

**Auxiliary Sailing Endorsement
Explorer's Guide Maritime Training**

MODLE 1 - TYPES OF SAILING VESSELS

There are many different types of sailing vessel, however, most will fall into the following groups

Catboat - a sailboat with a single mast and single sail, usually gaff-rigged

- smallest and simplest boats.
- classic fishing boat.
- popular movement in home-built boats, uses this rig to make "folk-boats."
- rigged with no boom to hit one's head or knock one into the water.
- gaff requires two halyards and often two topping lifts.
- weight of the gaff spar high in the rigging can be undesirable.
- gaff must slide down the mast, so no stays from bracing mast.

Sloop - a vessel with a fore-and-aft rig

- carries a single mast stepped farther forward than that of a cutter which is an important factor
- fore-triangle is smaller than a cutter's.
- clearest distinction between sloop and cutter is the run of the forestay.
 - on the sloop, it runs to the outboard end of the bowsprit,
 - spar must always stay in position and cannot be retracted.
 - on the cutter, the forestay runs to the stem head of the hull. This allows the bowsprit to be run back inboard and stowed.
- sloops are designed to optimize upwind sailing, However, overall compromise acceptable to all points of sail.
- light rig with fewer lines and spars, and the sails on a sloop tend to be flat which minimizes sideways force when well trimmed
- when sailing upwind, minimizes the drag of the tip-vortex with a high and narrow sail design (high aspect), maximizing the amount of sail for a given tip-vortex compared to a square-rigged or gaff-rigged ship.
- simplicity of the rig reduces the drag induced by control lines, masts and spars.
- typical foresail i.e. the jib, does not overlap the mast more than 10-20 percent, may be replaced by a Genoa jib, which overlaps the mast by as much as 55-100 percent for racing.
- mainsail and Genoa form an efficient double wing.
- a single mast with a single jib bent onto the forestay, held taut with a backstay.
- mainsail is usually managed with a "boom."

Cutter - a small single-masted vessel, fore-and-aft rigged, with two or more headsails, a bowsprit, and a mast set further back than in a sloop

- while sloop rig was a rig with single mast located forward of 70% of the length of the sailplane. Cutters had a rig with a single mast more centrally located, which could vary from 50% to 70% of the length of the sailplane,
- with multiple headsails and a reefing bowsprit.
- somewhere in the 1950s or 1960s there was a shift in these definitions such that a sloop only flew one headsail and a cutter had multiple headsails and mast position became irrelevant
- cutter, with two jibs (a staysail and a yankee) in the fore triangle. Better than a sloop for light winds, also easier to manage.

Yawl - like a sloop with a mizzen mast located aft of the rudder post.

- mizzen mast and sail is relatively small,
- intended use to provide helm trim and balance.
- often confused with the ketch, which also has two masts with the main mast foremost.
- mainsail is similar in size and proportioned sloop.
- originally developed as a rig for commercial fishing boats.
- rig popular with single-handed sailors, due to ability to be trimmed to follow a compass course accurately despite minor wind shifts.

Ketch - a "catch" or fishing boat.

- mizzen is bigger to hold the bow (front) of a boat toward the wind and oncoming waves.
- principal purpose of the mizzen mast is to help propel the vessel
- dd. mainsail would be dropped and mizzen trimmed tight on the centerline so boat points directly into the wind in a reliable way.
- ease the mizzen slightly to allow the boat to move slowly forward.
- in a fishing boat this attitude allows nets to be handled without the boat becoming "broadships" to the waves so they break over the sides of the boat.
- for enough sail area to propel a fishing boat, mizzen mast moved forward toward middle of the boat for larger sail with acceptable vessel balance.
- rig allows for shorter main sails than a sloop with the same sail area for lower center of sail and less center of gravity
- shorter masts reduce amount of ballast
- rig is less prone to broaching or capsize than a comparable sloop,
- one to three jibs may be carried forward of the main mast when going to windward.
- if not rigged with jibs it is called a cat ketch
- popular as long distance cruisers
- additional sail allows for a better balance,
- smaller more easily handled mainsail with same sail area.
- allows sailing on mizzen and jib only without excessive lee helm,
- in emergency can be quite well steered without use of the rudder.
- ketch rig distinguished from two masted schooner rig by the shorter aftermost mast on the ketch.

Schooner - sailing vessel characterized by the use of fore-and-aft sails on two or more masts.

- schooner rigging includes, Bowsprit, Jib, followed by fore staysail, (fore)gaff, topsail, Foresail, Main gaff topsail, Mainsail, End of boom
- has two or more masts with the forward mast being shorter or the same height as the rear masts.
- most traditionally rigged schooners are gaff rigged, sometimes carrying a square topsail on the foremast and occasionally, in addition, a square fore-course.
- schooners carrying square sails are called square-topsail schooners.
- gaff-rigged schooners generally carry a triangular fore-and-aft topsail above the gaff sail on the main topmast.
- distinguished from ketch where mainsail is flown from the most forward mast; thus it is the main-mast, and the other mast is the mizzen-mast.
- two-masted schooner has the mainsail on the aft mast, and therefore the other mast is the fore-mast.
- schooners were widely used in United States.
- two masted schooners most common.
- popular in trades that required speed and windward ability, such as privateering, blockade running and offshore fishing.
- no set number of masts.

