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# Exercise Science and Health Promotion

## Lab Manual

Florida Atlantic University

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# *Opening and Closing Procedures*

## **Gym 152**

### **Opening**

- Open door
- Turn on lights
- Prep for any daily activities

### **Closing**

- Clean up
- Place all trash in trash can
- Straighten up chairs and desks
- Clean any equipment used during the day
- Put equipment back in its correct place
- Make sure all computers are turned off
- Turn lights out
- Close door (make sure its shut and locked)

## **11A Field House**

### **Opening**

- Unlock all doors
- Open blinds
- Turn lights on
- Check phone for messages
- Prep for any testing to be done for the day
- Help to prep for any labs classes coming in

### **Closing**

- Clean all equipment used that day
- Check to make sure all electronics are turned off
- Leave nothing sitting in Cidex over night
- Turn off all computers, printer, etc.
- Return everything back to where it was found
- Close blinds
- Place all trash outside, unless medical/blood which should be in Sharp's container(s)

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- Turn lights off
- Make sure all doors are closed and locked. (includes back door to lab)

## *General Lab Safety Guidelines*

- Never use any equipment unless you are thoroughly versed in the method of operation.
- Do not use any equipment unless instructed to do so (i.e., practicing for Lab Methods).
- Subjects performing on the treadmill and ergometer are to be **supervised at all times**.
- Use protective equipment (gloves, goggles, etc.) when handling and /or coming into contact with any bodily fluids.
- No eating, gum chewing or drinking in the lab.
- Health History forms must be completed before any testing or class participation.
- Wear proper attire in the lab at all times (closed toe shoes and exercise attire if appropriate).
- Never perform tests on yourself without being supervised.
- Clean the equipment and the lab when you are done.
- Follow all protocols of testing properly to ensure no subjects are in danger.
- Biohazard containers designated for the disposal of sharps (scalpel blades, razor blades, needles; dissection pins, etc.) are present in each laboratory. Never dispose of any sharp object in the regular trash containers. Gloves and paper towels that have touched blood or sweat should be disposed of in the biohazard large containers or biohazard trash cans.
- In case of life threatening emergency, call 911 from a lab phone. Follow emergency procedures.
- File an Incident report for any injury and call security (ext. 7-3500) and department chair.

# Emergency Procedures

## Nonemergency

### Basic First Responder

- Instruct victim to stop activity
- Remain with victim until symptoms subside
  - o If symptoms worsen take to ER
- Advise victim to seek medical advice before further activity
- Document everything.
- Take Vital signs

### Basic Second Responder

- Assist first responder, drive victim to ER if necessary
- Bring blood pressure cuff to site
- Assist with taking and monitoring vital signs

## Potentially Life-Threatening

### Basic First Responder

- Establish Responsiveness
  - o Have victim sit
  - o Active EMS (have second responder call)
  - o Staying with victim until EMS arrive
  - o Note time
  - o Apply pressure to bleeding
  - o Note if victim is taking medication
  - o Take pulse
  
- Unresponsive
  - o Active EMS
  - o Place victim supine (on back)
  - o Open airway
  - o Check respiration.
  - o Maintain open air way
  - o Check pulse

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- Other Consideration
  - o If bleeding, compress area to stop/slow bleeding
  - o If suspected neck fracture open airway with jaw-thrust maneuver
  - o If seizing: prevent injury by removing harmful objects; place something under head if possible
  - o Turn victim on side, once seizure activity has stopped to help drain secretions
- Take Vitals every 1-5 minutes

#### Basic Second Responder

- Call EMS
- Wait to direct EMS to scene
- Assist first responder
- Take Vitals

### **Life-Threatening Situations**

#### Basic First Responder

- Position victim in spine, determine unresponsiveness
- Call for help
- Open airway; look, listen, and feel
- Give two ventilations if no responsiveness
- Check Pulse (carotid artery)
- Administer 30:2 compressions/ventilation if no pulse
- Continue ventilation if no respiration

#### Basic Second Responder

- Call EMS (911; if dialing from lab telephone, you must dial 99 for outside line, then dial 911)
- Help with two person CPR

# *Training of Graduate Assistants*

## **I. Training Objectives**

1. Practice the following basic operational procedures during spare lab hours.
  - a. During Lab hours take time to work with equipment you are uncomfortable with.
  - b. Use GA training days to ask questions and learn.
  - c. Ask questions if unsure before use.
2. Shadow faculty and/or senior GAs during exercise tests.
  - a. Work with faculty or senior GAs when doing VO<sub>2</sub> Max tests, Blood Lactate tests, etc. to get practice and experience in working with equipment.
3. While taking Lab Methods, practice test protocols and calibrations.
  - a. Make sure to make a good Lab Manual in this class to refer to because all equipment is used.
4. Review safety guideline section of lab notebook.



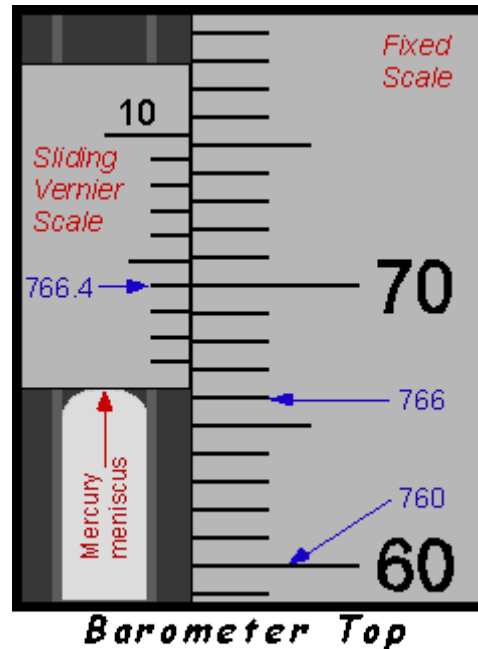
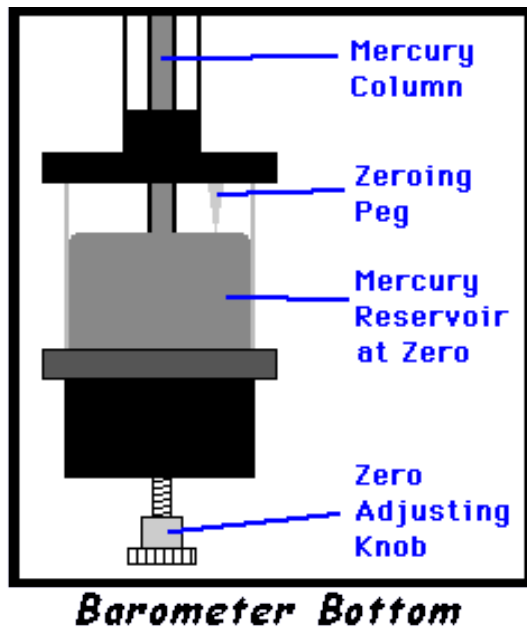
## II. Basic Operational Procedures for Commonly Used Equipment

