) TedEd

<https://www.youtube.com/watch?v=EkDhlzA-lwI>

How To Make a Barometer 3.15 minutes-<https://www.youtube.com/watch?v=hYXu1F1hWpM>

Building a Barometer (1.50 minutes) <https://www.youtube.com/watch?v=k4lQ9zvAE4U>



Professional information about meteorological conditions in the world

<https://www.ogimet.com/ranking.phtml.en>

World Meteorological Organization's World Weather & Climate Extremes Archive

<https://wmo.asu.edu/content/world-meteorological-organization-global-weather-climate-extremes-archive>

For Croatian students:

[https://edutorij.e-skole.hr/share/proxy/alfresco-noauth/edutorij/api/proxy-guest/673a7966-985a-40c6-976c-5562c11d277f/html/1014\\_Atmosferski\\_tlak.html](https://edutorij.e-skole.hr/share/proxy/alfresco-noauth/edutorij/api/proxy-guest/673a7966-985a-40c6-976c-5562c11d277f/html/1014_Atmosferski_tlak.html)

### Chemistry

<https://study.com/academy/lesson/how-to-calculate-boiling-point.html>

[https://www.youtube.com/watch?v=3hoQSz2uJw0&ab\\_channel=RavindraGodbole](https://www.youtube.com/watch?v=3hoQSz2uJw0&ab_channel=RavindraGodbole)

<https://brainly.in/question/10203675>

For Croatian students:

<https://www.skolskiportal.hr/kolumne/tlak-tlak-tlak-svuda-oko-nas/>

### Biology:

Exploring Blood Pressure

[file:///C:/Users/Korisnik/Desktop/Nova%20mapa/Karamanou\\_history\\_BP\\_measurement.pdf](file:///C:/Users/Korisnik/Desktop/Nova%20mapa/Karamanou_history_BP_measurement.pdf)

What is Blood Pressure?

<https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings>

Regulation of Blood Pressure

<https://study.com/academy/lesson/regulation-of-blood-pressure-short-term-regulation-baroreceptors.html>

What is Hypertension?

<https://www.webmd.com/hypertension-high-blood-pressure/guide/diastolic-and-systolic-blood-pressure-know-your-numbers#1>

Diagnosing High Blood Pressure

<https://www.webmd.com/hypertension-high-blood-pressure/guide/whypertension-diagnosing-high-blood-pressure#1>

For Croatian students:

<http://www.stampar.hr/hr/visoki-krvni-tlak>

<https://edutorij.e-skole.hr/share/proxy/alfresco-noauth/edutorij/api/proxy-guest/3b8a4b4e-84b0-4580-aa6f-e38efe028ed9/biologija-8/m04/j01/index.html>



## 21<sup>st</sup> century skills

This lesson plan will enhance among the students the following skills, defined as 21<sup>st</sup> century skills:

**Critical thinking:** Students develop their research and analysis skills, and learn how to search for and synthesize information

**Collaboration:** Students work in teams and exercise their debating and teamwork skills

**Problem solving:** Students learn how to calculate and operate in Excel

**Presentation and argumentation skills:** Students use evidence to support the thought process, analyse data

**Communication** – during the final group presentation

**Information and technology literacy:** the students are asked to inform from multiple source of information. They will create Power Point presentations

## Lesson Plan

Name of activity	Procedure	Time
<b>1<sup>st</sup> Lesson</b>		
<b>Brainstorming and discussion</b>	The teachers will introduce students to the goals of the lessons.  Students in physics, chemistry and biology class should write down (using a padlet) as much information as possible about pressure (what is pressure, examples of pressures in everyday life, devices where pressure is important, the relationship between pressure and health ...)	15
<b>2<sup>nd</sup> Lesson</b>		
<b>STEM Subject 1</b>	<b>Physics</b>	
<b>Discussion/questions</b>	<p><b>Discussion:</b> Students will have to respond to the following questions (or try to respond):</p> <ol style="list-style-type: none"> <li>1. What is pressure? What are the units of pressure?</li> <li>2. Write a few examples of some pressures you know from everyday life (e.g. tire pressure on a bicycle or car, blood pressure ...)</li> <li>3. What is atmospheric pressure?</li> <li>4. How heavy the air is?</li> <li>5. How much force does air press on each square meter (or square centimeter) of the earth's surface?</li> </ol>	15



