SAINT LOUIS UNIVERSITY.

Program-Level Assessment: Annual Report

Program: Program in Physical Therapy and Athletic Training Program	Department: Physical Therapy and Athletic Training
Degree or Certificate Level: Bachelor of Science Exercise Science (BSES)	College/School: Doisy College of Health Sciences
Date (Month/Year): September 2021	Primary Assessment Contact: Anthony Breitbach / Randy Richter
In what year was the data upon which this report is based collected? AY 2020 - 2021	
In what year was the program's assessment plan most recently reviewed/updated? Spring 2021	

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle?

PLO #1- Identify educational opportunities to continually seek new knowledge. This PLO is being revised and was not assessed this cycle.

PLO #3- Apply knowledge of the research literature to individual patients to estimate relative disease risk

PLO #4- Demonstrate foundational knowledge of injury-healing processes.

2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please identify the course(s) in which these artifacts were collected. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

PLO #3 Apply knowledge of the research literature to individual patients to estimate relative disease risk
1- DPT/MAT 3230 Exercise Physiology – Exercise response lab assignment and VO2max lab assignment
Due to COVID 19, this course was online for spring 2021. This course was not offered at the Madrid campus or at any other off-campus location.

Description of Assessment Method and Artifact

Note in spring 2021 the course coordinator for DPT/MAT 3230 Exercise Physiology changed and the lab assignment typically used as an artifact for PLO #3 was not incorporated into the course. The two labs chosen as artifacts were related to understanding disease risk. Specifically, the exercise response lab assignment and the VO2max lab assignment are designed to help students learn how to measure the body's response to activity (e.g., heart rate, respiratory rate, VO2max). Understanding the body's response to activity is necessary to understanding risk of disease.

The lab assignments follow the assessment rubric.

No Madrid artifacts were included

PLO #4 Demonstrate foundational knowledge of injury-healing processes.
1- DPT/MAT 4125 -Therapeutic Modalities- Inflammation Concept Mapping Activity
This course was a flipped class – lectures are recorded, and labs are in person. The flipped pedagogy was used in previous years and not due to COVID. This course was not offered at the Madrid campus or at any other off-campus location.

Description of Assessment Method and Artifact

The Inflammation Concept Mapping Activity Assignment served as the artifact for PLO #4. This assignment incorporates 4 concept maps with 16 team projects illustrating a stage of the inflammation process. Each team is responsible for graphically representing the stage in the inflammatory process, and then teaching the information back to their respective class. All of the stages in the inflammatory process from each lab section were assembled into a concept map for their lab section, which was displayed in the lab for the rest of the term for use as a reference by the entire class.

The assignment activity and example artifact follow the assessment rubric.

No Madrid artifacts were included

3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and include them in/with this report.

Data from DPT/MAT 3230 (PLOs #3) and DPT/MAT 4125 (PLO #4) was assessed by Drs. Breitbach and Richter to determine level of attainment for each PLO as per the assessment rubric (see below).

Artifacts:
PLO #3: Apply knowledge of the research literature to individual patients to estimate relative disease risk: DPT/MAT 3230 Exercise Physiology – The exercise response lab assignment and the VO2max lab assignment from the Spring 2021 course offering served as the artifacts.

PLO #4 Demonstrate foundational knowledge of injury-healing processes: DPT/MAT 4125 -Therapeutic Modalities- Inflammation Concept Mapping Activity from the Fall 2020 course offering served as the artifact.

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

<u>NOTE:</u>
The program target identified in the assessment plan, which is the minimum percentage of students able to achieve each PLO at the designated ranking, was established at the College Standard rate of 85% or better by the former Dean of the Doisy College of Health Sciences.

PLO #3--1-25% of assignments in the course will be reviewed with an average of 85% achieving a ranking of “reinforce” or higher using the corresponding assessment rubric. (met/ not met??)

PLO #3 was met. An average of 92% of students achieved a score of 93% or high across the two lab assignments; achieving a ranking of “reinforce” or higher.

PLO #4--1-25% of assignments in the course will be reviewed with an average of 85% achieving a ranking of “reinforce” or higher using the corresponding assessment rubric. (met/ not met??)

PLO #4 was met. On average, in each concept map 14 of the 16 groups (87.5%) communicated their stage at the “reinforce” or higher level.

For each course the same teaching modality (e.g., online, face-to-face labs) and location (e.g., STL campus) were used throughout to semester. Therefore, there were no differences by teaching modality or location.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

Regarding PLO #3, new artifacts were used to assess the PLO. At a faculty meeting in May 2021, the need to better inform faculty of assignments used for PLO artifacts was recognized. In fall 2021 additional artifacts for PLO #3 will be identified and the PLO may be modified.

Regarding PLO #4, students are demonstrating knowledge of the injury-healing processes.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss these results and findings from this cycle of assessment?

Findings from AY 2020-2021 on PLO #3 and #4, will be discussed at a department faculty meeting fall 2021.