\* Please refer to Operational Procedures and Testing Protocols for specific information

regarding equipment and testing.

### Calibration – Atmospheric Pressure

1. On the barometer, zero peg at the bottom by adjusting the knob
2. While at eye level, use the number above



### Calibration – Humidity

- 1) Wet wick with room temperature distilled water
- 2) Fan wick for a full minute
- 3) In order to arrive at the relative humidity, you'll need 2 readings
- 4) Check both values, dry and we bulb, on the chart to see the humidity level
- 5) The first reading comes the dry-bulb thermometer
- 6) The second reading comes from the wet bulb thermometer
- 7) Find the two values in their proper column, and read the relative humidity value where they intersect

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## **ParvoMedics Metabolic Cart**

1. Turn equipment on the back of computer (power switch)
2. Turn computer and treadmill on
3. Check all connections
4. Input valve should be warm should be warm

## **Calibration – Flowmeter**

Click on “Flowmeter”

1. Click on “Sample Baseline”
2. Check for spitcher and filter (wires should be pointing up)
3. Take out 3 L cylinder and connect to hose and calibration mouth piece.
4. Give 1 detection stroke
5. Give 4 flushes
6. Give 5 strokes of increasing speed (speed depends on the rate of breathing of the subject to be tested) Need to be smooth, and of varying speeds 60, 120, 180, 220, 300+
7. Line has to be smooth and linear.
8. Click “Save”

## **Calibration – Gas Calibration for ParvoMedics**

1. Click “Gas Calibration”
2. Enter temperature, barometric pressure, and humidity
3. Click “Ok”
4. Turn on gas valve 90° counter-clockwise
5. Click “Ok”
6. Wait for air to be sampled
7. Turn gas off
8. Click “Ok”
9. Click “Save”
10. Check to see if it passes

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## **Pulmonary Function Cart**

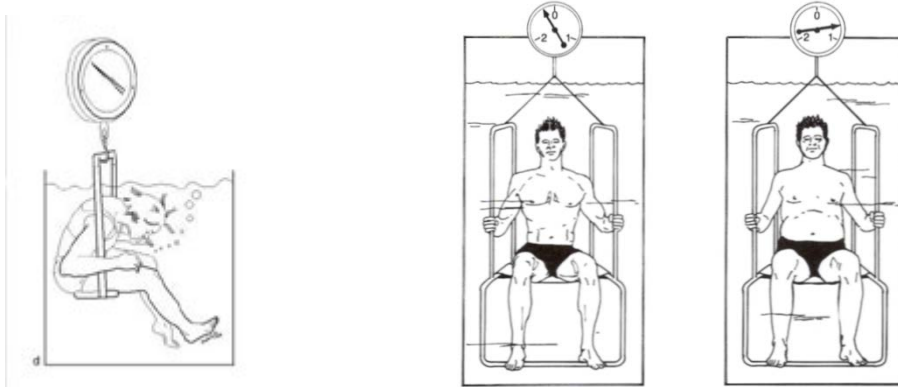
### **Calibration – Gases for MedGraphics**

Calibration is good for 25 minutes, do not leave pump on

1. Turn equipment on (computer switch on bottom shelf)
2. Select “BreezeEx”
3. Click “Calibration Menu”
4. Click on “Pneumatach Calibration”
5. Click “Environmental Conditions”
6. Enter humidity, pressure, and temp
7. Calibrate the pneumotach (calibrate to range to be used): Slow, Medium, and Fast
8. Attach clip to the pneumatach (wires upright and place honeycomb side in)
9. Zero pneumotach
10. Attach pneumatach to syringe
11. Click “Start”
12. Pump syringes at varying speeds, start at a slow speed and then increase the speed, make sure to follow the lines
13. Select “Return” to save if the calibration passed
14. Click “New Patient”
15. Input data

## Underwater Weighing

1. Fill tank with water, leaving ~ 12 inches to the top.
2. With the subject in a bathing suit, measure the dry land body weight
3. After subject is in the water have subject try to get all of the air bubbles off the body and the bathing suit
4. Measure the tare weight (the chair) without the subject touching it
5. The subject will go under the water and exhale as much air as possible



6. Repeat the procedure up to 10 times and only repeating further if the weights keep changing
7. Record the underwater weight
8. After the last trial record water temperature

## Bod Pod

- Keep door closed and temperature in mid 70's
- Humidity between 20 and 70%.
- Bod Pod should be turned on by opening the program on the desktop of computer.
- Bod Pod should be left to warm up 30 minutes prior to testing.
- Turn on Bod Pod:
  - A. Turn on isolation transformer (green switch on white box).
  - B. Turn Bod Pod on (on back side).
  - C. Turn on computer (on back next to fan).

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D. Turn on monitor (on front).

\*All power buttons can be left on the “on” position even if the Bod Pod is not in use. The computer must be shut down before turning off the isolation transformer.