Name of activity	Procedure	Time
	6. Why don't we feel that force (air pressure?) 7. Who was the first and how to measure atmospheric pressure? 8. How would you make your own barometer? 9. Can we forecast the weather by monitoring the air pressure?	
Watching a video, researching, making barometers and responding to questions	<p><b>Activity 1: Air pressure research</b></p> <p>Students watch the following videos:  <a href="#">Atmospheric Pressure</a> (Science On line) 5.11 minutes  <a href="#">What is Air Pressure?</a> 3.27 minutes  <a href="#">Exploring Air &amp; Air Pressure</a> 8.49 minutes</p> <p>After watching the video, students discuss (or answer again) questions 1-6 from the previous section</p> <p><b>Activity 2: Making a barometer</b></p> <p>Students watch video <a href="#">The history of the barometer (and how it works)</a> (4.45 minutes)</p> <p>After watching the video, students discuss (or answer again) questions 7 from the previous section</p> <p>Students watch the following videos:  <a href="#">How To Make a Barometer</a> 3.15 minutes  <a href="#">Building a Barometer</a> 1.50 minutes</p> <p>Using the obtained material, students are divided into groups of four. Each group made two „home“ barometers according to the instructions in the video.</p> <p><b>Activity 3: Exploring the relationship between air pressure change and meteorological conditions</b> (Annex 2 – Physics)</p> <p>Over the next month, students are given the task of recording the “pressure” shown by their barometer. Over the next month, students will measure their air pressure and write down what the weather was like that day.</p> <p>Students fill in a worksheet : Physics Data Sheet_1 (Word) – Annex 1</p>	105



Name of activity	Procedure	Time
	<p>Students will research and graph the movement of air pressure and precipitation for the last 30 days in their place (or the nearest place for which they find data on the <a href="#">Ogimet website</a>)</p> <p>Students will choose their country (e.g. Croatia) and their own (or the nearest city for which data is available). In the field <i>Items in ranking list</i> put value 42, select current date and time 06 UTC. After clicking on the selected city, a new web page with meteorological data for last 30 days will open. Students will write down the data on pressure and precipitation in an Excel spreadsheet and present it graphically.</p> <p>Based on the obtained data, students explain the connection between the changes of air pressure and meteorological conditions (precipitation)</p> <p>Repeat the same procedure for two more selected cities in the world (on two different continents)</p> <p>Students fill in a worksheet : Physics Data Sheet_2 (Excel) – Annex 1</p> <p><b>Activity 4: Research of extreme pressure dana</b></p> <p>Students are tasked with finding relevant data on official world records for the highest and lowest sea level pressures measured on Earth.  <a href="#">World Meteorological Organization Global Weather &amp; Climate Extremes Archive</a></p> <p>Students will write a short report on meteorological records related to ground air pressure.</p>	
<b>Learning products</b>	<p>Outcomes of various activities:</p> <p>Barometer models,</p> <p>Excel files with graphical representations of air pressure and precipitation for selected cities,</p> <p>Word document with data on extreme air pressures</p>	
<b>3<sup>rd</sup> Lesson</b>		