B. How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies	• Course content • Teaching techniques • Improvements in technology • Prerequisites	• Course sequence • New courses • Deletion of courses • Changes in frequency or scheduling of course offerings
Changes to the Assessment Plan	• Student learning outcomes • Artifacts of student learning • Evaluation process	• Evaluation tools (e.g., rubrics) • Data collection methods • Frequency of data collection

Please describe the actions you are taking as a result of these findings.

Findings from AY 2020-2021 on PLO #3 and #4, will be discussed at a department faculty meeting fall 2021. Possible actions will be identified at that time.

If no changes are being made, please explain why.

Findings from AY 2020-2021 on PLO #3 and #4, will be discussed at a department faculty meeting fall 2021.

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years as a result of assessment data?

Previous findings are similar, and changes have not been driven by the PLO outcomes. However, in spring 2021 faculty reviewed the assessment data from the previous academic year and the assessment plan. Faculty were interested in identifying additional artifact across multiple courses to assess the PLOs in greater detail. Additionally, faculty recommended that as a group

B. How has this change/have these changes been assessed?

During AY 2021 – 2022 assessment of PLOs and possible changes to artifacts will be discussed at a faculty meeting.

C. What were the findings of the assessment?

During AY 2021 – 2022 assessment of PLOs and possible changes to artifacts will be discussed at a faculty meeting.

D. How do you plan to (continue to) use this information moving forward?

During AY 2021 – 2022 assessment of PLOs and possible changes to artifacts will be discussed at a faculty meeting.

IMPORTANT: Please submit any assessment tools and/or revised/updated assessment plans along with this report.

Bachelor of Science in Exercise Science (BSES) Assessment Rubric		
PLO #1 - Identify educational opportunities to continually seek new knowledge.		
Introduce	**Reinforce**	**Mastery**
• Identifies importance of educational opportunities to continually seek new knowledge.	• Describes outcomes associated with educational opportunities to continually seek new knowledge.	• Proposes strategies for obtaining educational opportunities to continually seek new knowledge.
PLO #2 - Determine strategies that aim to improve health or promote wellness.		
Introduce	**Reinforce**	**Mastery**
• Identifies strategies that aim to improve health or promote wellness.	• Develop strategies that aim to improve health or promote wellness.	• Communicates strategies that aim to improve health or promote wellness to appropriate stakeholders.
PLO #3 - Apply knowledge to estimate relative disease risk.		
Introduce	**Reinforce**	**Mastery**
• Identifies importance of risk assessment on disease.	• Describes process of risk assessment.	• Conduct lab assignment to assess potential risk of disease.
PLO #4 - Demonstrate foundational knowledge of injury-healing processes.		
Introduce	**Reinforce**	**Mastery**
• Identifies foundational knowledge of injury-healing processes.	• Describes understanding foundational knowledge of injury-healing processes.	• Communicates foundational knowledge of injury-healing processes to appropriate stakeholders.
PLO #5 - Evidence the ability to advocate for healthy lifestyle behaviors.		
Introduce	**Reinforce**	**Mastery**
• Identifies importance of advocacy for healthy lifestyle behaviors.	• Describes strategies for advocacy for healthy lifestyle behaviors.	• Communicates advocacy for healthy lifestyle behaviors to appropriate stakeholders.

Artifact
PLO #3: Apply knowledge of the research literature to individual patients to estimate relative disease risk: DPT/MAT 3230 Exercise Physiology – Two lab assignments from the Spring 2021 course offering served as the artifacts

SLU Department of Physical Therapy and Athletic Training
DPT-MAT 3230: Exercise Physiology (created by Dave Gutekunst, Ph.D., 2021)

This form is optional, and for data collection purposes while you are performing the lab activity. Please enter the numeric values and short responses in the Google Form that is linked from the course Blackboard page.

Overview: The purpose of this short, DIY lab activity is to review concepts of cardiac output, heart rate, stroke volume, and respiratory rate at rest and in response to acute aerobic exercise. You will need to record your heart rate at rest, following several short bouts of activity, and during recovery. Therefore, you will need to either record your heart rate manually or use a smart watch or heart rate monitor.

