What are Tides?
Tides are the ‘up and down’ motion or ‘rising and falling’ of water caused by the gravity of the Moon on our Earth. Some bodies of waters experience 2 high tides and 2 low tides each day which is not the case in some parts of the lagoon or even other parts of the world.

Objective: 1) Measure the change in tides for your sampling site, if any.

Materials: * Pencil
          * Clipboards
          * Tape Measure
          * Long, slender, strong sticks
          * Timing device [Ex. stopwatch, watch, etc.]

Procedure: Carefully read all directions before beginning the procedure!

Tide Measurement and Tidal Change:
1. Insert one stick deep into the sediment at exactly the water’s edge. Pile stones at the base of the stick to give it extra support in order to hold it upright. Use your best judgement where the water’s edge is if there are waves.
*Hint: Make sure the stick is not placed in a location that will interfere with other teams!

2. After 10 minutes, check your tide marker. If the water’s edge has moved in either direction, use the second stick (planting it the same way as the first one) to mark the new edge. Do not move the first stick!

3. Measure the distance between the first and second stick to get a change in tide.

4. Continue measuring the tides for approximately 30 minutes

<table>
<thead>
<tr>
<th>Time</th>
<th>Vertical Tidal Change (between stick #1 &amp; #2)</th>
<th>Rising, falling or unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1unchanged unchanged</td>
</tr>
<tr>
<td>10 minutes</td>
<td>0</td>
<td>1no change  unchanged</td>
</tr>
<tr>
<td>20 minutes</td>
<td>Down 1/2&quot;</td>
<td>Down 1/2&quot;  Falling</td>
</tr>
<tr>
<td>30 minutes</td>
<td>Down 1&quot;</td>
<td>Down 1&quot;  Falling</td>
</tr>
</tbody>
</table>

OVERALL VERTICAL TIDAL CHANGE = 1"
GROUP 1: CURRENT DIRECTION AND SPEED

What is a Current?
A current is the internal movement of water, sometimes described as a push or pull in the river or bay. Scientists will often measure the direction the current is flowing and calculate current speed.

Objective: 1) Determine the direction of the water current
2) Calculate water current speed

Materials: * Pencil
* Calculator
* Metric Tape Measure
* Several floatable objects [Ex. oranges, sticks (~ the length of forearm)]
* Clipboards
* Timing device [Ex. stopwatch, watch, etc.]
* Compass

*Note: You are using a stick or an orange instead of a float or water bottle because they are biodegradable. Please recover the object you use, if possible.

Procedure: Carefully read all directions before beginning the procedure!

Current Direction:
1. Toss the orange or stick into the middle of the river or bay to allow the water current to move the object

2. As a group, observe which direction the object moves. This is also the water current direction!

3. Using the compass, determine the current direction (east, west, etc.).
   A. What type of object did you use to measure current direction? **Orange**
   B. Water current direction **North**

Current Speed: (Current speed = distance traveled / time)
1. Student #1 stands at the water’s edge at the starting point with a floatable object in hand. Student #1 tosses the object in the water.

2. After floating/moving for 60 seconds, Student #2 will quickly line up with the floating object’s position on the shoreline and call stop. This is the stopping point.
3. Using the **metric** measuring tape, record the distance between Student #1 and Student #2

4. Determine current speed three times at three different locations within your site. Average the results to get ‘average current speed’. Record results below.