Name of activity	Procedure	Time
	<ul style="list-style-type: none"> <li>• Determine the altitude of your home.</li> <li>• Determine the boiling point of water in your home and compare it with the results of a friend.</li> </ul> <p><b>EXPERIMENT: DETERMINATION BOILING POINT OF WATER</b> Heat a vessel containing 500mL of distilled water, continue heating until boiling, and read the temperature on a thermometer that must be close to the surface of the water but not immersed in it. Immediately after the boiling process begins, record the temperature shown by the thermometer. Monitor the thermometer for at least 5 minutes, record readings every minute.</p> <p>Students fill in a worksheet (Chemistry worksheet - Annex 2)</p> <p>Data interpretation If there is a difference between a certain boiling point by experiment and those determined by a calculator explain what is the possible cause? After experimenting and comparing the results with friends answer and explain the answer to the questions asked in the story in the introduction.</p>	
<p><b>Conclusion</b></p>	<p>Boiling occurs when the vapor pressure of a liquid is equal to the pressure of the surrounding gas. As the altitude increases, the air becomes thinner, since the air is thinner, the pressure is lower at higher altitudes. Therefore, cooking occurs at a lower temperature at higher altitude due to a smaller difference between the vapor pressure of the liquid and the ambient pressure. So, on Učka, the water boils earlier, on lower temperature. Your water will boil later, precisely because of the higher boiling point of water in "your" conditions. <b>However, you will finish your lunch earlier, because the higher temperature accelerates the chemical reactions during cooking.</b></p>	<p>10</p>
<p><b>Discussion</b></p>	<p>Ask students where in everyday life we apply what we have learned about the dependence of water boiling point and external pressure. <b>Example:</b> pressure cookers, autoclave</p>	<p>20</p>
<p><b>Learning products</b></p>	<p>Conducting real experiments, collecting data , represent graph Students worksheet - Chemistry</p>	



Name of activity	Procedure	Time
<b>4<sup>th</sup> Lesson</b>		
<b>STEM Subject 3</b>	<b>Biology</b>	
<b>Discussion with students asking them the questions</b>	<ol style="list-style-type: none"> <li>1. Do you know what blood pressure is?</li> <li>2. Why is blood pressure important?</li> <li>3. Who was the first person who measure the blood pressure?</li> <li>4. What are systolic and diastolic blood pressures?</li> <li>5. How is blood pressure measured?</li> <li>6. What is normal blood pressure?</li> <li>7. What are blood pressure disorders?</li> <li>8. Can blood pressure disorders be cured?</li> <li>9. How can we checking blood pressure at home?</li> <li>10. What is manometer?</li> <li>11. What is the most accurate way to determine heart rate?</li> </ol>	15
<b>Video presentations and questions answering</b>	<p>Teacher will explain to the students what a blood pressure is. Teacher will demonstrate to the students how to take a blood pressure, and explain to them the sounds they will hear when taking a blood pressure. The apical pulse and the radial pulse will be explain too.</p> <p>After this the students will watch this video presentations:  <a href="#">How to: Measure Blood Pressure (4:08)</a>  <a href="#">How to: Measure Resting Heart Rate (1:15)</a></p> <p>Than, the students will answer the questions.</p>	10
<b>Blood pressure determination</b>	<p>Activity 1. Blood pressure determination</p> <p>Students will divide up into groups of two. Each student will take their partner’s blood pressure and have their blood pressure taken by their partner.</p> <p>They will measured by the auscultatory method, in the brachial artery of the upper arm (with a stethoscope) .</p> <p>The first pressure they will listening is systolic pressure. After this, when they stop hearing the heartbeat, this blood pressure will be diastolic pressure.</p> <p>The students will recorded the blood pressure on theirs worksheets.</p>	25
<b>Heart rate determination</b>	<p>Activity 2. Heart rate determination</p>	25