Background: How did you record your heart rate? (e.g. manually, smart watch, HR monitor)

Part 1: Resting values

1	Lie down and relax for a few minutes. (If you meditate or do breathing exercises, do that too.) Once you're calm, record your heart rate for either 15 or 30 seconds. Then multiply either by 4 (if you recorded for 15 sec) or by 2 (if you recorded for 30 sec) to get your supine resting HR in beats per minute. Just be consistent across the lab measurements. If you're wearing a smart watch or heart rate monitor, just record your lowest measured heart rate.
	Answer:
2	Now stand up and allow yourself to relax again for a few minutes. Once you're calm, repeat your heart rate measurement technique and record your standing resting HR here:
	Answer:
3	Estimate your resting cardiac output (CO) using the "7 Percent Rule." Recall that at rest, our CO is roughly equivalent to our total blood volume, per minute. To estimate your total blood volume, you'll first need to compute your body mass in kilograms by dividing your weight in pounds by 2.2 (an estimate is fine if you don't have access to a scale). Then, multiply your body mass in kilograms by 7% (0.07) to get an estimated blood volume in liters (L). *Example:* a person who weighs 150 lbs has a body mass of 68.2 kg. Multiply by 0.07 to get an estimated blood volume of 4.77 L and an estimated resting CO of 4.77 L/min.
	Answer:
4	Now compute your supine resting stroke volume in mL per heartbeat. You'll need to convert your estimated resting CO from L/min into mL/min. Example: if our previous imaginary classmate with a resting CO of 4.77 L/min had a resting supine HR of 60 beats/min, then their resting SV would be 79.5 mL/heartbeat.
	Answer:
5	Do the same SV calculation based on your standing resting HR.
	Answer:
6	How did your resting HR and SV compare in the standing and supine positions? Why, on average, do people have a lower resting HR in the supine position compared to standing?
	Answer:

Part 2: Estimated maximum HR and heart rate reserve (HRR) training zones. In this section you'll compute your age-predicted max HR, then calculate some heart rate training zones using your resting HR and the heart rate reserve (HRR) method.

7	Compute your predicted maximum HR using the equation Max HR = 208 - 0.7*Age. Example: a 30 year-old person would have a predicted max HR of 208 - 0.7*30 = 187 beats/min.
	Answer:
8	Compute your heart rate reserve (HRR), which is the difference between your resting HR and your predicted max HR. Use whichever resting HR value is lower from the previous section. Example: a 30-year old who has a predicted max HR of 187 bpm and a resting HR of 60 bpm would have a HRR of 127 bpm.
	Answer:
9	To get an aerobic benefit from physical activity, it is recommended that a person's HR reaches at least 40-50% of their HRR. (This is another "continuum" concept, but most research suggests this ~40-50% HRR range to stimulate aerobic adaptations.) Using your resting HR and your HRR, compute your 50% HRR value. Example: a person with a resting HR of 60 bpm, estimated max HR of 187, and HRR of 127 would have a 50% value of: 60 bpm + 0.50*(127) = 123.5 bpm. (So, round up to 124 bpm)
	Answer:
10	Make the same calculation for 70% of HRR, which represents the midrange of a HR that should be sustainable for long-duration exercise like a 60-minute jog or bike ride. Example: 60 bpm + 0.70*(127) = 148.9 bpm. (So, round up to 149 bpm)
	Answer:
11	Finally, make the same calculation for 85% of HRR, which represents the HR where a moderately trained person would typically experience their lactate threshold. (Recall that one of the adaptations from long-term training is to be able to exercise at a higher % of VO2max and HRR before beginning to build up excess lactate.) Example: 60 bpm + 0.85*127 = 167.95 bpm. (So, round up to 168 bpm)
	Answer:

Part 3: HR Responses to Exercise. In this section you will do some physical activity. (Huzzah!) If you have an injury or any other physical limitation, email me and I'll provide some HR data for you to use. Find a flat route where you can jog continuously for at least 3 minutes. The ideal location would be something like around Hermann soccer stadium or the track on the med campus. You'll be doing a slow walk, brisk walk, light jog, and "anaerobic threshold" pace.

12	**Light Walk:** walk at a light, easy pace for 3 minutes. Once you're done, record your HR as soon as possible. A 15-second count if preferable in this instance, as your HR will begin to decline as soon as you stop moving. Convert your heartbeat count to beats/minute and record it here.
	Answer:
13	**Brisk Walk:** rest until you feel ready to go again, then walk at a brisk pace (as if you were rushing to class or a bus) for 3 minutes. Afterward, record your HR again and record it here.
	Answer:
14	**Light Jog:** rest until you feel ready to go again, then repeat the same 3 minute exercise bout at a light jog. Afterward, record your HR.
	Answer:
15	**"Ventilatory Threshold" Pace:** rest again, then complete your last 3 minute exercise bout. This time you will run at a speed that is moderately hard, but at which you could still carry on a short conversation. (This intensity approximates the ventilatory threshold, above which your respiratory rate increases rapidly as you breathe off excess CO2 from buffering lactic acid.) Afterward, record your HR as you've done before.
	Answer:
16	**Recovery Heart Rate (2-3 minutes post-exercise):** Rest for 2 minutes after your last exercise bout, then record your HR again. This is your first recovery HR.
	Answer:
17	**Recover Heart Rate #2 (4-5 minutes post-exercise):** Rest for 2 more minutes and record another recovery HR. This is your 4-5 minute recovery HR.
	Answer:

Part 4: Summary Questions (fill out within Google Form)

__Data Sheet__ **(easier format to print or enter data as a Google Doc)**

Part 1: Resting values

1. Supine resting HR	
2. Standing resting HR	
3. Estimated CO using 7% Rule	
4. Calculated supine resting SV	
5. Calculated staning resting SV	
6. (free response) How did HR and SV compare in standing vs supine positions?	