*If you note that the current appears to be different in the main channel than it is near the shoreline area please record this observation. The data from the main channel is the most useful. Please endeavor to get accurate readings from as close to mid-lagoon as possible.

```
<table>
<thead>
<tr>
<th>Location</th>
<th>Starting time</th>
<th>Stopping time</th>
<th>Distance object traveled (cm)</th>
<th>Direction</th>
<th>Current speed (cm/sec)</th>
<th>Current Speed (knots)</th>
<th>Ebb, Flow, Slack or Tide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>Near-shore</td>
<td>11:53</td>
<td>11:55</td>
<td>105 cm</td>
<td>NORTH</td>
<td>1.75 cm/sec</td>
<td>Ebb</td>
</tr>
<tr>
<td>Trial 2</td>
<td>11</td>
<td>11:55</td>
<td>120 cm</td>
<td>NW</td>
<td>2 cm/sec</td>
<td>0.39 knots</td>
<td>Ebb</td>
</tr>
<tr>
<td>Trial 3</td>
<td>11</td>
<td>11:57</td>
<td>110 cm</td>
<td>NW</td>
<td>1.8 cm/sec</td>
<td>0.35 knots</td>
<td>Ebb</td>
</tr>
<tr>
<td>Average</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1.85 cm/sec</td>
<td>x</td>
</tr>
</tbody>
</table>

*Current speed calculation example
Julia’s orange traveled 125 cm in 60 seconds.
Her current speed =

\[
\text{Current speed} = \frac{125 \text{ cm}}{60 \text{ sec}} = 2.08 \text{ cm/second}
\]

*Convert current speed (cm/second) to knots
Current speed = 2.08 cm/second

1 knot = 51.44 cm/sec

\[
2.08 \div 51.44 = 0.04 \text{ knots}
\]

5. Convert current speed (cm/sec) to knots. Use the conversion example above to assist your calculations. Record your data in the chart.

6. Record ebb, flood, or slack tide in data chart above.

**River sites**

* **Ebb tide** = current is moving downriver towards the bay
* **Flood tide** = current is moving upstream
* **Slack tide** = no change in water movement

**Bay sites**

* **Ebb tide** = receding or outgoing tide
* **Flood tide** = incoming or rising tide
* **Slack tide** = no change in water movement
**GROUP 1: AIR TEMPERATURE, CLOUD COVER, AND WIND**

**What is a Weather?**
Weather includes current conditions and recent conditions at a particular place and time that may have an impact on the water quality of the lagoon.

**Objective:**
1) Record **air temperature** in BOTH Fahrenheit and Celsius
2) Estimate **cloud cover**
3) Determine **wind direction** and **speed**

**Materials:**
* Pencil
* Thermometer
* Beaufort Scale (See Diagram)
* Calculator (optional)
* Clipboards
* Anemometer (measures wind speed)
* Compass (optional)

**Procedure:** Carefully read all directions before beginning the procedure!

**Air Temperature:**
1. Record **air temperature** in BOTH Fahrenheit and Celsius once every hour, if possible (see chart below)

   *Note: Place your thermometer in a shady location, if possible*

<table>
<thead>
<tr>
<th>Time</th>
<th>Air Temperature (° Fahrenheit)</th>
<th>Air Temperature (° Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:07 PM</td>
<td>83 ° F</td>
<td>30 ° C</td>
</tr>
<tr>
<td>12:08 PM</td>
<td>84 ° F</td>
<td>31 ° C</td>
</tr>
<tr>
<td>12:09 PM</td>
<td>87 ° F</td>
<td>35 ° C</td>
</tr>
</tbody>
</table>

*If your thermometer is not able to read both Fahrenheit and Celsius, then you will need to use the conversion chart to assist you.

To calculate Celsius from Fahrenheit: ° C = (° F - 32) x 0.556

To calculate Fahrenheit from Celsius: ° F = (1.8 x ° C) + 32
GROUP 2: PHYSICAL CHARACTERISTICS OF THE SITE

What are the physical characteristics of a site?
The physical characteristics of a sampling site are the geographic features. This includes trees, shrubs, dunes, lagoon, buildings, parking lot, etc.

Objective: 1) Describe the shoreline of your sampling location
2) Create a site map
3) Work with the Documentation Team to take photos of your site from several angles

Materials: * Pencil
          * Clipboards
          * GPS unit/ Phone with capabilities

Procedure: Carefully read all directions before beginning the procedure!

Shoreline Description:
1. Walk down to the shoreline. This is going to be your sampling site.
   A. Identify the latitude and longitude of your sampling site
      \[28°42'31" N\]
      \[80°44'4" W\]
   B. Check all of the characteristics that apply.

<table>
<thead>
<tr>
<th>Sandy</th>
<th>Bulkhead</th>
<th>Vegetated (grasses, shrubs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Road Ending</td>
<td>Rocky</td>
<td>Pipe entering lagoon</td>
</tr>
<tr>
<td>Gentle beach slope</td>
<td>Steep slope</td>
<td>Pier</td>
</tr>
<tr>
<td>Riprap (large amounts of rocks piled up)</td>
<td>Garbage</td>
<td>Oyster reef</td>
</tr>
</tbody>
</table>