Name of activity	Procedure	Time
<p><b>Effect of exercise on blood pressure and heart rate</b></p> <p><b>Form a hypothesis for the experiment</b></p>	<p>Working with their partner, students will determined both their apical and radial pulse. The apical pulse is the actual counting of the heartbeats using the stethoscope over the heart.</p> <p>The radial pulse is measured by counting the pulses of blood in the radial artery . After that the students will recorded their apical and radial pulses. A pulse deficit is the difference between the apical and radial pulse. A pulse deficit greater than four can indicate some physiological problem.</p> <p>Activity 3. Effect of exercise on blood pressure and heart rate</p> <p>After exercised for 3 minutes the students will measured the pulse rate and blood pressure and recorded data on the worksheets provided.</p> <p>Activity 4: Form a hypothesis for the experiment of Activity 3.</p> <p>The students will be able identified the dependent and the independent variable. After that, they will be able identified at least one controlled variable and create a class diagram.</p>	<p>25</p> <p>30</p>
<p>Quiz Kahoot</p>	<p>1.What name is the actual counting of the heartbeats using a stethoscope over the heart? Apical pulse</p> <p>2. What is the name of the instrument used to measure blood pressure? Sphygmomanometer.</p> <p>3. What is hypertension? High blood pressure.</p> <p>4. What's considered low blood pressure ? Hypotension.</p> <p>5. The name of the difference between the apical and radial pulse is? Pulse deficit</p> <p>6. Pressure exerted in aorta during ventricular contraction is named? Systolic pressure.</p> <p>7. Which is the normal blood pressure? 16/10,7kPa (120/80 mm Hg)</p>	<p>5-6</p>
<p><b>Learning products</b></p>	<p>Developing students practical competences,</p> <p>Raising awareness of healthcare,</p> <p>Developing students critical thinking skills,</p> <p>Developing research questions: hypothesis and variables.</p>	
<b>5<sup>th</sup> lesson</b>		
<p><b>STEM Subject 4</b></p>	<p><b>Informatics (ICT)</b></p>	<p>45'</p>
<p><b>non-STEM subject</b></p>	<p><b>English language</b></p>	<p>45'</p>
<p><b>Preparing presentation; groupwork</b></p>	<p>Students are preparing final group presentation (Power Point)</p> <p>Students prepare a final Powerpoint presentation in which they will present the results of their work. The presentation is prepared in the mother tongue and translated into English.</p>	



Name of activity	Procedure	Time
Learning products	Powerpoint presentation	

## Assessment

### Initial assessment

At the beginning of each lesson, a list of questions through which the initial assessment will be conducted is listed

### Formative evaluation

During every subject lesson, several formative assessments will take place in a form of a short quizzes and rubrics

### Final assessment

A final quiz with question related to the topics covered in all the lessons

The evaluation of the Power Point presentation

The students will express their opinion writing short essays on this topic.

### Student feedback

Students will answer following questions (online form platform):

- Have all planned activities and goals been achieved?
- How can you use the new information in your real life?
- To what extent did you find the content of the classes useful?
- What did you like about the project?
- What would you improve

### Teacher feedback

*The teachers are expected to provide feedback on how the lessons were received and implemented.*



# Annexes

## Annex 1

Physics Data Sheet\_1 (Word)

Date	Pressure/hPa	Daily weather summary			
					
	14:00				
19.11.2020.	1024,0 hPa	x			
20.11.2020.	1021,4 hPa		x		
21.11.2020.	1007,5				x
...	....				

Physics Data Sheet\_2 (Excel)

Date	Pressure/hPa	Precipitation/mm
22.10.2020.	1024,5	0,0
23.10.2020.	1024,0	0,0
..	...	....