- small schooner has two or three masts, but they were built with as many as six .
- two or three masted schooner quite maneuverable, can be sailed by a smaller crew than some other sailing vessels.
- schooners were used to carry cargo in different environments, from ocean voyages, to coastal runs and on large inland bodies of water.
- scow schooners, which use a schooner rig on a flat bottom blunt ended scow hull, were popular in North America for coastal and river transport.
- built with Marconi rigs than gaffs; performs poorly to windward without gaff topsails.

MODULE - RULES OF THE ROAD

As with driving a car, you need to understand the rules of the road on the water. They are a complicated as we are do not have the benefit of marked roads. Here is an overview of the rules related to sailing vessels.

- I. **Navigation Rules** - consist of international and inland rules. These rules are separated by the COLREGS Demarcation Lines and delineate those waters upon which mariners shall comply with the Inland and International Rules.
 - **International Rules** were formalized in the Convention on the International Regulations for Preventing Collisions at Sea, 1972 which is why they are called The 72 COLREGS . They were developed by the Inter-Governmental Maritime Consultative Organization (IMCO) which is now the International Maritime Organization (IMO). These Rules are applicable on waters outside of established navigational lines of demarcation.
 - **Inland Rules** replaced the old Inland Rules, Western Rivers Rules, Great Lakes Rules, their respective pilot rules and interpretive rules, and parts of the Motorboat Act of 1940. These Rules were enactment as part of the Inland Navigational Rules Act of 1980.

- II. **RULE - Responsibility**
 - Nothing in these Rules shall exonerate any vessel, or the owner, master, or crew from the consequences of any neglect to comply with these rules or any precaution required by the ordinary practice of seamen, or by the special circumstances of the case.
 - A vessel may make a departure from these rules necessary to avoid immediate danger.

- III. **RULE - General Definitions**
 - The term “power-driven vessel” means any vessel propelled by machinery.
 - The term “sailing vessel” means any vessel under sail provided that propelling machinery, if fitted, is not being used.

- IV. **RULE - Look-out**
 - Every vessel shall at all times maintain a proper look-out by sight and hearing. This maybe more then just the helmsman especially when maneuvering or restricted visibility.

- V. **RULE - Risk of Collision**
 - You must determine if there is a risk of collision by
 - Use all available means appropriate to prevailing circumstances and conditions.
 - If there is any doubt of risk, deemed it to exist.
 - To determine if there is a collision risk exists, take following considerations into account:
 - A risk exist if the compass bearing of an approaching vessel does not appreciably change.
 - A risk may exist even when an appreciable bearing change when approaching a very large vessel/tow or when approaching a vessel at close range.

VI. RULE - Action to Avoid Collision

- Any action you take to avoid collision must, if possible, be made in ample time and using good seamanship. In other words do not wait to the last minute to take action
- To avoid collision or give you more time to assess the situation, you must slow down, stop or reverse your propulsion.

VII. RULE - Narrow Channel

- When traveling along a narrow channel/fairway keep as near to the outer limit of the channel/fairway to starboard (right) side as is safe and practicable. Just as when traveling on a highway, keep to the right.
- If you are a power driven vessel less than 20 meters in length or a sailing vessel, you can not impede the passage of a vessel that **can safely navigate only within a narrow channel or fairway.**

VIII. RULE - Traffic Separation Schemes

- Traffic separation schemes are similar to our lanes on a highway.
- Avoid crossing traffic lanes but if you must, do so at right angles to the traffic flow.
- If you are fishing, power driven less than 20 meters in length or a sailing vessel, do not impede the safe passage of a power-driven vessel following a traffic lane.

VIII. RULE - Sailing Vessels

- When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows:
 - When each has the wind on a different side, the vessel which has the wind on the port side (port tack) shall keep out of the way of the other.
 - When both have the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.
 - If a vessel with the wind on the port side sees a vessel to windward and cannot determine its tack, keep out of the way of the other.
- For the purpose of this Rule the windward side shall be deemed to be the side opposite to that on which the mainsail is carried or, on a square-rigged vessel, the side opposite of the largest fore and- aft sail is carried.

IX. RULE - Overtaking

- A vessel overtaking any other shall keep out of the way of the vessel being overtaken. Just like on a highway, the person passing has control of the situation and so the responsibility to do it correctly.
- Overtaking occurs when coming up with another vessel from a direction more than 22.5 degrees abaft her beam; at night she would be able to see only the stern light of that vessel and not either sidelights.

X. RULE - Head on Situation

- A. Head-on is a meeting situation. If you meet another power-driven vessel on reciprocal or nearly reciprocal courses with any risk of collision, each shall alter course to starboard (right) so that each shall pass on the port side of the other. Neither vessel has the right of way.

XI. RULE - Crossing Situation

- When two power-driven vessels are crossing and there is a risk of collision, the vessel on the port side to give-way to the other vessel and keep out of the way of to avoid crossing ahead of the other vessel.

XII. RULE - Action by Give-way Vessel

- Every vessel which is directed (required by rule and common sense) to keep out of the way of another vessel shall take early and substantial action to keep well clear.
- If you are the give-way vessel - give way early enough and by making substantial moves so there is no misunderstanding of your actions.

XIII. RULE - Action by Stand on Vessel

- It shall keep her course and speed.
- The stand-on vessel may take action to avoid collision by her maneuver alone as soon as it becomes apparent that the vessel required to keep out of the way is not taking appropriate action required by rules.
- If the stand-on vessel takes action to avoid the collision, this rule does not relieve the give-way vessel of her obligation to keep out of the way.