* What are some other noteworthy features or characteristics of your sampling site (ex. muddy)

muddy, sandy, on the Indian River lagoon,

A lot of small crabs→fiddler habitat

C. Lagoon bottom is predominately (circle one)

<table>
<thead>
<tr>
<th>Sandy</th>
<th>Muddy</th>
<th>Rocky</th>
<th>Weedy</th>
<th>Muck</th>
<th>Unable to determine</th>
</tr>
</thead>
</table>

D. What percentage of the lagoon bottom is covered in vegetation?

[ ] 0-25%  [ ] 25-50%  [ ] 50-75%  [ ] 75-100%

E. What percentage of the lagoon surface is covered in vegetation?

[ ] 0-25%  [ ] 25-50%  [ ] 50-75%  [ ] 75-100%
Sketch a Site Map:

Locate your sampling site. Sketch a detailed map of your location. Include features found within 100 feet on either side of you. Be sure to include any physical characteristics that may help others identify your sampling site and label them accordingly.
1. Carefully, withdraw the sediment corer from the water. Keep the core upright as you move it to collection tray or bin for observation. Position one hand on the bottom of the corer and the other on the top (see photo above) to keep the sample steady.

2. If possible, slide the sediment core out of the tube onto the tray or bin.

A. Sketch a detailed picture of the sediment sample

*Remember: Be sure to include the different layers, plants, animals, and other items you see

B. Total length of your sediment core \[18\] cm

C. Length of oxidized layer (if present) \[6\] cm

D. Length of anoxic layer (if present) \[12\] cm

*Interesting Fact: The anoxic layer may have a sulfur-like or 'rotten egg' smell. This is from bacteria that thrive in anoxic zones and produce hydrogen sulfide (H₂S) as a respiratory waste product.

F. Observe and dissect the sediment core. Fill out the chart below based on your findings.

<table>
<thead>
<tr>
<th></th>
<th>Absent</th>
<th>Rare</th>
<th>Common</th>
<th>Abundant</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay (feels thick &amp; dense)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mud (smooth between fingers)</td>
<td></td>
<td></td>
<td>[x]</td>
<td>[x]</td>
<td>thick + smooth gritty</td>
</tr>
<tr>
<td>Sand (gritty; fine sand paper)</td>
<td></td>
<td></td>
<td>[x]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravel (pea-sized sediment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pebbles (larger than pea-sized)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bivalve Shells (Ex. clam, oyster)</td>
<td></td>
<td></td>
<td></td>
<td>[x]</td>
<td>very shelly + hard</td>
</tr>
<tr>
<td>Snail Shells (single shell)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macroinverts (Ex. worm, crab)</td>
<td>[x]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muck (black in color; thick ooze)</td>
<td>[x]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Material (Ex. leaves; grass)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What is an Aquatic Biological Survey?
During an aquatic biological survey, the investigator identifies and counts each species of fish or macro-invertebrate that is caught during collection. This gives the scientist a better idea as to species diversity and overall health of a given site along the lagoon.

What is a macro-invertebrate?
A macro-invertebrate is an organism that is easily visible without magnification and does not have a vertebrate or backbone! Examples of common, aquatic macro-invertebrates include crabs, horseshoe crabs, barnacles, clams, oysters, snails, shrimp, jellyfish, sand hoppers, worms, and much more!

Objective: 1) Conduct an aquatic biological survey to get a total number of each species caught, largest individual species, and overall total number of species
2) Calculate Catch Per Unit Effort (CPUE)

Materials: * Pencil
* Measuring tape
* Collection buckets
* Net(s) for collection (seine \textit{Preferred}, dip nets, plankton, cast, etc.)

Materials: * Clipboards
* Binoculars
* Reference guide

Procedure: Carefully read all directions before beginning the procedure!

Fish & Macro-invertebrate Inventory Using a Seine Net:
1. Students in Group #3 must have all of the Aquatic Biological Survey rules reviewed with them prior to starting this station. Below are a few of the most important rules!

*Respect all animals and equipment
*Do not stand on the seine net
*When the seine net is hauled to the beach, students are to kneel at its edge gently lifting out the fish first and then other invertebrates (crabs, barnacles, shellfish, etc)

2. Prior to seining, answer the following questions:

A. Length of the seine net _____ feet/ meters