Examples od DataSheet and graph (City: Pazin/Croatia, 22.10.2020.-19.11.2020)

<https://www.ogimet.com/ranking.phtml.en>

<https://www.ogimet.com/cgi->

<bin/gsynext?lang=en&state=Croa&rank=42&ano=2020&mes=11&day=19&hora=06&Send=send>

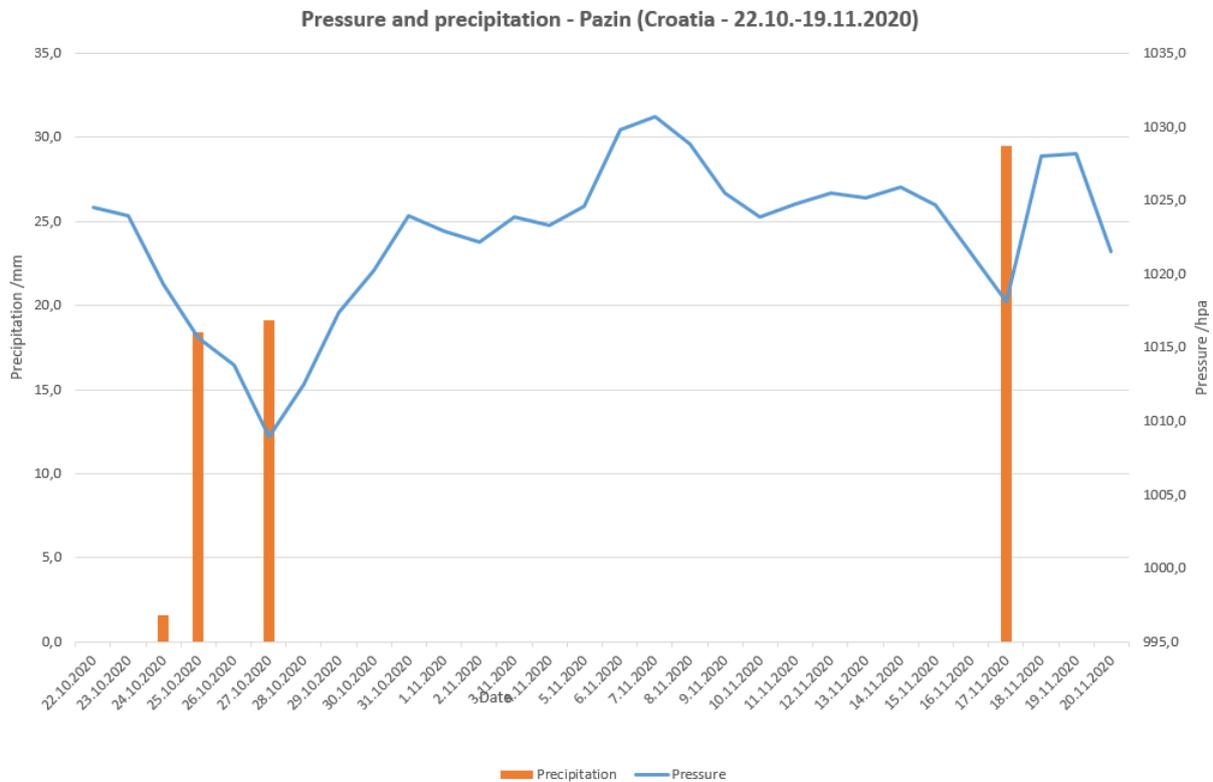
<https://www.ogimet.com/cgi->

<bin/gsynres?lang=en&ind=14308&ano=2020&mes=11&day=19&hora=6&min=0&ndays=30>

Date	Pressure/hPa	Precipitation/mm
<b>22.10.2020</b>	<b>1024,5</b>	<b>0,0</b>
<b>23.10.2020</b>	<b>1024,0</b>	<b>0,0</b>
<b>24.10.2020</b>	<b>1019,3</b>	<b>1,6</b>
<b>25.10.2020</b>	<b>1015,7</b>	<b>18,4</b>
<b>26.10.2020</b>	<b>1013,8</b>	<b>0,0</b>
<b>27.10.2020</b>	<b>1008,9</b>	<b>19,1</b>
<b>28.10.2020</b>	<b>1012,5</b>	<b>0,0</b>
<b>29.10.2020</b>	<b>1017,4</b>	<b>0,0</b>