XIV. RULE - Responsibilities between Vessels

- This is how one treats a vessel of a different type. Priority from most to least
 - A vessel not under command is the most privileged vessel.
 - A vessel restricted in her ability to maneuver.
 - A vessel constrained by her draft is an international rule. She can not operate outside the channel and as such "shall navigate with particular caution in regards to her special condition."
 - A vessel engaged in fishing/trolling is different than sport fishing.
 - A sailing vessel, under sail and NOT motoring is the next in line.
 - A power driven vessel, underway has the best ability to maneuver around others

XV. RULE - Conduct of Vessels in Restricted Visibility

- This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility. Key point is they can not see each other.
- You shall proceed at a safe speed. Safe speed is determined by the prevailing circumstances and conditions of restricted visibility.
- A power-driven vessel shall have her engines ready for immediate maneuver.
- If you hear apparently forward of your beam the fog signal of another vessel, or cannot avoid a close quarters situation with another vessel forward of your beam,
 - You shall reduce speed to the minimum at which she can be kept on course.
 - You shall if needed take all way off (stop) and navigate with extreme caution until danger of collision is over.

XVI. RULE - Application Lights and Shapes

- The required lights must be displayed from sunset to sunrise. Or, from sunrise to sunset in restricted visibility. Or may be exhibited in all other circumstances when it is deemed necessary.

XVII. RULE - Power Driven Vessels Underway

- A power-driven vessel under 50 meters in length, underway (away from the dock or mooring) must exhibit:
 - A masthead light forward

- Sidelights
- A stern light.

XVIII. RULE - Sailing Vessels Underway and Vessels Under Oars

- A sailing vessel and a vessel (boat) powered by oars are limited in the amount of energy they have for lighting as well as limits to their maneuverability when underway.
- A sailing vessel shall exhibit sidelights and a stern light:
 - If less than 20 meters in length, the sidelights and stern lights may be combined in one lantern carried at or near the top of the mast where it can best be seen.
 - Or have the normal side and stern lights and exhibit at or near the top of the mast, two all-round lights in a vertical line, the upper being red and the lower green.
- A sailing vessel of less than 7 meters (23 ft) in length shall, if practicable, exhibit the lights side and stern lights but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light to exhibited in sufficient time to prevent collision.
- If you are under sail and also being propelled by machinery you must exhibit forward where it can best be seen a conical shape, apex downward. (Unless you are less than 12 meters in length).

XIX. RULE - Anchored Vessels and Vessels Aground

- When you anchor away from designated anchorages, you need to show lights and day shapes so others know what you are doing and where you are.
- If Anchored during the day, a vessel of any length must display one black ball shape where it can best be seen.
- At night, a vessel less than 50 meters (164 ft) in length at anchor shall exhibit may exhibit an all-round white light where it can best be seen.
- If you have the misfortune of running aground you must exhibit day shapes and lights.
 - The day shape of three balls in a vertical line are the same for vessels of any length.
 - The required lights at night are the same as above plus two all-round red lights in a vertical line.
- As with many rules there are exceptions. Here are three of them:
 - If your vessel of less than 7 meters (23 ft) in length, when at anchor, and not in or near a narrow channel, fairway, anchorage, or where other vessels normally navigate, you are not required to exhibit these lights or shape.
 - A vessel of less than 12 meters (39.6 ft) in length when aground shall not be required to exhibit the required lights or shapes
 - If your vessel is less than 20 meters in length and anchored in a special anchorage area designated by the Secretary, you are not be required to exhibit the anchor lights and shapes required by this rule.

XX. RULE - Maneuvering and Warning Signals

- The following signals are required if you are a power-driven vessels; are in sight of one another within half a mile of each other; and each of you are underway.
 - In a meeting or crossing situation you need to signal your intention by the following signals:
 - Signals of one short blast meaning "I intend to leave you on my port side"
 - Signals of two short blasts meaning "I intend to leave you on my starboard side"
 - Signals of three short blasts meaning "I am operating astern propulsion".
 - When hearing the one or two blast signal AND in agreement, sound the same whistle signal and take the steps necessary to effect a safe passing.

- If you, from any cause, doubt the safety of the maneuver, sound the danger signal (five or more short blast. each vessel must take appropriate precautionary action until a safe passing agreement is made.
- In a overtake situation you need to signal your intention by the following signals:
 - One short blast meaning "I intend to overtake you on your starboard side"
 - Two short blasts meaning "I intend to overtake you on your port side"
 - The power-driven vessel about to be overtaken shall, if in agreement, sound a similar sound signal.
 - If in doubt she shall sound the danger signal.
- Under international rule, when in sight of one another in a narrow channel or fairway a vessel intending to overtake another in compliance with Rule shall indicate her intention by:
 - Two prolonged blasts followed by one short blast meaning "I intend to overtake you on your starboard side"
 - Two prolonged blasts followed by two short blasts meaning "I intend to overtake you on your port side".
 - The vessel about to be overtaken shall indicate her agreement with - one prolonged, one short, one prolonged and one short blast, in that order.