## **Basic Procedures**

1. Warm Up Bod Pod
  - a. Start Bod Pod application and let warm up for 30 minutes.
2. Analyze Hardware
  - a. From utilities menu, go to diagnostics.
  - b. Choose “analyze hardware activity”.
  - c. Perform 1 test.
  - d. If any steps in the activity fail, repeat the analyze hardware activity.
  - e. Passing is defined as “no problems detected” and failing is defined as “possible problems detected”. A list of errors will follow.
  - f. If two tests fail, write down problems and call customer service.
3. Autorun (optional)
  - a. Go to utilities.
  - b. Choose “autorun”.
  - c. Perform 1 test.
  - d. Passing is defined as “the slope  $\pm$  30 mL and the SD  $<$  60 mL.
  - e. If the tests fail, perform two more tests. If more than two fail, call customer service.
4. Test System
  - a. Assess Bod Pod volume performance by going to utilities.
  - b. Choose “autorun”.
  - c. Choose “Test system activity”
  - d. Look at calibration volume provided by Life Measurement Inc.
  - e. Perform 1 test.
  - f. Passing is defined as “results of mean volume within  $\pm$  100 mL of actual volume” and SD  $\leq$  75 mL.
  - g. If test fails, perform 1 more test. If more than 1 fails, call customer service.
5. Scale Calibration
  - a. Should be done every two weeks or if scale is moved.
  - b. Go to utilities.
  - c. Choose “calibrate scale activity” and use gold calibration weights provided.

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- d. Perform 1 test.
  - e. Passing is defined as “20.00 kg” displayed on the scale performance results screen.
  - f. Failing is more or less than 20.00 kg.
  - g. If the test fails repeat it, and if it fails twice call customer service.
6. Weight
- a. Go to practice and choose “weight”.
  - b. Use calibration weights provided.
  - c. Perform 1 test.
  - d. Passing and failing criteria are specified in the QC document.
  - e. If the test fails, perform 1 more test.
7. Subjects
- a. Assess height and clothing
  - b. Clothing must be form fitting, such a speedo. Not padded. A hair cup must be worn to collect hair and no jewelry.
  - c. Should not eat or exercise two hours prior to testing.
  - d. Should remain quiet and still during testing.
8. Start Test
- a. Choose directory to save test file
  - b. Follow prompts (ex: enter subject information, etc.)

## **Blood Lactate Analyzer**

1. Wear gloves
2. Wipe finger with alcohol and then dry it off
3. Prick with the lancet on the tip of the finger
4. Fill the capillary tube until it reaches desired level.
5. Analyze sample
6. Press Run button and follow directions on screen
  - a. When analyzing a sample press the sample button
  - b. Wait for the arm to stop moving
  - c. Place the capillary tube under the arm until it hits the bottom and then back down.
  - d. Press sample again to start the LA.
  - e. Dispose of Capillary tube into the Biohazard container

\*When taking samples during an exercise test, take samples during the last 30 seconds of the stages.

## **Blood Pressure**

### **American Heart Association Guidelines for Measuring Resting Blood Pressure:**

1. *Have* paper and pen at hand for immediate recording of the pressure.
2. Seat the subject in a quiet, calm environment with his or her bared arm resting on a standard table or other support so the midpoint of the upper arm is at the level of the heart.
3. Estimate by inspection or measure with a tape the circumference of the bare upper arm at the midpoint between the acromium and olecranon process (between the shoulder and elbow) and select an appropriately sized cuff. The bladder inside the cuff should encircle 80% of the arm in adults and 100% of the arm in children less than 13 years old. If in doubt, use a larger cuff. If the available cuff is too small this should be noted.
4. Palpate the brachial artery and place the cuff so that the midline of the bladder is over the arterial pulsation, then wrap and secure the cuff snugly around the subject's bare upper arm. Avoid rolling up the sleeve in such a manner that it forms a tight tourniquet around the upper arm. Loose application of the cuff results in overestimation of the pressure. The lower edge of the cuff should be 1 in (2 cm) above the antecubital fossa (bend of the elbow), where the head of the stethoscope is to be placed.
5. Place the manometer so the center of the mercury column or aneroid dial is at eye level and easily visible to the observer and the tubing from the cuff is unobstructed.
6. Inflate the cuff rapidly to 70 mm Hg, and increase by 10 mm Hg increments while palpating the radial pulse. Note the level of pressure at which the pulse disappears and subsequently reappears during deflation.<sup>25</sup> This procedure, *the palpatory method*, provides a necessary preliminary approximation of the systolic blood pressure to ensure an adequate level of inflation when the actual, auscultatory measurement is made. The palpatory method is particularly useful to avoid underinflation of the cuff in patients with an auscultatory gap and overinflation in those with very low blood pressure.

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7. Place the earpieces of the stethoscope into the ear canals, angled forward to fit snugly. Switch the stethoscope head to the low-frequency position (bell). The setting can be confirmed by listening as the stethoscope head is tapped gently.
8. Place the head of the stethoscope over the brachial artery pulsation, just above and medial to the antecubital fossa but below the lower edge of the cuff, and hold it firmly in place, making sure that the head makes contact with the skin around its entire circumference. Wedging the head of the stethoscope under the edge of the cuff may free up one hand but results in considerable extraneous noise.
9. Inflate the bladder rapidly and steadily to a pressure 20 to 30 mm Hg above the level previously determined by palpation, then partially unscrew (open) the valve and deflate the bladder at 2 mm/sec while listening for the appearance of the Korotkoff sounds.
10. As the pressure in the bladder falls, note the level of the pressure on the manometer at the first appearance of repetitive sounds (Phase I) and at the muffling of these sounds (Phase IV) and when they disappear (Phase V). During the period the Korotkoff sounds are audible, the rate of deflation should be no more than 2 mm per pulse beat, thereby compensating for both rapid and slow heart rates.
11. After the last Korotkoff sound is heard, the cuff should be deflated slowly for at least another 10 mm Hg, to ensure that no further sounds are audible, and then rapidly and completely deflated, and the subject should be allowed to rest for at least 30 seconds.
12. The systolic (Phase I) and diastolic (Phase V) pressures should be immediately recorded, rounded off (upwards) to the nearest 2 mm Hg. In children, and when sounds are heard nearly to a level of 0 mm Hg, the Phase IV pressure should also be recorded. All values should be recorded together with the name of the subject, the date and time of the measurement, the arm on which the measurement was made, the subject's position, and the cuff size (when a nonstandard size is used).
13. The measurement should be repeated after at least 30 seconds, and the two readings averaged. In clinical situations additional measurements can be made in the same or opposite arm, in the same or an alternative position.



