Coaching ACA strokes – as presented in a ACA newsletter by Roger Schumann (http://eskapekayak.com/aca-instructor-certification-workshops/aca-strokes-maneuvers-refinement/)

Forward "Power" Stroke

1. Comfortable extension forward and maintain box
2. Hands at shoulder height and "in plane"
3. Drive foot peg on the same side as the stroke
4. Torso rotation (10 o'clock to 2 o'clock)
5. Short stroke (early catch in at feet, out at hips)
6. Relatively high shaft angle (depending on boat, anatomy, paddle length etc.)

Reverse Stroke

1. Maintain paddler's box
2. Rotate torso and look behind you
3. Place back face of paddle flat on water
4. Unwind torso to power the stroke
5. To correct heading, hold edge longer and finish stroke further toward the bow

Sweep Strokes: "Spin Turn" Drill:

1. Torso rotation (windup)
2. Plant blade in at feet just below water
3. Horizontal shaft angle for maximum extension
4. In flat water, follow blade with eyes. In rough water, look through turn
5. Maintain box & drive w/ on-water peg
6. Catch, release = bow to stern waterline
7. More edge = less waterline

Stern Rudder

1. Establish hull speed!
2. Blade in water at stern quarter, with back face away from boat
3. Edge to outside, away from turn: "offside edge"
4. Load back face to turn toward blade
5. Load power face to turn away (technically this is a "stern draw")

Draw Strokes - Standard Draw

1. Face your work (rotate torso)
2. Anchor off water arm across chest

3. Sight over off-water wrist
4. Control w/ on-water hand
5. Extend shaft and pull power face to boat
6. Blade deep in water
7. Rotate wrist and slice away for “in-water recovery”

Draw Strokes - Sculling Draw

1. Power with torso, not arms
2. Vertical shaft
3. Angle leading edge of blade slightly away
4. Rotate wrist to change leading edge
5. Short stokes (1-2 ft. arc, 6-18 inches out)

Low-Brace

1. Flat shaft angle
2. Elbow over shaft
3. Maintain reference grip
4. Use back face to create “depth charge”
5. Hip snap “C-to-C” to recovery

High Brace

1. Flat shaft angle
2. Elbow under shaft
3. Slap power face on water
4. Hip snap “C-to-C” to recovery

Sculling Brace

1. From high brace position, power face down, flat shaft angle
2. Blade at surface, slight climbing blade angle
3. Control w/ on-water hand
4. Torso over water
5. Don’t push down, create lift by pushing blade fore & aft w/ slightly high leading edge

Low-Brace Turn

1. Establish hull speed!

2. Initiate turn with sweep stroke and edging to outside of turn
3. Transition quickly to inside edge
4. Extend paddle blade, reaching both hands out over the water, and delay contact with the water
5. Use back face with slightly climbing blade angle, and hold brace ("ride the glide" and do not push forward until recovery)
6. Recover with hip snap
7. Transition to forward sweep on the opposite side to continue the turn

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Bow Rudder (A.K.A.: "stationary bow draw," "running bow draw," and "Duffek")

1. Establish hull speed!
2. Initiate turn (outside edge & sweep)
3. Submerge blade near foot
4. Rotate wrist slightly to open leading edge and load power face, keeping blade as vertical as possible
5. Control with on-water hand and allow off- water hand to drop to a comfortable fulcrum position
6. Don't over-expose power face
7. Adjust as hull speed decreases
8. Blend into forward stroke to regain momentum

Side Slip ("stationary" or "running" draw)

1. Establish hull speed!
2. Rotate to face your work
3. Place paddle off hip, with slightly open-faced blade angle
   *(Option A, for beginners) Slice blade from aft quarter forward into place at hip or…
   *(Option B, more advanced) Transition from forward stroke to open-faced blade angle off hip, (as shown in video).
4. Rotate on-water wrist to keep leading edge angled slightly outward, away from boat.
5. Search for the sweet spot. Too far forward draws the bow. Too far aft draws the stern.

Rescues

Objective

- Minimize exposure
- Swimmer back in kayak
- Seaworthy kayak
- Swimmer composed and ready to paddle in conditions

Wet exit w/ spray skirt

- Paddle under arm
- Capsize
- Bang boat bottom with both hands
- Eject – "Pants off"
- Surface by boat and place leg in boat

Re-enter and roll

- Over, exit, paddle under arm, leg in boat facing forward
- Position pump for immediate use
- Hands on outer stern edges of cockpit, paddle in upper hand along top edge of cockpit
- Second leg into cockpit
- Roll up

Scramble

- Empty boat, SWIM onto back deck, climb the kayak into seat, skirt on
- Over, exit, paddle under arm
- Go to bow of the boat
- Lift, flip upright, empty boat using flat paddle technique
- Orient into waves, kick and swim onto back deck
- Straddle the boat, climb to bow till butt is over seat, use paddle to brace as needed
- Sit up, drop butt into seat, stabilize with paddle brace, get legs in
- Pump out