Mesh size _____ mm

B. Names of those using the seine net ______

Did not measure

many people - all participated
3. While the seine is being pulled;

**Remember:** Be sure to ask for assistance if you are unsure how to use a seine properly

A. Record the distance the seine is pulled **25 meters** (units)

B. Fill buckets with water

4. Haul seine to the shoreline.

A. First, collect all **fish** and gently place into buckets

B. Second, collect all **macro-invertebrates** and gently place into buckets

**Remember:** Work quickly to get all living organisms into buckets or bins of water

5. Use the reference guides to help identify each organism to the best of your abilities. Fill out the data chart. Have your **Documentation Team** take pictures of each species that you observe, especially those that you are unsure about!

**Remember:** If you have trouble identifying organisms to the species level, list them in the most specific level of classification possible. Many killifish species also look similar to one another. If you are unsure, group them together as 'killifish'.

6. Record the total number of each species counted during each seine pull in the data chart

7. Measure the largest individual of each species. For most species it will not be possible to determine **gender**, but for those that you can (ex. crabs) it is useful to know the ratios of the sexes of the samples.
Collection Method #1

*Record length of collection net and mesh size of the equipment used

Seine net [preferred testing method] ✔

Optional Methods: Dip net Crab Trap Cast Net Other

Length of Pull 25 m

<table>
<thead>
<tr>
<th>Species</th>
<th>Total # of individuals</th>
<th>Size of largest individual</th>
<th>Units (mm, cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Crab (2 males)</td>
<td>2</td>
<td>8.5 cm</td>
<td>cm</td>
</tr>
</tbody>
</table>
| Comb Jelly
  Shrimp
  Snails
  Crab
  Hardheaded catfish
  Crown conch
  Minnows                  | 15                     | 4 cm cm                     | cm cm          |
|                          | 2                      | 8 cm cm                     | cm cm          |
|                          | 4                      | 2 cm cm                     | cm cm          |
|                          | 3                      | 3 cm cm                     | cm cm          |
|                          | 1                      | 12 cm cm                    | cm cm          |
|                          | 1                      | 10 cm cm                    | cm cm          |
|                          | 4                      | 3 cm cm                     | cm cm          |

Total fish in collection #1 5

Comments: Low diversity due to poor water quality and no seagrass.
What is a Habitat Association Survey?

A habitat association survey is an important record of the various organisms (birds, mammals, etc.) that are observed at your study site.

**Objective:** 1) Identify and count organisms at your study site during your visit

*Note: If you are unsure of an organism, please describe it in the notes section below*

**Materials:** * Pencil
* Binoculars
* Clipboards
* Reference guide

**Procedure:** Carefully read all directions before beginning the procedure!

**Wildlife Inventory:**

1. Spend some time observing the area around your study site. Using binoculars if possible, identify and count birds, mammals or other organisms seen during your visit to your study site. Record the organisms in the chart below. These are in addition to any organisms caught using nets in the lagoon. Other teams’ observations of animals should be included as well.

<table>
<thead>
<tr>
<th>Location</th>
<th>Species</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brazilian pepper</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Blanket flower</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Spanish needle</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Osprey</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dragonfly</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Golden Astor</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Secaeda's</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Caesar weed</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Skipper</td>
<td></td>
</tr>
</tbody>
</table>

* Description of unknown organisms: ____________________________
**Group 4: WATER TEMPERATURE, DISSOLVED OXYGEN, & pH**

Water temperature, dissolved oxygen, and pH are important factors to study when learning about a specific study site. Organisms are adapted to survive in specific range of temperatures, pH, and dissolved oxygen (DO) before they become stressed.