## **Skinfolds**

Procedures according to ACSM guidelines

- All measurements should be made on the right side of the body with the subject standing upright
- Caliper should be placed directly on the skin surface, 1 cm away from the thumb and finger, perpendicular to the skinfold, and halfway between the crest and the base of the fold
- Pinch should be maintained while reading the caliper
- Wait 1 to 2 seconds (not longer) before reading caliper
- Take duplicate measures at each site and retest if duplicate measurements are not within 1 to 2 mm
- Rotate through measurement sites or allow time for skin to regain normal texture and thickness

<b>SKINFOLD SITE</b>	
Abdominal	Vertical fold; 2 cm to the right side of the umbilicus
Triceps	Vertical fold; on the posterior midline of the upper arm, halfway between the acromion and olecranon processes, with the arm held freely to the side of the body
Biceps	Vertical fold; on the anterior aspect of the arm over the belly of the biceps muscle, 1 cm above the level used to mark the triceps site
Chest/Pectoral	Diagonal fold; one-half the distance between the anterior axillary line and the nipple (men), or one-third of the distance between the anterior axillary line and the nipple (women)
Medial Calf	Vertical fold; at the maximum circumference of the calf on the midline of its medial border
Midaxillary	Vertical fold; on the midaxillary line at the level of the xiphoid process of the sternum. An alternate method is a horizontal fold taken at the level of the xiphoid/sternal border in the midaxillary line.
Subscapular	Diagonal fold (at a 45-degree angle); 1 to 2 cm below the inferior angle of the scapula
Suprailiac	Diagonal fold; in line with the natural angle of the iliac crest taken in the anterior axillary line immediately superior to the iliac crest
Thigh	Vertical fold; on the anterior midline of the thigh, midway between the proximal border of the patella and the inguinal crease (hip)

## ***Equipment maintenance***

- All computerized equipment (i.e. metabolic cart, bod pod, pulmonary function cart, KinCom, etc) must be operated correctly according to the operational manual. Please see operational procedures section of notebook.
- Do not leave any metabolic cart or pulmonary function cart on for more than the time it is needed, as this can burnout the analyzers.

### **Metabolic cart**

- Replace filter in front of mixing chamber after about three uses. Filters are located in the office area lab closet.
- Cleanout mixing chamber about once every 3 months. This depends on cart usage. Chamber is cleaned out under sink with soap and water.
- Clean mouth pieces in cidex. Scrub and rinse thoroughly. Place on drying rack. Do not leave anything in cidex for more than 30 minutes maximum.
- Hoses are cleaned under sink with water and left to dry hanging over divider.

### **Lactate Analyzer**

- Membranes need to be replaced approximately every two weeks or when nanoamps get below 5 for LA and 10 for glucose (replacement procedure will be included under operational procedures section of notebook).

### **Strength Training Equipment**

- All equipment must be wiped down after use.

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- Weights must be properly stacked and put away after use.

### **Hydrostatic Weighing Tank**

- The underwater weighing tank should be treated and scrubbed with bleach every few months depending on use.

### **Bod Pod**

- Clean seat and floor area of Bod Pod as needed
- Wash caps in the bin marked “Laundered”
- Calibration will be in operational section of lab notebook.

### **Equi-test**

- The Equi-test should be kept clear of any extraneous equipment
- Clean force plate(s) as needed

### **Heart rate monitors, Skinfold Calipers, BP cuffs**

- Heart rate monitors must be cleaned with soap and water after use. DO NOT wipe sensor area with alcohol.
- Blood Pressure cuffs may be sanitized with alcohol wipes if needed.
- Skinfold calipers should be calibrated once every semester to ensure accuracy.

### **Treadmills and Ergometers**

- Treadmills and Ergometers need to be calibrated once per semester. (Calibration techniques will be described in operational procedures section of notebook)
- Treadmills and Ergometers should be wiped down with sanitizing wipes when needed.

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## *Inventory with Replacement System*

Notify secretary and/or Dr. Graves/Dr. Zoeller as equipment needs to be ordered. Amount to be ordered is contingent upon department budget and cost of the items to be replaced.

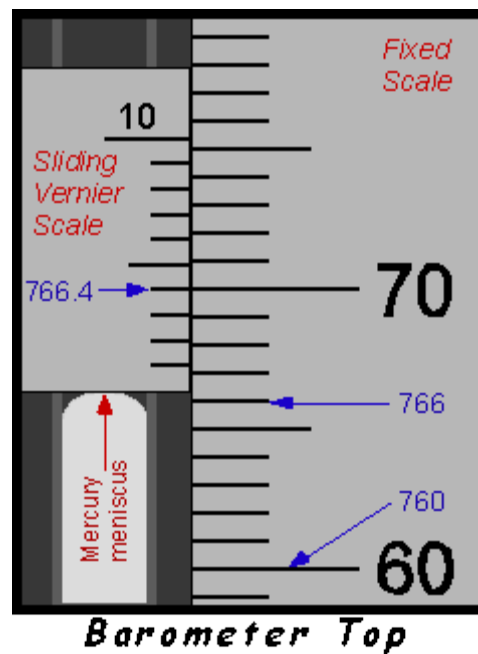
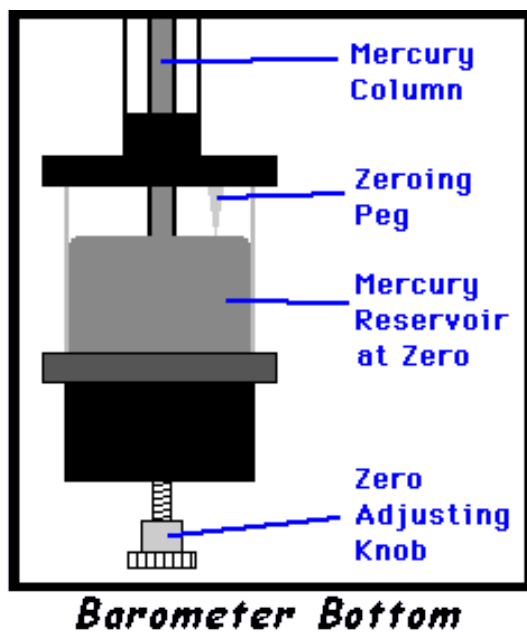
Order when:

- Cidex has 2 bottles remaining. Order 1 case containing 4 bottles.
- Alcohol pads has 5 boxes remaining. Order 10 boxes.
- Lactate membranes has 2 remaining. Order depending on need and usage.
- Head coverings for Bod Pod has 5 remaining.
- Mouth piece parts (spit catch, etc.) has 2 remaining. Order 2 of all parts to make four mouth pieces.
- Capillary tubes has 2 boxes remaining. Order 1-2 boxes depending on need and usage.
- Lancets has 2 boxes remaining. Order 1 box.
- Gloves (small, medium, large, extra large) has 2 boxes left of a specific size. Order 2 boxes (1 box of small/ extra large).
- Electrodes (ECG and EMG) have 4 boxes. Order 3-4 boxes depending on need and usage.

# *Operational Procedures*

## Calibration – Atmospheric Pressure

1. On the barometer, zero peg at the bottom by adjusting the knob
2. While at eye level, use the number above



## Calibration – Humidity

1. Wet wick with room temperature distilled water
2. Fan wick for a full minute
3. In order to arrive at the relative humidity, you'll need 2 readings
4. Check both values, dry and we bulb, on the chart to see the humidity level
5. The first reading comes the dry-bulb thermometer

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6. The second reading comes from the wet bulb thermometer
7. Find the two values in their proper column, and read the relative humidity value where they intersect

### **Calibration – Flowmeter Calibration for ParvoMedics**

1. Click on “Flowmeter”
2. Click on “Sample Baseline”
3. Check for spitcher and filter
4. Connect tube to adapter
5. Give 1 detection stroke
6. Give 4 flushes
7. Give 5 strokes of increasing speed (speed depends on the rate of breathing of the subject to be tested) Need to be smooth, and of varying speeds 60, 120, 180, 220, 300+
8. Line has to be smooth
9. Click “Save”

### **Calibration – Gas Calibration for ParvoMedics**

1. Turn equipment on the back of computer
2. Turn computer and treadmill on
3. Check all connections

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4. Input valve should be warm should be warm
5. Click “Gas Calibration”
6. Enter temperature, barometric pressure, and humidity
7. Click “Ok
8. Turn on gas valve 90° counter-clockwise
9. Click “Ok”
10. Wait for air to be sampled
11. Turn gas off
12. Click “Ok”
13. Click “Save”
14. Check to see if it passes

### **Metabolic Hood**

1. Make sure the Velcro seal is tight from the hood to the green plastic.
2. Once subject is in place, place hood over subject and then tuck green plastic around subject.
3. Make a good seal so there is no air flowing out or in from the hood itself.
4. Make sure the hose is attached and that the Parvo Medic Dilution Pump is turned on to help increase air flow through the hood to the mixing chamber.

### **Medgraphics**

1. Make sure all switch are on.
2. Turn on computer and monitor
3. Click on Medgraphics Breeze Ex



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4. Click Calibration Menu
5. Check humidity, barometric pressure, temperature
6. Click on pneumotach
7. Click zero
8. Click start
9. Place honeycomb side of pneumotach in cylinder
10. Place spirometer wire in pneumotach
11. Calibrate according to red lines and prompts
12. Once calibration test passes click return
13. Click return again

### **Pulmonary Function Test Procedure**

1. Give patient instructions of what they will be doing during test (see 21-25).
2. Click New Patient
3. Enter new patient info
4. Click Spirometry
5. Click zero
6. Give nose clip and pneumotach to patient
7. Click start
8. Instruct patient to take maximal inhalation (when inhalation line hits zero, click start effort).
9. Instruct patient to take maximal exhalation
10. Instruct patient to take maximal inhalation

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11. Click stop
12. Repeat test three times
13. Click select
14. Click the best trial
15. Click return
16. Click Spirometry Report Menu
17. Click Review Report

Criteria for stopping according to the ATS (American Thoracic Society)

- At least 3 trials that are consistent
- At least 3 seconds of exhaling
- Let all the air out
- Should have a plateau
- 2 FVC's within 5% or 100ml of each other
- Always pick best values
- Peak flows have to be at 10% of each other
- Test must be at least 6 seconds.

### **Maximal Voluntary Ventilation**

1. Click "MVV"
2. Have subject put apparatus in mouth and sit comfortably
3. Put nose clip on the subject
4. Have the subject breathe normally
5. Have the subject breathe as deeply and as rapidly as possible for 12 seconds
6. 2 trials needed
7. 2-5 minutes in between
8. 2 trials must be 10% of each other

9. Only 2 trials of MVV because of the necessary effort (within 10% of each other)

## **Pulmonary Terms**

**Inspiratory Reserve Volume (IRV):** The maximal amount of air that can be inhaled following a normal inhalation.

**Expiratory Reserve Volume (ERV):** The maximal volume of air that can be exhaled following a normal exhalation.

**Inspiratory Capacity (IC):** The maximal amount a subject can inhale following a normal exhalation.

**Vital Capacity (VC):** The maximum amount of air that a subject can exhale after a maximal inhalation.

The following volumes or capacities cannot be measured with a spirometer but require the use of more complicated dilution techniques or methods which simultaneously measure changes in lung volumes and pressures.