<b>30.10.2020</b>	<b>1020,2</b>	<b>0,0</b>
<b>31.10.2020</b>	<b>1024,0</b>	<b>0,0</b>
<b>1.11.2020</b>	<b>1022,9</b>	<b>0,0</b>
<b>2.11.2020</b>	<b>1022,2</b>	<b>0,0</b>
<b>3.11.2020</b>	<b>1023,9</b>	<b>0,0</b>
<b>4.11.2020</b>	<b>1023,3</b>	<b>0,0</b>
<b>5.11.2020</b>	<b>1024,6</b>	<b>0,0</b>
<b>6.11.2020</b>	<b>1029,8</b>	<b>0,0</b>
<b>7.11.2020</b>	<b>1030,7</b>	<b>0,0</b>
<b>8.11.2020</b>	<b>1028,8</b>	<b>0,0</b>
<b>9.11.2020</b>	<b>1025,5</b>	<b>0,0</b>
<b>10.11.2020</b>	<b>1023,9</b>	<b>0,0</b>
<b>11.11.2020</b>	<b>1024,8</b>	<b>0,0</b>
<b>12.11.2020</b>	<b>1025,5</b>	<b>0,0</b>
<b>13.11.2020</b>	<b>1025,2</b>	<b>0,0</b>
<b>14.11.2020</b>	<b>1025,9</b>	<b>0,0</b>
<b>15.11.2020</b>	<b>1024,7</b>	<b>0,0</b>
<b>16.11.2020</b>	<b>1021,4</b>	<b>0,0</b>
<b>17.11.2020</b>	<b>1018,1</b>	<b>29,5</b>
<b>18.11.2020</b>	<b>1028,0</b>	<b>0,0</b>
<b>19.11.2020</b>	<b>1028,2</b>	<b>0,0</b>
<b>20.11.2020</b>	<b>1021,5</b>	<b>0,0</b>



**Annex 2**
**Chemistry student sheet**

Student name(s) \_\_\_\_\_

Date: \_\_\_\_\_

Collecting data:

Temperature					Mean boiling point of water
Starts to boil $t_1$ (°C)	Continue cooking				$(t_1 + t_2 + t_3 + t_4 + t_5 + t_6)/6$ (°C)
	$t_2$	$t_3$	$t_4$	$t_5$	$t_6$

**THE RESULTS:**

ALTITUDE: \_\_\_\_\_,

AVERAGE VALUE OF WATER BOILING: \_\_\_\_\_,

**Data interpretation:**

 DETERMINE THE BOILING POINT OF WATER USING A CALCULATOR <https://planetcalc.com/275/>

THE BOILING POINT OF WATER IS \_\_\_\_\_

**Annex 3**
**Biology student sheet**
**1. Blood pressure determination**

Take a blood pressure and record both pressures:

Student 1

Name \_\_\_\_\_

Systolic pressure \_\_\_\_\_

Diastolic pressure \_\_\_\_\_

Student 2

Name \_\_\_\_\_

Systolic pressure \_\_\_\_\_

Diastolic pressure \_\_\_\_\_

**2. Measuring an Apical and Radial pulse and Pulse deficit**

After measures apical pulse with stethoscope and pulse at radial site record the both pulses:

Student 1

Apical pulse \_\_\_\_\_

Radial pulse \_\_\_\_\_

Student 2

Apical pulse \_\_\_\_\_

Radial pulse \_\_\_\_\_



Pulse deficit \_\_\_\_\_

Pulse deficit: \_\_\_\_\_

The apical pulse minus the radial pulse equals the pulse deficit.

**3. Effect of exercise on blood pressure and heart rate**

Student 1 (gender) \_\_\_\_\_

Student 2 (gender) \_\_\_\_\_

Record your puls rate and blood pressures before and after exercise for a period of 3 minutes. Use a table below to record your data.

Time after exercise/min	Pulse rate/ Blood pressures
1	
2	
3	

**Plot this data as a line graph to see who will have best recovery rate.**