XXI. RULE - Sound Signals in Restricted Visibility

- If you are in or near an area of restricted visibility, whether by day or night, you must use the following signals to let other know where and what you are doing.
- A power-driven vessel, making way through the water shall sound at intervals of not more than 2 minutes one prolonged blast.
- A power-driven vessel underway but stopped and making no way through the water shall sound at intervals of not more than 2 minutes two prolonged blasts.
- All others (*a sailing vessel*) shall, sound at intervals of not more than 2 minutes, one prolonged followed by two short blasts.
- For vessels NOT UNDERWAY but away from docks need to let others know were they are to avoid a collision.
- A vessel at anchor shall at not more than 1 minute ring the bell rapidly for about 5 seconds.
- A vessel at anchor (of any size) may in addition sound one short, one prolonged and one short blast, to give warning of her position.
- A vessel aground shall give the bell and if required the gong signal then must give three separate and distinct strokes on the bell immediately before and after the rapid ringing of the bell.
- A vessel less than 12 meters (39.4 ft) in length is not be obliged to give the anchor or aground signals but, must make some other efficient sound signal.
- Vessels anchored in a special anchorage area designated by the Secretary shall not be required to sound signals if you are less than 20 meters.

XXII. RULE - Distress Signals

- Under the Good Samaritan law you are required to provide assistance.
- Distress signals are defined in ANNEX IV as:
 - A gun or other explosive signal fired at intervals of about a minute;
 - A continuous sounding with any fog-signaling apparatus;
 - Rockets or shells, throwing red stars fired one at a time at short intervals;
 - A signal sent by radiotelephony consisting of the spoken word "Mayday";
 - The International Code Signal of distress indicated by N.C.;

- A signal consisting of a square flag having above or below a ball or anything resembling a ball;
- A rocket parachute flare or a hand flare showing a red light;
- A smoke signal giving off orange-colored smoke;
- Slowly and repeatedly raising and lowering arms outstretched to each side;
- The radiotelephone alarm signal;
- Signals transmitted by emergency position-indicating radio beacons;
- Signals transmitted by radio communication systems, including survival craft radar transponders meeting the requirements of 47 CFR 80.1095.
- A high intensity white light flashing at regular intervals from 50 to 70 times per minute. This is an Inland Rule only.

MODULE - PART'S OF A SAILING VESSEL

To work safely around a sailboat you must know the terms for the various parts of the boat and its components.

1) **Sails** - Power supplies for the vessel as they interact with the winds to provide motion.

- Head - Top corner of the sail. Provide attachment point for halyard .
- Clew - the back corner of the sail attached to the outhaul.
- Tack - lower front corner which is attached to the mast or stay.
- Leech - trailing edge or back edge of the sail.
- Luff - is the leading edge of the sail and is attached the sails attachment point to the stay or mast.
- Foot - bottom edge of the sail. On the mail sail it is attached to a groove in the boom with the bolt rope which is sewn into the foot of the sail.
- Reefing point - holes in the sail with reinforced ring to pas reefing lines.
- Reefing straps - pieces of webbing to tie a reefed sail to the boom.
- Jib Hanks - a snap type device to attach the jib to the front stay.
- Battens - plastic or wood slats to give shape to the mail sail and minimize flapping.
- Batten packets - packet in the sail to hold the battens.

2) **Basic types of sails:**

- Mainsail, most important sail raised from the main mast
 - On a square rigged vessel, it is the lowest and largest sail on the main mast.
 - On sloop the only a triangular sail aft of the mast
- Jib, is a triangular staysail set ahead of the foremost mast of a sailing boat.
- storm jib - is that smallest jib carried when the winds are very strong
- Spinnaker is a special type of sail that is designed specifically for sailing off the wind from a reaching course to a downwind, i.e. with the wind 90°-180° off the bow. The spinnaker fills with wind and balloons out in front of the boat when it is deployed, called genoa
- Genoa is larger, with the leech going past the mast and overlapping the mainsail. To maximize sail area the foot of the sail is generally parallel and very close to the deck when close hauled. Genoas are categorized by the percentage of overlap.
- Fore and aft sail is one that, when flat, runs fore and aft. These types of sails are the easiest to manage, because they often do not need to be relaid when the ship changes course.
- Gaff rigged sail is a sail shaped like a truncated triangle the upper edge of which is made fast to a spar called a gaff.
- Square sail is set square to the mast from a yard, a spar running transversely in relation to the hull (athwartships). To furl and unfurl this sail, sailors would have to climb the rigging

and walk out on "footropes" under the yard. It is not, as commonly thought, named after its approximate shape.

- Marconi sail is a triangular sail with one point going straight up.
- Staysail is a piece of cloth that has one or two sides attached to a stay, that is, one of the ropes or wires that helps hold the mast in place. A staysail was classically attached to the stay with wooden or steel hoops. Sailors would test the hoops by climbing on them.
- Jib is a staysail that flies in front of the foremost vertical mast
- Telltails

3) Rigging:

- Standing rigging does not change position. Usually it braces the masts.
 - A Collection of wires that supports the mast includes the headstay, forestay, Backstay, spreaders shrouds
- Boom topping lift
- Running rigging is used to adjust sails and anchors.
- Consists of ropes that pull sails up and adjust their shape; includes halyards, mainsheet, jib sheet(s), downhaul, outhaul, Cunningham, reefing line,
- A line is a rope.
- A stay is a rope that does not move, part of the standing rigging, usually located in the fore-aft plane of the vessel.
- A shroud is similar to a stay, but is located in the athwartship plane of the vessel. Thus, shrouds come down to the sides of the boat and are attached to chainplates.
- A vang is a line used to pull something around or down.
- A sheet is a line used to adjust the position of a sail so that it catches the wind properly.
- A block is the nautical name for a pulley. It may be fixed to some part of the vessel or spars, or even tied to the end of a rope.
 - The sheave is the wheel.
 - A fiddle block has two or more sheaves in one block.
 - A snatch-block can be closed around a line, to grab the line, rather than threading the end of the line through the block
- A shackle is a piece of metal to attach two ropes, or a block to a rope, or a sail to a rope.
- A snap-shackle does not screw, and can be released by hand, but it is usually less strong or more expensive than a regular shackle.
- Halyards are the ropes on which one pulls to hoist something. E.g. the main-topgallant-halyard would be the rope on which one pulls to hoist (unfur!) the main-topgallant-sail. jib sheet(s),
- A Gooseneck is a device that secures the boom to the mast.
- Fairlead v s. Padeye (fittings for lines)
- Cleats are fittings used to secure a line under strain.
- Spring / breast lines (lines used when docking)
- Fenders/bumpers are used to protect the boat from the float or pier when docking
- A Boom Vang is a rope running from the boom to or near the bottom of the mast which holds the boom down.
- Cunningham, used to shifts the point of maximum draft of the sail forward or aft optimizing sail shape and performance
- The Down Haul is the line attached to the bottom of the boom used to flatten the sail by pulling the boom down, and thus tightening the luff of the sail.
- Belaying-pins located in pin-rails are used to make running lines fast (unmoving) (belaying i.e. wrapping them around)

4) **Parts of the vessel proper**

- Keel- Have a heavy weight underneath them (representing around 40% of the total boat weight). The keel has two main functions: lift which allows it to sail into the wind by preventing boat from being pushed sideways, and weight, which makes it less likely to capsize than a centerboard boat.
- Mast – The mast of a sailing ship is a tall vertical pole which supports the sails. standard terminology assumes three masts, from front to back
 - the fore-mast
 - main-mast (On ships with less than three masts, tallest is the main-mast.)
 - mizzen-mast
- A bowsprit is a horizontal spar extending from the bow (front) of the boat. It is used to attach the forestay to the foremost mast.
- Spars of all types are used in the rigging of sailing ships to resist compressive and bending forces, and to provide support for the sails.
- A boom is a spar (pole), along the foot (bottom) of a fore and aft rigged sail, that greatly improves control of the angle and shape of the sail.
- The deck of a boat is the surface we can walk on.
- The cabin of a boat is the part covered which provide protection from the environment.
- The hull is the main body of the boat.
- The bow is the forward part of the boat.
- A bow pulpit is.
- The stern is the after section of the boat.
- A stern pulpit is.
- The lifelines of a boat are wires that encircle the deck to prevent crew from falling overboard.
- Rudder/tiller are in the rear of the boat and are instrumental in steering (tiller controls the rudder).
- Winches are mechanical devices made to aid in trimming a line.

MODULE - WHY SAILBOATS FLY

1. Sailboat can not travel directly into the wind

- Sail shape, keel and hull are major factors to permit sailboats the ability of sailing upwind.
- Using triangular sail design and centerboard, sailboats can tack to zigzag across a headwind it was possible to travel against the wind using a technique known as tacking.
- Tacking allows the boat to travel forward with a wind at right angles to the boat.
- Boat travels for a time at an angle toward its desired course, then swings boat through the wind and tacks back across the desired course at an angle in a zig-zag pattern.
- Tacking allows the boat to use prevailing wind from many other angles than in earlier sailing methods.
- Boat is dependent on the wind for propulsion, the strength of the wind and the area of the sail used to catch the wind.
- Boat is normally pushed sideways by the wind and not upwind.
- To sail upwind, three things are needed – center of resistance, center of effort , and sail-shape.

2. Center of resistance

- How does wind at right angles to the boat allow the boat to move forward?
- Wind pushes at approximate right angles to the boat,
- The large keel develops a drag force as the boat is pushed in the winds direction.

- With the keel in aligned with boat length-ways, the boat moves forward
- When a boat heels with wind in the sail, it can capsize.
- The keel prevents it from going completely over.
- Positioned beneath the sailboat near the center of the hull, the keel's broad, flat surface creates sideways force by displacing water.
- This force counters the effects of the sail to keep the boat.

3. Center of effort based - First we need to understand lift

- Mainsail and jib harness wind energy with their aerodynamic shapes when the wind impacts them.
- Bernoulli's theorem, known as the "Longer Path Explanation", explains lift in terms of high and low air pressures on either side of the sail.
- As the boat angled into the wind, wind hits the sails.
- Air particles rush over both sides.
- Air particles moving across the outer, convex side of the sail travel a longer distance during the same amount of time as the particles moving across the inner, concave side.
- Particles on the outer side are traveling farther in the same amount of time they must have a higher velocity than the particles on the other side.
- Higher-velocity particles spread out, forming a low-pressure area.
- On the inside of the sail, slower air particles are denser, creating a higher-pressure area.
- This difference in the pressure on the sails acts as a forward suction, producing lift.
- This only works when the wind is forward of the sails. It does not work when the wind hits the sail from behind as there is no aerodynamic shape.

4. Weather and Lea Helm

- Sails and the keel create opposite reactions to propel the boat forward rather than sideways.
- However, they are not always balance
- Each sail exerts an amount of sideways force depending on its size.
- These forces affect the boat differently depending on their location to the center of resistance.
- If the jog and mail center of effort is balanced over the center of resistance the boat will sail in a straight line.
- If the main exerts for effort the boat will have weather helm. It will push the boat into the wind.
- If the jig has more effect, it will permit the boat to drop off the wind. This is called lea helm.
- Most boats have a little weather helm so if control of the boat is lost, it will round up into the wind and stall.