**Residual Volume (RV):** The volume of air that remains in the lungs after a maximal exhalation.

**Functional Residual Capacity (FRC):** The volume of air left in the lungs after a normal exhalation.

**Total Lung Capacity (TLC):** The total volume of the lungs.

You will notice that some of the measurements use the term volume and others use capacity. There is a reason for this differentiation of terms. A volume is one non-

overlapping measurement, whereas a capacity consists of more than one volume added together. These volumes and capacities are generally used when characterizing subjects, and they vary with body height, age, and gender, as well as with the pulmonary health of the subject. Residual volume is often used in the measurement of body composition because it is part of the volume of the body but carries no weight. In a healthy person, the above volumes are not indicators of fitness, and although most of the volumes change with disease states, these are seen only after the disease has progressed sufficiently to be detected by other, more precise, means. One of the other means to detect pulmonary disease is through forced volumes, which are maximal breaths performed using an all-out effort. Typical forced volumes and flows are de-scribed below:

**Forced Vital Capacity (FVC):** The total volume expired after a maximal inhalation, during which time the subject is attempting to exhale as rapidly and forcefully as possible. In a healthy subject, FVC should be the same as Vital Capacity above.

**Forced Expiratory Volume in One Second (FEV<sub>1</sub>):** The amount of air exhaled in the first one second of a forced vital capacity maneuver.

**Forced Expiratory Flow from 25%-75% of exhalation (FEF<sub>25-75</sub>) or Maximal Mid-Expiratory Flow (MMEF):** The flow rate during the middle 50% of the forced vital capacity maneuver, or from 25% to 75% of the exhaled volume.

The FVC and FEV<sub>1</sub> are the most commonly measured volumes and have been shown to be the best predictors of the presence or absence of disease in large test groups (Ferris, 1978). The FEF 25-75 is also described since it is a relatively common test and can be obtained from the

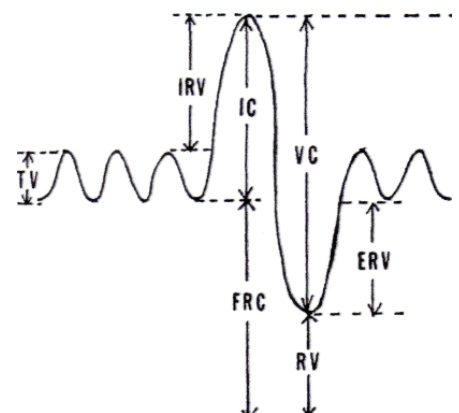
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forced expiratory spirogram used for the other forced measurements. Another typical measurement that can be obtained from the spirogram is the ratio between FVC and FEV<sub>1</sub>, or the FEV<sub>1</sub>. This is calculated from the division of the FEV<sub>1</sub> by the FVC measurements and is widely used in the detection of disease. Other measurements may be made in certain instances during forced exhalations or inspirations if physician determines the need to do so. However, these are generally tests to determine specific types or sites of disease and are not routinely performed in the exercise physiology laboratory.

Another relatively common and simple measurement is the maximal ventilatory volume or MVV. The MVV is the maximal amount of air that a person can breathe in or out in a short period of time, typically 10, 12, or 15 seconds.

It is sometimes used as an indicator of disease, respiratory muscle weakness, or athletic ability, although its ability to predict the latter is not very strong unless there is prior indication of a pulmonary impairment. It is, however, commonly performed and may provide information about the health of the subject.

Spirogram seen during unforced breathing. Volume is on the Y axis, and time is on the X axis.

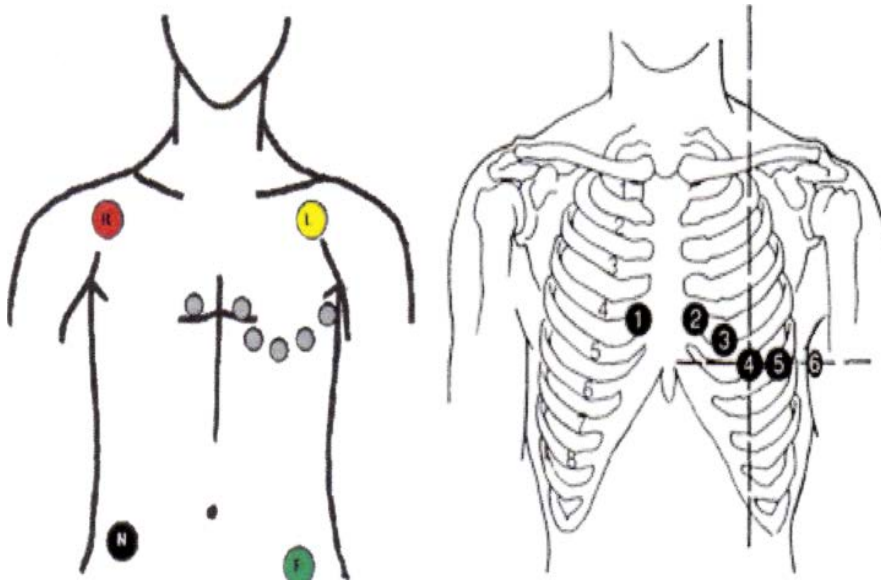
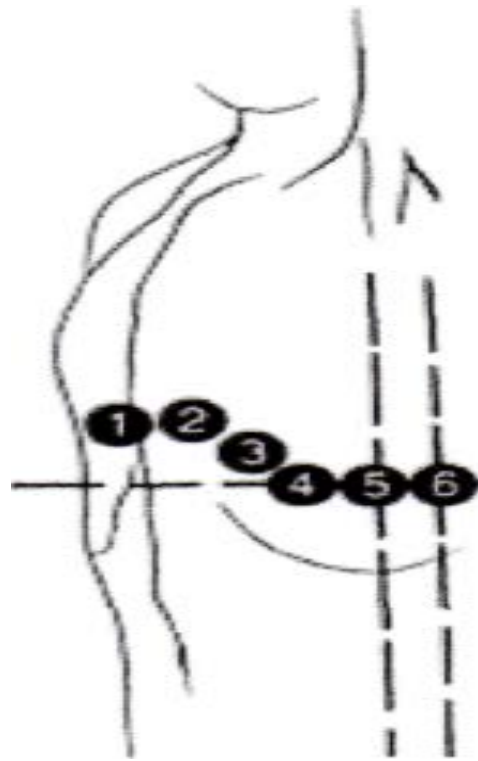


## **Electrocardiogram**

1. Turn on machine next to Quniton treadmill
2. Turn on treadmill (red light should not be lit if treadmill is on)
3. To enter new patient arrow over to patient tab on bottom of screen
4. Click start test
5. To start treadmill hit green start button on console
6. Treadmill speed and incline is controlled by buttons on console
7. Arrow over to leads to change ECG view. Select the view needed and hit ESC button.
8. Hit 12 lead button on keyboard to print a 12 lead
9. To turn off, ESC to home screen and turn off.