Part 2: Estimated max HR and HRR training zones

7. Age-predicted max HR	
8. Heart Rate Reserve (HRR)	
9. HR at 50% of HRR	
10. HR at 70% of HRR	
11. ing SV	

Part 3: HR Responses to Exercise

12. HR after light walk	
13. HR after brisk walk	
14. HR after light jog	
15. HR after "ventilatory threshold" job	
16. Recovery HR #1 (2-3 mins post)	
17. Recovery HR #2 (4-5 mins post)	

Saint Louis University Department of Physical Therapy and Athletic Training
DPT-MAT 3230: Exercise Physiology

(created by Wendy Kohrt, Ph.D.; adapted by Dr. Ethel Frese; updated in 2020 by Dave Gutekunst, Ph.D.)

Submit your lab report by email using file name **VO2maxlab_2021_Group##.docx**
(where ## is your group number).

OBJECTIVES:

1. To measure resting metabolic rate (RMR) and estimate resting energy expenditure per minute, per hour, and per day.

2. To a) predict VO_2max from predicted maximal HR and submaximal determinations of VO_2 and HR, and b) compare this value with measured VO_2max.

3. To compare techniques using either VO_2max or HR_{max} to identify relative exercise intensity.

4. To calculate target HR range.

5. To determine oxygen deficit and EPOC.

6. To calculate the energy expenditure of the 3 submaximal exercise intensities.

PROCEDURES

1. Measure resting heart rate, VO_2, and RER for 5 minutes while seated.

2. Perform 3 progressively harder exercise stages of 4 minutes each; record heart rate, VO_2, and RER data for 30-sec segments.

4. At the end of the third stage, increase either/or speed and incline for one minute stages. Record the speed, grade, heart rate, VO_2, and RER for each 1-minute stage. Continue incrementing the intensity each minute until exhaustion.

5. Monitor recovery for >5 minutes.

LAB REPORT. Answer these questions in addition to creating graphs using the Excel data sheet.

Section 1: Resting values

1	Calculate the average HR, VO_2, and RER at rest. Recall that a MET equivalent is 3.5 mL/kg/min and is considered the standard value for resting oxygen consumption. How does the subject's resting VO_2 compare?
	Answer:
2	Using the subject's body mass, determine her/his resting VO_2 in mL/min
	Answer:
3	What was the subject's average RER value during the resting period? Using Table 5.1 on page 126 of the Kenney textbook, *estimate* what percent of the subject's resting energy expenditure was coming from lipids? Carboydrate?
	Answer:
4	Next, using the average resting RER, the average resting VO_2, and the subject's body mass, determine the subject's resting energy expenditure in kcal/min, kcal/hr, and kcal/day.
	Answer:

Section 2: Graded exercise test results

5	Plot the VO_2 data for the entire test (rest, exercise, and recovery) in the Excel data sheet. VO_2 (in mL/kg/min) should be on the y-axis and Time on the x-axis. What do you notice about the shape of the VO_2 vs Time curve within each stage? Why does this occur and what does it represent?
	Answer:
6	For each of the first three stages, compute the average VO_2 over the last minute of the stage (e.g. the 3:30 and 4:00 measurements for Stage 1, the 7:30 and 8:00 measurements for Stage 2, etc.). This is the ***steady-state*** VO_2 for each workload.
	Answer:
7	Then calculate the difference between the ***steady-state*** VO_2 and the VO_2 measurements for the other timepoints in each stage. For example, the difference at the 4:30 timepoint is the measured value at 4:30 minus the average of the 7:30 and 8:00 measurements. In other words, O_2 deficit = Actual VO_2 – Steady State VO_2 demand Calculate the sum for each stage. **What does this sum represent?**
	Answer:

8	As you did for the resting data, use the average RER for each of the first three stages to calculate the percent energy that was derived from lipids and the percent from carbohydrates. (If the RER is above 1.0 for a stage, then assume that the energy utilization was 100% carbohydrate.)
	Answer:
9	Then, using the subject's body mass and the average VO_2 and RER values for each stage, compute the average rate of energy expenditure in kcal/min for each stage. Lastly, multiple the rate of energy expenditure (in kcal/min) by the time in each stage to determine the total energy expenditure for each stage.
	Answer:
10	Did the subject satisfy the criteria for attaining VO_2max? Explain your answer.
	Answer:
11	Calculate the average VO_2 and HR over the last minute of each of the first 3 exercise stages. On another Excel graph, plot HR (y-axis) vs VO_2 (x-axis) and include a linear regression line for these 3 points. See Figures 8.1 and 8.2 on page 201 of the Kenney textbook. Now extend the line to the subject's age-predicted maximal HR (HR_{max}). Use the equation **HR_{max} = 208 – 0.7*Age).** What is the predicted VO_2max? How does this compare with the measured VO2 max? How do the predicted and measured values for HR max compare? Discuss the limitations of trying to predict VO_2max from submaximal HR values (see pp. 243-244 of your textbook).
	Answer:
12	Use the measured VO_2max and HR max values and the VO_2 and HR values calculated in (11) to determine the relative intensity of each of the three submaximal exercise stages as follows?: a) Express the VO_2 at each stage as a percent of VO_2max b) Express the HR at each stage as a percent of HR_{max}. c) Express the HR at each stage as a percent of HR reserve: HR reserve = $HR_{max} – HR_{rest}$ $\% \text{ HR Reserve} = \left(\frac{\text{Exercise HR} - \text{HR}_{\text{rest}}}{\text{HR Reserve}}\right) * 100$ When you exercise at a given % of VO_2max, are you exercising at the same % of HR_{max}? Explain.
	Answer:

13	Calculate the target HR range for exercise at 60-85% of HR reserve using the Karvonen method (use actual HR_{max}): HR Reserve = HR_{max} - HR_{rest} 60% target HR = HR_{rest} + 0.6*(HR Reserve) 85% target HR = HR_{rest} + 0.85*(HR Reserve)
	Answer:

Section 3: Recovery, EPOC, and post-exercise energy expenditure

14	Calculate the total **excess post-exercise oxygen consumption (**EPOC) during recovery. EPOC = Actual VO_2 – Resting VO_2 See pages 130-131 in the Kenney textbook (especially Figure 5.5 on page 131) for a more detailed explanation of how to calculate this answer. Convert the actual VO_2 for each minute to L/min. Add these post-exercise VO_2 values to compute the total liters of O_2 consumed post-exercise.
	Answer:
15	Then, use the resting VO_2 that you calculated in Section 1 and convert to L/min. Multiply this resting VO_2 by the number of minutes that post exercise VO_2 was measured. Subtract this number from the total VO_2 that you calculated post exercise. This is the EPOC, and the answer should be in liters. *Why is there an EPOC? In other words, why doesn't VO_2 return immediately to baseline after exercise?*
	Answer:
16	"Afterburn" concept of additional post-exercise energy expenditure: using the EPOC (in liters) and the average RER during recovery, compute the energy expenditure associated with this additional oxygen consumption.
	Answer:

Artifact

PLO #4 Demonstrate foundational knowledge of injury-healing processes.
1- DPT/MAT 4125 -Therapeutic Modalities- Inflammation Concept Mapping Activity

DPT/MAT 4125 – Therapeutic Modalities

INFLAMMATION & HEALING

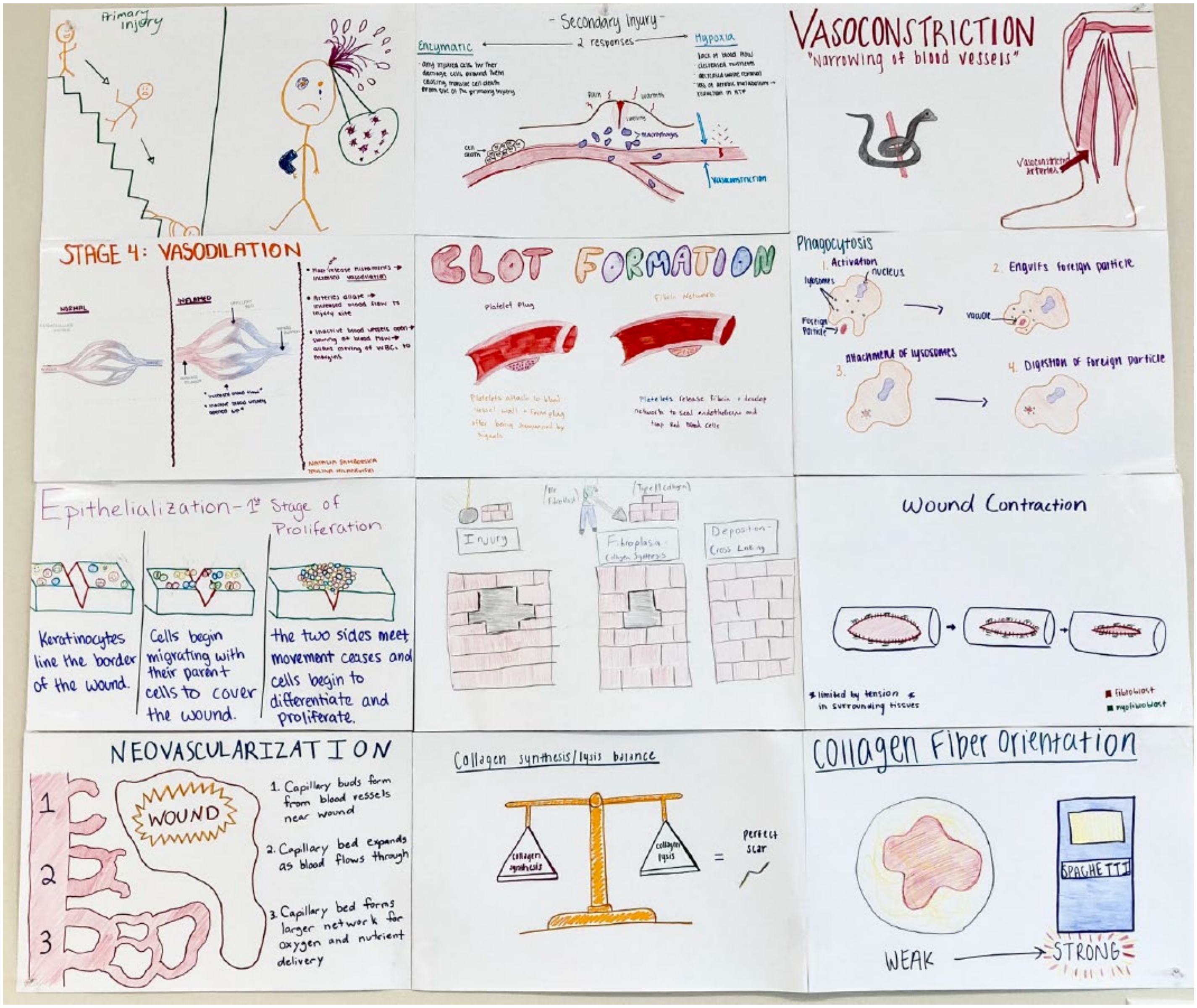
DESCRIPTION:
This is a concept mapping activity to get practice and show understanding of the inflammatory and tissue healing processes.