5. True and apparent winds

- As sailboats are powered by wind we need to understand the impacts of true and apparent winds
- Official definition is "apparent wind is the vector sum of the true wind and the wind generated by the motion of the vessel."
- Ridding in a boat on a windless day, the wind you feel is apparent wind.
- It is wind caused by your forward motion through the air.
- It gets stronger as you go faster.
- If you travel at five kts. you have a five kt. apparent wind
- True wind is the wind that is blowing naturally.
- Again a five kt. *breeze* means the wind is blowing at five kts.
- What is important is how these two winds interact?
- Going directly into a wind add your boat speed to the wind speed

- Going directly away from a the wind, each one cancels out the other so a boat speed of ten kts. going directly down wind which is blowing at ten kts. will give you a feeling of not wind.
- With winds from an angle, apparent is always in front of true and apparent can move faster the true as you are compounding the effect.
- When true and apparent cancel each other, you would not feel any wind at all.
- Under optimum conditions, the apparent wind is greater than the true wind.
- As you approach a close reach, apparent-wind is forward of true and appears stronger the true-wind. However, when you are going downwind in a broad reach, it is just the opposite.
- Apparent wind is what you feel while the ship's moving.
- Combination of the true wind and apparent wind powers the sailboat.

6. Changing center of effort impacts on sailing

- The ability to change the center of effort can be used to turn the boat quickly.
- To fall off the wind quickly, loosen the mail sheet and let the jig power the boat quick to a beam reach. Center of effort is moved forward.
- Loosen the jig to help you head into the wind or tack. Center of effort is moved backwards.
- They same concept is true of boats with two masts.
- Beam reach is the fastest point of sail. Heading to wind will reduce boat speed.

MODULE - MANUVERS AND COMMANDS

As with any ship at sea, someone must be in charge and able to communicate efficiently with the crew. Here is how it is done on a sailing vessel

1. Tacking

- *Tacking* allows the boat to travel forward with a wind at right angles to the boat. The boat travels for a time at an angle toward its desired course then the captain swings the boom of the sail and tacks back across the desired course at an angle in a zig-zag fashion. In this way, tacking allows the boat to use prevailing wind from many other angles. Tacking, or coming about, is changing the boat's direction so that the bow comes through the eye of the wind. Since a 45 degrees is about the best a sailboat can point into the wind, tacking requires a turn of about 90 degrees.
- On *Starboard Tack*, the wind comes over the starboard or right side, the boom is always on the port side when sailing this way.
- On *Port Tack*, the wind comes over the port side or left and the boom is always starboard.
- In a *Roll Tack* you use your weight and sail trim and little rudder to change course.
- Procedures For Tacking
 - Helmsman gives the command: "Prepare to tack." This gives the crew a chance to get ready and set up for the maneuver.
 - Helmsman puts the tiller over towards the mainsail, (leeward side) and gives the command: "Helms-a-lee". This notifies the crew that the boat is being turned.
 - The bow comes up through the eye of the wind, the sails come across to the other side of the boat, and as the sails fill, the tiller is brought back to the middle of the boat, the new heading is assumed.
 - *Note:* When sailing close-hauled, the mainsail is sheeted in tight so little or no adjustment of the mainsheet is necessary when tacking. As the boat begins turning up through the eye of the wind, the sails begin to luff. When the main fills on the other side, the tiller is straightened, and the boat assumes the new heading.

2. Jibing

- Jibing is the maneuver of changing tacks downwind. It involves taking the stern of the boat through the eye of the wind. As the boat turns and the stern comes through the eye of the wind, the sails must be brought across to the opposite side of the boat.
- Types of jibing
 - S-Jibe method of jibing used in high/strong winds.
 - Roll Jibe method of jibing used in smaller vessels and in calm air.
 - Chicken Jibe, the process of turning a fore-and-aft rigged upwind and tacking through more than 180 degrees to avoid having to jibe on a downwind course. While much slower, this technique avoids the dangers of passing the boom across the boat under load.
- Procedures for Jibing
 - When the boat is on a broad reach, (wind off stern quarter) the boat will be turned to where the centerline of the boat will pass through the eye of the wind. The helmsman gives the command: "Prepare to Jib."
 - On that command, both main and jib are sheeted in close to the centerline of the boat.
 - As the boat turns further, the wind crosses to the other side. The sails are carefully eased out to their proper position.
 - **Note:** As the boom nears the centerline, the helmsman commands: "Jib Ho." This alerts the crew that the boom will be crossing over.
Caution: The sails should be controlled while crossing over the boat. They should not be allowed to swing on their own.
- Jibing vs. coming about. The choice depends upon which direction the boat is sailing, if you're sailing upwind or downwind. If you're sailing upwind you come about (tacking), If you're sailing down wind you jibe. There are times when jibing can be too dangerous (strong winds) that coming about is the preferred maneuver.

3. Point of Sail

- A sailboat's directional heading with respect to the wind is called her *Point of Sail*.
 - Close Hauled - is the point of sail closest to the wind "beating to windward"
 - When the boat is traveling approximately perpendicular to the wind, this is called reaching.
 - Close reach is any upwind angle between Close Hauled and a Beam Reach.
 - Beam Reach - course steered at right angles to the wind.
 - Broad Reach - wind is coming from behind the boat at an angle.
 - Running Downwind - wind is coming from directly behind the boat.
- Beating - (wind is from ahead) Beating is referred to as the way a sailboat can reach an upwind destination through a series of tacks.
- Running - (wind is from astern) When a boat is sailing in the same direction as the wind it is *running* with the wind coming directly from behind. On a run the lifting effect of the sail is replaced with a pushing effect.
- Surfing is when the wind and the waves are helping to push the vessel downwind allowing the vessel to gain speed.
- In Irons - boat has stopped, pointed directly into the wind, having lost all headway.