## **ECG electrode placement**

1. Left Arm (LA) - The base of the left shoulder against the deltoid border about 2 cm below the clavicle but above border of pectoralis (in deltoid fossa)
2. Right Leg (RL) - Right anterior axillary line halfway between the costal margin and iliac crest
3. Left Leg (LL) - Left anterior axillary line halfway between the costal margin and iliac crest
4. V<sub>1</sub> - Fourth intercostal space at right sternal border
5. V<sub>2</sub> - Fourth intercostal space at left sternal border
6. V<sub>3</sub> - Midway between positions for V<sub>2</sub> and V<sub>4</sub>
7. V<sub>4</sub> - Fifth intercostal space at left midclavicular line
8. V<sub>5</sub> - Horizontal level of V<sub>4</sub> at left anterior axillary line
9. V<sub>6</sub> - Horizontal level of V<sub>4</sub> at left midaxillary line



## **Under Water Weighing (Hydrostatic)**

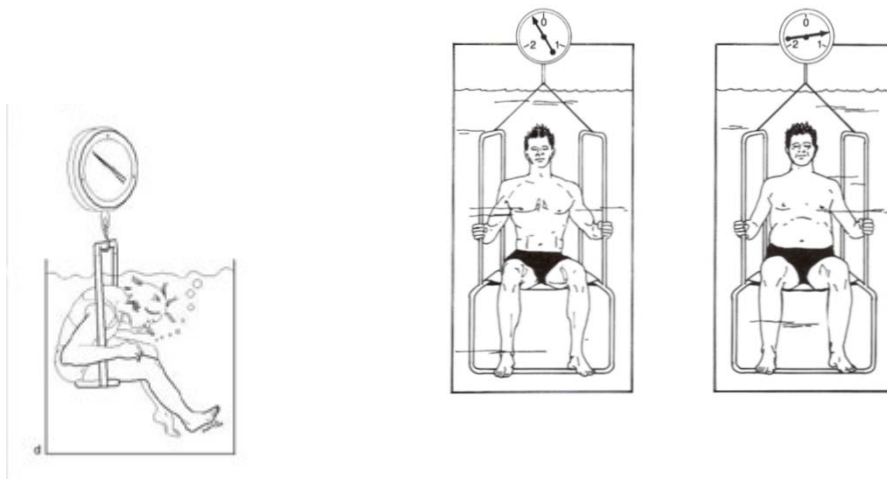
Underwater (hydrostatic) weighing, based on Archimedes' Principle, is generally regarded as the "gold standard" for body composition assessment. Because body fat is less dense than water, it increases one's buoyancy while the fat-free mass, which has a density greater than water, makes one sink. After correcting for residual volume—which increases buoyancy and decreases the underwater weight—percent fat can be calculated based on the underwater weight. The largest source of error in underwater weighing is thought to be the determination of residual volume (RV; the amount of air remaining in the lungs following maximal expiration).

The procedure for measuring underwater weight is used to determine the body density. Using body density, percent fat can be estimated using the Siri or Brozek formula.

There is an excellent interactive web site on body composition and underwater weighing that was produced at the University of Vermont (<http://nutrition.uvm.edu/bodycomp/uww/uww-toc.html>). Included is a simulated underwater weighing procedure.

## **Testing Procedures**

1. Fill tank with water, leaving ~ 12 inches to the top.
2. With the subject in a bathing suit, measure the dry land body weight (to nearest .1 kg).
3. After subject is in the water have subject try to get all of the air bubbles off the body and the bathing suit
4. Measure the tare weight (the chair) without the subject touching it
5. The subject will go under the water and exhale as much air as possible





6. Repeat the procedure up to 10 times and only repeating further if the weights keep changing
7. Record the underwater weight (to the nearest lb)
8. After the last trial record water temperature

### Equations

#### **Determination of Body Density**

$$\text{Body Density} = \text{dry weight} / [((\text{dry weight} - \text{wet weight}) / \text{water density}) - \text{RV} - 0.1]$$

Note: Units for all weights are in kg and RV is in L. The 0.1 represents an estimated volume (L) of gas in the GI tract.

#### **Estimation of Percent Fat**

The two most commonly used equations for estimating percent fat from body density are the Siri (1961) and Brozek (1963) formulae. A limitation to these formulae is that they assume the density of fat-free mass to remain a constant across the population when in fact it varies. Thus, the actual percent fat tends to be slightly higher than the measured percent fat in the lean, muscular individual and the opposite effect in obese individuals.

Siri      Percent Fat =  $[(495 / \text{Body Density}) - 450] * 100$

Brozek    Percent Fat =  $[(4.570 / \text{Body Density}) - 4.142] * 100$

### **YSI 2700 Select Biochemistry Analyzer**

The simple procedure for running your sample is

1. Hit “Run Sample”. This will summon the manual injection needle from its housing and cause it to extend from the upper left front of the unit.
2. After the aspiration needle is still and fully extended, carefully hold your sample-containing test tube so that the needle tip is immersed in the sample. While holding the sample in this position, hit “Aspirate Sample”.
3. Hold your sample until the aspiration needle withdraws back into the unit’s housing.
4. Wait for the analysis of your sample to be completed and for the results to display on the LCD screen.
5. Repeat 4 -7 as desired.
6. When you are finished, change the instrument to “Standby” mode in the front control panel.
7. Turn off the YSI 2700 Select Biochemistry Analyzer.