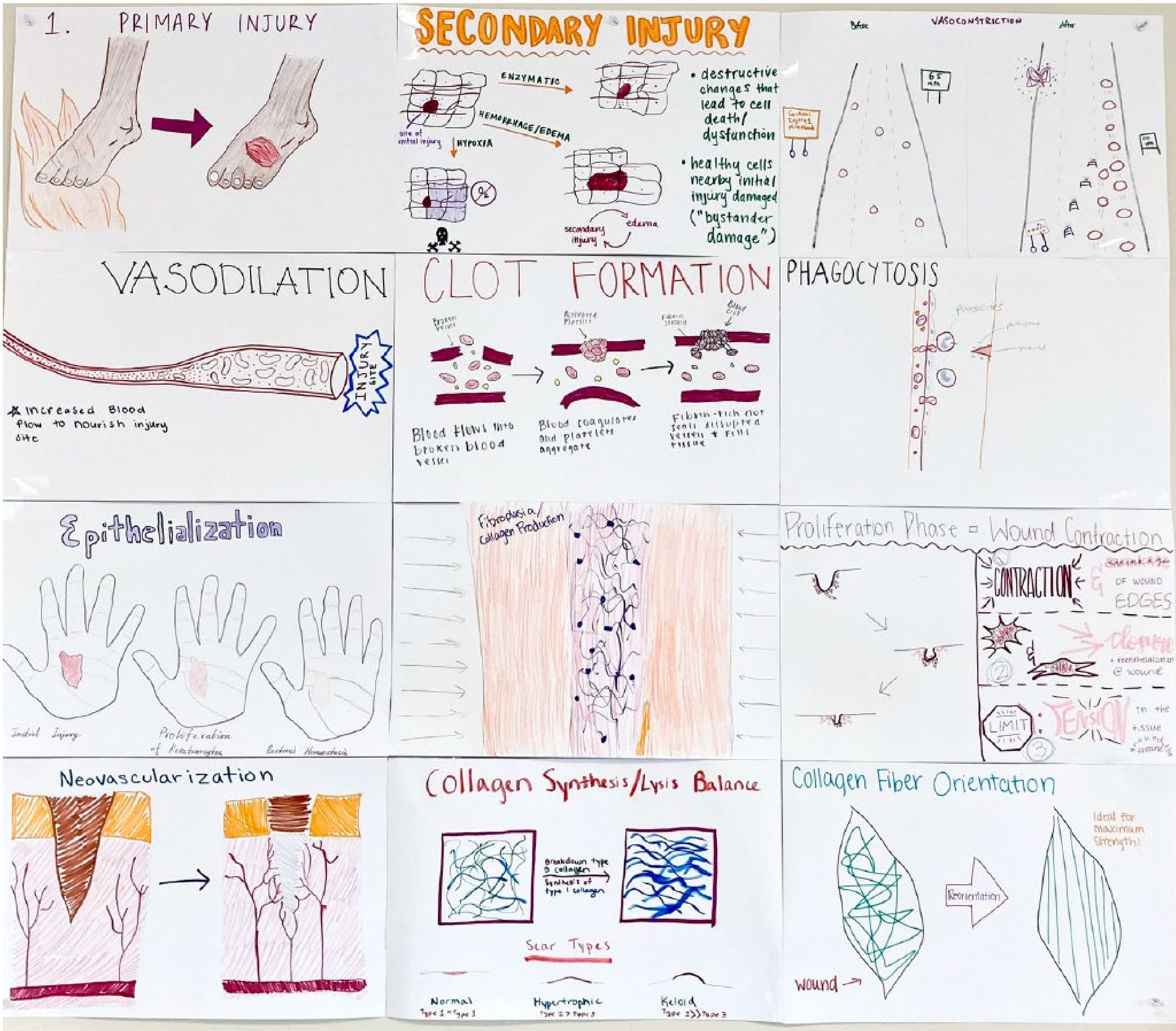
LAB ACTIVITY:

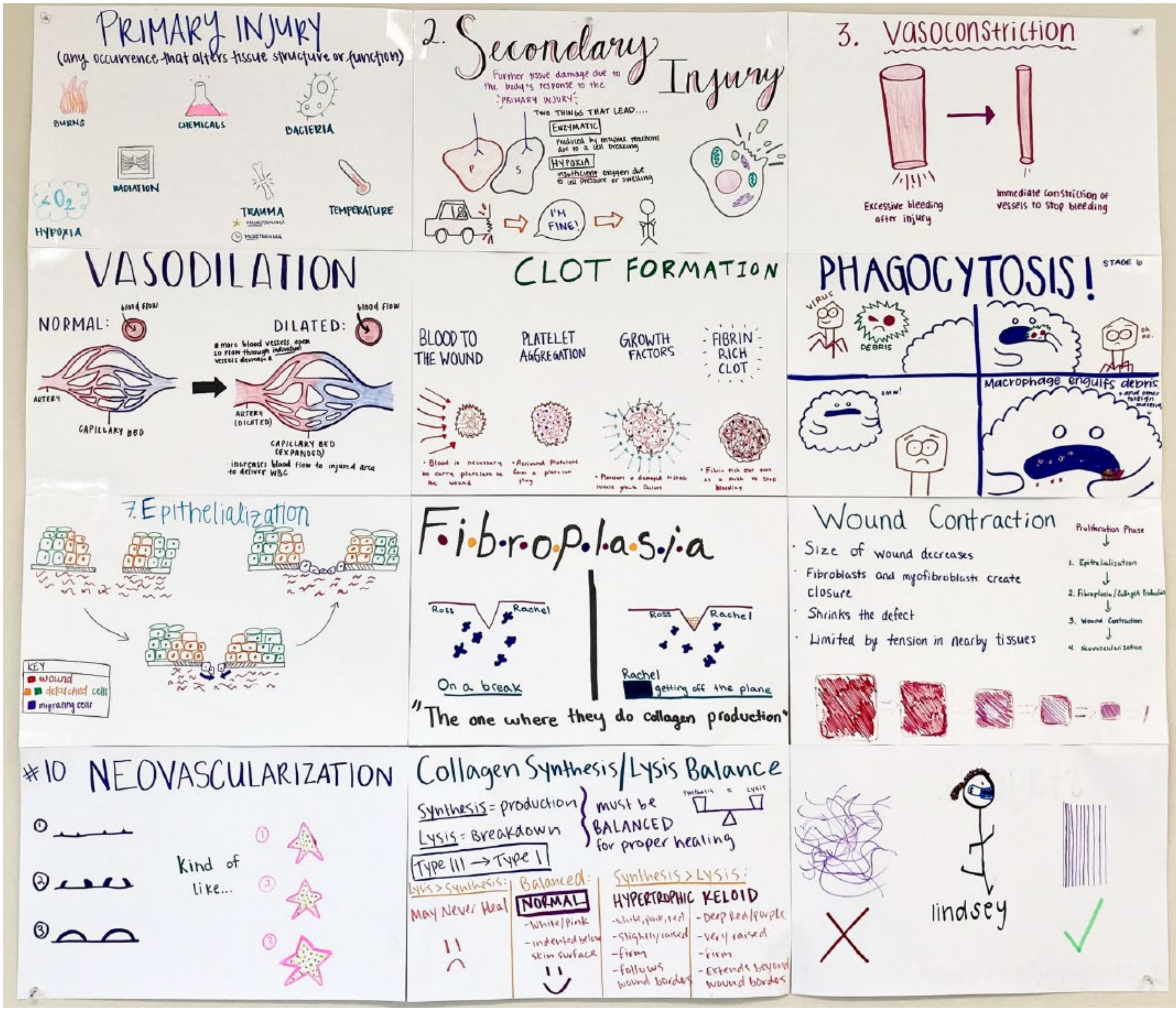
1. Lab partners with develop individual concept maps of an assigned stage in the inflammatory process, trying to get as much detail as possible.
2. Students will then be required to explain their individual concept map to the class.
3. These individual concept maps will then be combined in a class concept map to form a large presentation.
4. Concepts can be shown in words and drawings to demonstrate their understanding of the principles of inflammation and healing.