4. Maneuvering and operating Sails

- Raising Gaff Sails
 - A *gaff rigged* sail is a sail shaped like a truncated triangle the upper edge of which is made fast to a spar called a gaff. The top of the gaff rigged sail tends to twist away from the wind reducing its efficiency when close-hauled.
- Reefing - reducing sail area.

- Slab reefing, which involves lowering the sail by about one-quarter to one-third of its luff length and tightening the lower part of the sail using an outhaul or a pre-loaded reef line through a cringle at the new clew, and hook through a cringle at the new tack.
- In-mast (or on-mast) roller-reefing. This method rolls the sail up around a vertical foil either inside a slot in the mast, or affixed to the outside of the mast. It requires a mainsail with either no battens, or newly-developed vertical battens.
- In-boom roller-reefing, with a horizontal foil inside the boom. This method allows for standard- or full-length horizontal battens.
- Note: It is important to reef before there is so much wind that the process becomes difficult or dangerous.
- Sailing *wing and wing* is when the jib sheet is eased until the jib is full and parallel to the mainsail

5. Heaving To

- A technique for laying a boat across the wind so that it makes slow progress leeward is *heaving*.
- Note: The major safety concern when to hove is to check that there are no obstructions to leeward in your path of drift.

6. **Conclusion:** Student will have an understanding of key maneuvers of sailing vessel, and knowledge of commands, definitions, and terminology.

MODULE - SAFETY

There are many safety issues with sailing vessels. We are covering several of the more important issues and concerns.

1. **Man over board-** is a very dangerous situation as people have been lost on the calmest of days.
 - Man overboard recovery is series of action taken to keep track of the person and complete a recovery.
 - When you see a person go overboard thee things must happen.
 - Call out “Man overboard Starboard” indicating which side then went over so helms person turns to the side to get stern of vessel away from them.
 - Posting a lookout whose sole job is to watch that person.
 - Mark the location by throwing something in the water.
 - Alerting all remaining crew.
 - Bringing the boat back to the original spot using techniques for under sail or power.
 - Throwing a buoy with a line attached to connect the swimmer to boat.
 - And, most importantly, recovering the person back aboard the boat.
 - Recovery is one of the most difficult parts of the operation. Each vessel needs to identify ways to recover a person in different types of weather. If a 300 # person fell overboard how would yo recover them. If you do not know how, then do not go out until you developed the correct recovery method.
 - Prepare yourself and crew by conducting some unexpected drills.
 - Ask a member of the deck crew, "I just went overboard! What are you gonna do?" to test their reflexes.
 - Next time you're out sailing with your faithful crew, toss a fender over the side and call "Man overboard!".
 - Don't do or say anything to help, to create the illusion of a situation in which you're no longer aboard.
 - After the crew recovers the fender, immediately take a few minutes to discuss the effectiveness of the response, what was done well, and areas for improvement.

2. Dangers and Concerns

- **Gaff rig** – The main concern is the control of the gaff. With minimal winds and large swells. The vessel will rock back and forth, swinging the gaff from side to side. If enough energy is applied the gaff can demast the vessel.
- **Accidental Jibing** - An accidental jibe happens when the boat is steered or the wind shifts such that the stern of the boat accidentally passes through the eye of the wind.
 - This causes that main boom to swing violently to the other side of the boat.
 - Without proper preparation when jibing, the force of the boom's motion can injure crew and damaging equipment.
 - In strong winds a preventer is used to reduce the possibility of an accidental jibe.
- **Head reach** – The distance it takes a vessel to stop from the time efforts were made to stop the vessel such as reverse propulsion.
 - The point is vessels do not stop on a dime.
 - Depending on design, displacements and other factors it will take a hundred feet or more to bring a 30 feet sailboat to a complete stop.
 - Larger boats will take more distance.
 - If this is not taken into account you may not be able to avoid a collision with a dock or another vessel.
- **Boom** – There is a chance of being hit by the boom when you are anywhere in the plane of the boom as it swings across in a jibe or tack. You must duck! Along with the boom, be aware of all the associated rigging, including the boom vang and the mainsheet.
- **Visibility** - Sometimes it is difficult to see in all directions on a sailboat, especially when sailing close hauled.
 - Jib can block 25% of view from the cockpit.
 - Area of obstruction occurs on the leeward side from straight ahead to abeam.
 - Sailboats on a close hauled or close reaching on the opposite tack will remain within this blind spot sometimes right until the time of collision.
 - Important for crew members to keep an eye out to leeward when ever the jib obstructs your view.

3. Lines – There are two safety concerns with lines – entanglement and breaking point.

- Entanglement is a serious hazard. As a line is being released, considerable forces are at work such as anchoring, releasing a sail, or dock lines.
- If you are entangled you can be seriously injured or killed.
- All lines must be properly coiled, flaked or faked so they can run freely. Crew must be aware of lines at all time and stay clear when they are released.
- Bearing point is the second hazard with lines. All line break, which is called their breaking point.
- A lines should not be loaded over 20% of its breaking strength.
- Any hardware used with the line should not be loaded over 17% of its breaking strength. As such the hardware must have a higher breaking strength then the line.
- All lines must be inspected for damage and ware when used.
- Never stand behind a loaded line. If it breaks you will be injured.