### **Special Notes:**

- Every 5 – 6 samples, the machine will automatically recalibrate itself to make sure that the current measured for reference standards is not drifting too far from the previously established calibration. The autocalibration takes some minutes to complete. Be patient.
- Periodically, buffer tanks run low and enzyme electrodes need to be replaced. See Jose for advice on how to do this.

### **Periodic Maintenance: Changing the Membrane Electrodes**

1. Make sure you have purchased unexpired membrane electrodes from YSI, and have them ready at the instrument. Make sure the instrument is powered off.
2. Use salt solution (part YSI2392) to wet the surface of the membrane. Be careful not to touch the membrane during this process.
3. Open the YSI front casing by pulling on the left side of the instrument.
4. Unscrew the electrode (L=lactate, G=glucose) you intend to change.
5. Using tweezers, carefully remove the old membrane from the electrode.
6. Wash the electrode with salt solution, and blot dry with a kimwipe.
7. Carefully press the clean electrode tip onto the bead of salt solution which is wetting the new membrane. Capillarity will make the membrane stick to the electrode surface.
8. Turn the electrode over, making sure not to separate the membrane from the electrode in the process.
9. Carefully move the membrane into place by pressing with tweezers \*only on the rubber septum which borders the membrane\*. Do not touch the membrane directly.
10. Blot any excess droplets of salt solution away from the electrode casing.
11. Re-screw the electrode into the housing chamber.
12. Close the YSI and turn on its power.
13. Press Menu, Service, and monitor the current.
14. Periodically press "flush" until the basal currents for each membrane are under 5 nA.
15. Exit from the "monitor" mode. The YSI is ready to put into run mode! After the machine autocalibrates itself, it will be ready to use.

### **Periodic Maintenance: Changing Buffer and Waste**

#### **To make more buffers:**

1. Buffer solution is found in the refrigerator.
2. Mix one package of buffer solution into 475 ml of distilled water.
3. Refill the Buffer container in used in the machine and place the rest in a sealed container next to it.

#### **To remove a full waste container:**

1. Take an empty jug and mix waste product with bleach and let sit for 30 minutes.
2. After the 30 minutes have lapsed it may then be poured down the sink. Rinse the sink out with bleach afterwards.

### **Calibration – Ergometer**

1. Check belt for wear and tear
2. Align pendulum with the “0” using the thumb screw
3. Attach the weight holder to the spring. Begin with the highest weight you will use in the actual test
4. The weight of the holder and the weights have to be the same as the number on the scale
5. If the weight do not match the scale, adjust the pendulum
6. Now that the scale is calibrated at 0kg and at a high weight, check calibration at an intermediate weight

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Check for:

- Chain is snug and there is no play on the pedal crank
- Pedal crank is secure to the crank axle
- Pedals moving smoothly, and is the pedal axle clear of dirt and fibers
- Pedals are securely fitted to the pedal crank
- Handlebar not higher than min required insertion length
- Flywheel rotating smoothly and central
- Handlebars and saddle adjustment screws lubricated
- Pressure washer on saddle tube is present
- Saddle clip is tight and that the saddle is at a correct angle.
- Brake belt does not show significant signs of wear
- Pedals and chain are lubricated

### **Calibration- Treadmill Speed**

Check for level of the floor and check for level of the treadmill

1. Make a mark on the treadmill belt
2. Measure the length of the treadmill belt by using the marks for each yard stick length made and record length. Convert inches to meters.
3. Place a piece of tape on one edge of the treadmill belt
4. Turn the treadmill on
5. Set the speed to the highest speed to be used on the exercise test
6. Count how many times the tape goes around in approximately one minute. Count the exact number of revolutions and not the time

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***Formula for RPM: Seconds measured/60 = X***

***Number of revolutions /X = RPM***

1. Multiply RPM by the belt length

***Formula for speed = RPM x Belt length***

Convert it to miles per hour

***Formula for MPH = Speed/26.822***

If the actual speed and the speed displayed on the treadmill are equal, then the treadmill speed is calibrated

Make sure to calibrate at least 2 speeds.

### **Calibration - Treadmill Grade**

1. Elevate the grade on the treadmill to the desired incline level
2. Using a carpenter's square and the level, measure the exact incline of the treadmill. The level should be on top of the square, parallel to the floor
3. The slope or grade is equal to the raise divided by the run multiplied by 100

***Formula for grade = (Rise /Run) x 100***

4. If the actual slope is equal to the grade displayed on the treadmill are equal, then the treadmill grade is calibrated
5. You could also use TAN.

### **Isokinetic KINCOM Dynamometer**

- 1) Turn on system
- 2) Turn on computer
- 3) Hit F1 to begin program

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- 4) Hit Enter
- 5) Select Evaluation
- 6) Select Isokinetic
- 7) Select Continuous
- 8) Hit F2 to enter new patient
- 9) Follow prompts to change exercise, if needed
- 10) Adjust subject as needed. The dynamometer head and chair has controls located on the console for positional adjustments.
- 11) Select joint angle
- 12) Move joint positive
- 13) Come all the way to stop angle
- 14) Return to beginning angle
- 15) To change reps, speed, contraction type, etc., select change
- 16) To review results, select reports, choose patient name, and select appropriate test.

## **Electromyography**

1. Turn on computer and Biopac
2. Plug in cables, Ethernet, and AC adapter

### **Set up the following:**

- A. Channel 1
- B. Gain – 1,000
- C. 500 Hz
- D. Off
- E. 1.0Hz
- F. MP150

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- G. Set-up acquisition
  - H. Auto-save to file
  - I. Disk
  - J. Sample rate 1,000
  - K. File
  - L. Length: 120
  - M. Display
  - N. Grid
  - O. Autoscale
  - P. Transform
  - Q. Digital Filters
  - R. IIR
  - S. Low + High Bandpass: 10 – 500
3. Clean surface of skin with alcohol pad
  4. Place electrodes on desired area with reference point.
  5. Click start to begin.
  6. To change time parameters, go to Acquisition tab.