STAGES:

1. Primary injury
2. Secondary Injury
3. Vasoconstriction
4. Vasodilation
5. Clot Formation
6. Phagocytosis
7. Epithelialization
8. Fibroplasia/Collagen Production
9. Wounds Contracture
10. Neovascularization
11. Collagen Synthesis/Lysis Balance
12. Collagen Fiber Orientation


Primary injury
- Secondary Injury -
2 responses
Enzymatic
Hypoxia
Vasoconstriction
VASOCONSTRICTION
"Narrowing of blood vessels"
STAGE 4: VASODILATION
NORMAL
INFLAMED
CLOT FORMATION
Platelet Plug
Phagocytosis
1. Activation
nucleus
2. Engulfs foreign particle
3. Attachment of lysosomes
4. Digestion of foreign particle
Epithelialization - 1st Stage of Proliferation
Keratinocytes line the border of the wound.
Cells begin migrating with their parent cells to cover the wound.
the two sides meet movement ceases and cells begin to differentiate and proliferate.
Injury
Fibroplasia
Deposition
Cross Linking
Wound Contraction
limited by tension in surrounding tissues
NEOVASCULARIZATION
WOUND
1. Capillary buds form from blood vessels near wound
2. Capillary bed expands as blood flows through
3. Capillary bed forms larger network for oxygen and nutrient delivery
Collagen synthesis/lysis balance
collagen synthesis
collagen lysis
perfect scar
Collagen Fiber Orientation
SPAGHETTI
WEAK
STRONG


1. PRIMARY INJURY
SECONDARY INJURY
ENZYMATIC
HEMORRHAGE/EDEMA
site of initial injury
HYPOXIA
secondary injury
edema
• destructive changes that lead to cell death/ dysfunction
• healthy cells nearby initial injury damaged ("bystander damage")
VASOCONSTRICTION
Before
After
VASODILATION
INJURY SITE
Increased Blood flow to nourish injury site
CLOT FORMATION
Broken Vessel
Activated Platelets
Fibrin Strand
Blood Clot
Blood flows into broken blood vessel
Blood coagulates and platelets aggregate
Fibrin-rich clot seals disrupted vessels + fills tissue
PHAGOCYTOSIS
Epithelialization
Initial Injury
Proliferation of Keratinocytes
Restored Homeostasis
Fibroplasia/ Collagen Production
Proliferation Phase = Wound Contraction
CONTRACTION
OF WOUND EDGES
closure
+ reepithelialization @ wound
LIMIT
TENSION
in the tissue
Neovascularization
Collagen Synthesis/Lysis Balance
Breakdown type 3 collagen
Synthesis of type 1 collagen
Scar Types
Normal
Type 1 = Type 3
Hypertrophic
Type 1 > Type 3
Keloid
Type 1 >> Type 3
Collagen Fiber Orientation
Ideal for Maximum Strength!
Reorientation
Wound


PRIMARY INJURY
(any occurrence that alters tissue structure or function)
BURNS
CHEMICALS
BACTERIA
RADIATION
TRAUMA
TEMPERATURE
HYPOXIA
2. Secondary Injury
Further tissue damage due to the body's response to the PRIMARY INJURY
TWO THINGS THAT LEAD....
ENZYMATIC
HYPOXIA
I'M FINE!
3. Vasoconstriction
Excessive bleeding after injury
Immediate constriction of vessels to stop bleeding
VASODILATION
NORMAL:
DILATED:
ARTERY
CAPILLARY BED
CAPILLARY BED (EXPANDED)
increases blood flow to injured area to deliver WBC
CLOT FORMATION
BLOOD TO THE WOUND
PLATELET AGGREGATION
GROWTH FACTORS
FIBRIN RICH CLOT
PHAGOCYTOSIS!
DEBRIS
Macrophage engulfs debris
7. Epithelialization
KEY
wound
detached cells
migrating cells
Fibroplasia
Ross
Rachel
On a break
getting off the plane
"The one where they do collagen production"
Wound Contraction
Size of wound decreases
Fibroblasts and myofibroblasts create closure
Shrinks the defect
Limited by tension in nearby tissues
#10 NEOVASCULARIZATION
Kind of like...
Collagen Synthesis/Lysis Balance
Synthesis = production
Lysis = Breakdown
must be BALANCED for proper healing
Type III → Type I
Lysis > Synthesis:
May Never Heal
Balanced:
NORMAL
-White/Pink
-indented below skin surface
Synthesis > Lysis:
HYPERTROPHIC
-Slightly raised
-Firm
-Follows wound borders
KELOID
-Deep Red/purple
-Very raised
-Firm
-Extends beyond wound borders
lindsey