4. **Anchoring** – There are several safety concerns with anchoring.

- Entangled in the anchor line.
- When working with anchor rode, crew must be very careful not to get entangled or step on the rode.
- When the anchor is release or set, you can be pulled off the vessel, caught in the hardware, or seriously injured.
- Holing in hull.
- It is important that the anchor is properly secured at all times. A loose anchor in wind and/or waves can move or break loose.
- This can result in an impact to the hull or deck. Vessels have been sunk by the anchor holing their vessel.
- Dragging anchor.

5. **Winch** -

- **Loading Winches** -
 - The line on a winch is always wrapped in a clockwise direction, and it's important when loading a winch to start the first wrap at the bottom of the winch and add subsequent turns above that, but never overlapping the last wrap on the winch. Initially, just a single or possibly two wraps should be made before taking in the slack from the line.
 - If you put too many turns on the winch when the line is still slack, that can cause foul-ups and a possible "over-ride." An over-ride is when the line traps itself under another turn of line on the winch. Improper wrapping of the drum or uneven tension when tailing usually causes this.
 - Tailing is, of course, the process of handling the line as it exits the winch. To add additional wraps to a winch while the line is under load, grab the tail end of the line at a distance away from the drum that is just greater than one wrap. While maintaining tension on the line, keep your fingers pointing away from the winch and make your clockwise rotation around the drum placing the new wrap above the existing top wrap on the winch.
 - To prevent the line from slipping around the winch while its under load, you'll need a minimum of three turns, particularly if you're trying to crank the line in. Less than three turns will not provide adequate friction and the line will most likely slip as the winch turns, negating any progress. That's also one way that a hand can get pulled toward the drum.
 - If possible, all wraps should be made before inserting winch handle. Adding winch wraps with a handle in place results in a sloppy and dangerous technique and often leads to overrides.
- **Tailing Winches** is one of the most important jobs in ensuring smooth and safe operation. Tail the line (again, taking in the slack) as the winch does its job.
 - Standard winches simply feature a drum and a winch handle. If a winch is not self-tailing, you'll need to have one hand free or have an additional crewmember nearby to help tail the line (again, taking in the slack) as the winch does its job.
 - The angle of the tail of the line coming off the winch is crucial to smooth operation. If the angle is too low, the line may try to rearrange itself on the drum, and create an over-ride. If the angle is too high, it will interfere with the free rotation of the winch handle on top.
 - The goal is to ensure the line stays neatly wrapped on the drum as it turns, and to provide enough tension so that the line does not slip and negate your winching progress.
 - Most standard winches require having a cleat nearby to secure the line after the required tension has been achieved.
 - Self-tailing winches add a line stripper on top that's designed with teeth to hold the line for you as you turn the handle.
 - Self-tailing winches like this one allow you to have both hands free for grinding.

- When it comes to easing the line off the drum, it helps to use the palm of your hand to govern the friction as you release the line.
- Self-tailer stripping arm feeds the line leaving the winch drum into a specially designed set of teeth at the top of the drum. These teeth capture the line and prevent it from slipping. Lines must be properly sized.
- **Grinding Winches** - It is important to position your body so that the larger muscles of the back and legs can assist in the process.
 - When winching from low side of boat, keep your center of gravity low so if you happen to slip you will not go overboard.
 - When choosing a winch handle, longer handles provide more power. A short handle is good for speed in light winds
 - Winch handles come in both lock-in and non-lock-in varieties. Lock-in handles can easily fall overboard. Lock-in handles are slower to insert and remove.
- **Never have jewelry, scarves, or loose clothing, etc.,** hanging down when using any winches.
 - If these items get caught up between the line and the winch, they'll be destroyed and you may well be injured.
 - Electric winches need to be turned off when not in use to avoid inadvertently hitting the power button
- **Easing Line** - The friction created by a wrapped line on a winch drum maybe too great that the line will not run when removing tension from the tail.
 - Carefully remove one wrap from the drum, or coax the line into motion by using the inside heel of your hand as you reduce tension on the tail. Never use your fingers as they could be pinched by the line.
 - To release the line off a winch, pull upward in a counter-clockwise motion, and be sure the tail of the line is free to run.
 - When easing line that is held by a clutch stopper in front of a winch, always winch in slightly with the handle and hold the tail firmly before releasing the clutch. This will take the pressure off the clutch and make it easier to open, and it can prevent your hand from being pulled into the clutch stopper. Never underestimate the amount of tension that a clutch stopper is holding.
- **Releasing Line** - Before releasing line from a loaded winch, make sure that the tail will be able to run out freely with no tangles. Remove the winch handle and place it in a winch handle holder. To release the line, position one hand with the tail of the line above the winch, and quickly make counterclockwise rotations to remove the wraps as you raise your hand. Never allow your hand to be in a position where it could get tangled with the line that is being released.
- **Emergency Measures** - Always have a knife available or somewhere handy nearby. Ideally, a razor-sharp, blunt-tipped knife in a sheath should be close to the winch. If you become entangled in the fast releasing line, use the knife to free yourself. When a fully loaded jib sheet or mainsheet is cut away from a jammed winch, the loose line on the sail can be a very dangerous weapon whipping in the wind.