**Objective:**
1) Record water temperature in BOTH Fahrenheit and Celsius
2) Measure dissolved oxygen
3) Measure pH

**Materials:**
- * Pencil
- * Clipboards
- * Water thermometer
- * LaMotte Water Quality Kit (DO & pH) [required method]
- * pH reference guide (optional)

**Procedure:** Carefully read all directions before beginning the procedure!

1. **Water Temperature:**
   Record in situ water temperature in BOTH Fahrenheit and Celsius every 15 or 30 minutes and then average the results (see chart below)

   *Note:* It may help to have the thermometer securely tied to a string or lanyard for ease of use.

<table>
<thead>
<tr>
<th></th>
<th>Location</th>
<th>Time</th>
<th>Temperature °C</th>
<th>Temperature °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>WLR</td>
<td>12:09</td>
<td>32</td>
<td>91</td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td>12:11</td>
<td>32</td>
<td>90</td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td>12:18</td>
<td>31</td>
<td>89</td>
</tr>
<tr>
<td>Average</td>
<td>X</td>
<td>X</td>
<td>31.7</td>
<td>90</td>
</tr>
</tbody>
</table>

*If your thermometer is not able to read both Fahrenheit and Celsius, then you will need to use the conversion chart to assist you.*

To calculate Celsius from Fahrenheit: $\degree C = (\_\_\_\_\_\_\_\_ F - 32) \times 0.556$

To calculate Fahrenheit from Celsius: $\degree F = (1.8 \times \_\_\_\_\_\_\_\_ C) + 32$
GROUP 4: SALINITY AND TURBIDITY

Salinity and turbidity are factors that scientists study to better understand a specific study site. Organisms are only adapted to survive in a specific range of salinity and increased turbidity can negatively influence the biodiversity of the lagoon.

**Objective:**
1) Measure salinity
2) Determine turbidity

**Materials:**
* Pencil
* Clipboards
* Salinity measurement Tool (hydrometer, refractometer, test strip, etc.)
* Turbidity measurement tool (Secchi disc, short sight tube, and/or long sight tube, etc)

**Procedure:** Carefully read all directions before beginning the procedure!

1. **Salinity:**
   Salinity is the measure of ‘total salts’, ‘conductivity’, or more specifically the concentration of Chloride ions (Cl-). In freshwater parts of the river, the unit of measurement may be parts per million (ppm) or milligrams per liter (mg/ L). These two units are equivalent. In saltier parts of the bay, you may measure salinity in parts per thousand (ppt); one part per thousand equals 1000 mg/ L.

   A. **Circle** the measuring method(s) used for salinity

   Hydrometer   Test strips   LaMotte Water Quality Kit (requires distilled or deionized water)

   Refractometer   Other ________________

   B. Record salinity three times at three different locations within your site and average the results. Record results below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Reading 1</th>
<th>Reading 2</th>
<th>Reading 3</th>
<th>Average*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LaMotte Water Quality Kit</td>
<td>Shore line 11:46</td>
<td>6</td>
<td>9</td>
<td>10.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Other Test Method Hydrometer</td>
<td>24</td>
<td>22</td>
<td>26</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

25
2. **Turbidity:**

   Turbidity is a measure of water clarity, which is an important feature of an estuary. Different techniques for determining turbidity use different units of measurement.

   A. *Circle* the measuring method(s) used for turbidity
      
      Secchi disc  
      Short sight tube/ LaMotte Water Quality Kit  
      **Long sight tube**  
      Turbidimeter  
      Other

   B. Record turbidity three times at three different locations within your site and then average the results. Record results below. Be sure to enter data on the correct line for the technique you use.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Location</th>
<th>Time</th>
<th>Reading 1</th>
<th>Reading 2</th>
<th>Reading 3</th>
<th>Average</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secchi Disc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Feet or cm</td>
</tr>
<tr>
<td>Short Sight Tube</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JTUs</td>
</tr>
<tr>
<td>Long Sight Tube</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>8 cm/meter</td>
</tr>
<tr>
<td>Turbidimeter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NTUs</td>
</tr>
</tbody>
</table>

   ![Image of turbidity measurement tools]