Paddle float

- Use paddle and float as temporary outrigger

- Over, exit, paddle under arm, leg in boat facing forward
- Attach paddle float to paddle and inflate
- Position paddle as outrigger immediately behind cockpit
- The hand closest to the bow should be holding onto both the cockpit and paddle
- Put the leg that is closest to the stern onto the paddle shaft
- The hand closest to the stern should be holding the paddle shaft, near your hip
- The boat will be stable as long as you keep your weight on the float side of your kayak
- Keeping your weight on the paddle shaft, move your other leg into the cockpit
- Keep that paddle perpendicular to the boat
- With the forward leg well inside the cockpit, shift some of your weight onto the boat and bring your other leg into the cockpit
- Keep leaning on the paddle shaft, to get support from the float
- Slide forward in the boat (toward your feet) until your stomach is over the seat
- Twist your body around facing the paddle until you are in the seat
- Keep your hands on the paddle shaft and let the paddle float work as a stabilizing outrigger

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Heel hook

- Exit the kayak and get onto the upwind side
- Stick your feet into the cockpit to hold the kayak while you grab your paddle float
- Put the paddle float onto your paddle and secure it and inflate it
- Stay about even with the cockpit and in front of the paddle shaft
- Stick your paddle blade under the far deck line of your kayak directly behind your cockpit with the float away from the kayak and the paddle shaft perpendicular to the kayak
- Turn towards the cockpit
- Grab the paddle shaft and the near deck line with your aftward hand
- Grab the coaming with your other hand
- Put your bow-ward heel into the cockpit
- Use your heel and leg to leverage yourself into the kayak just as you would when doing the heel hook t-rescue. You move your bow-ward hand to the other side of the coaming while you do this.
- You'll be face down on the back deck as you put your second leg into the cockpit

- Spin your body towards the paddle float and switch your hands on the paddle shaft while keeping your weight on the float
- Finish the rescue as you would with the standard paddle float reentry

Sling

- Use the cow tail or dedicated stirrup as a re-entry sling from deck or paddle

Boat over boat (T-rescue)

- Rescuer - "Stop, swimmer"
- Closest person does the rescue
- Swimmer - hold on to paddle and boat
- Speedy but cautious – boat between you and the paddler
- Paddle towards bow of the swimmer's boat if ok (while well away from the swimmer and before determining status)
- Rescuer to swimmer – "Are you OK?'
- OK – Ask swimmer to turn boat upright
- "No" - stay away until swimmer calms down
- Grab bow of the boat
- Tuck paddle under the bottom edge of the PFD or store under bungees
- Direct swimmer to the rescuer's boat, always holding on to one boat or the other
- No need send swimmer to the stern of their boat (unless boat is heavily loaded)
- Minimize movement in the water. Depending on the swimmer's position, move swimmer toward the bow or stern of the rescuer's boat.
- SLIDE the swimmer's upright boat onto the rescuer's boat till the front hatch cover of the swimmer's boat is even with the rescuer's chest
- Turn swimmer's boat over to empty water
- Do not lift. If needed edge boat away to lift the swimmer's boat higher so more water can drain out
- Slide swimmer's boat back into the water and arrange the two boats bow to stern
- OK bow to bow if will increase speed
- Direct swimmer to come to the outside of the swimmer's boat, just behind the cockpit
- Take swimmer's paddle and create bridge between the two boats
- Lean onto the swimmer's boat in front of the cockpit, facing stern, paddles under arms, all weight on it for stabilization. Hold on to deck lines.

- Direct swimmer to kick feet toward the surface of the water to swim up onto the back deck (Heel-hook entry is also option)
- Direct the swimmer to slowly spin around so that head is facing the stern of the swimmer's boat and feet are over or in the cockpit
- Direct swimmer to slowly move backwards, staying low, until the swimmer's legs are in the cockpit and butt is over the seat
- Direct swimmer to slowly spin toward rescuer (staying low) using rescuer's boat for support until swimmer is seated back in his/her boat
- Keep weight on swimmer's boat until he/she has pumped out and has spray skirt attached
- Direct swimmer to take a deep breath, wait another 10 seconds or so, gives the swimmer's paddle back
- Push straight forward or straight backward to split the boats apart
- Pushing the boats sideways away from each other increases likelihood of capsize

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Eskimo rescue (bow / stern / paddle)

- Capsized paddler stays in boat, bang the hull to get attention
- Waves open hands in air forwards and back along hull on both sides, hands well off kayak
- Rescuer approaches from any angle to slowly offer bow or stern by sliding it along capsized boat to open hand
- Capsized paddler grabs boat, slowing raises self to surface, and grabs boat with other hand
- Hip snap up, head last
- For paddle rescue
- Rescuer positions boat parallel to capsized boat, places shaft across the hulls
- Grab wrist of capsized paddler's open hand and place it on the paddle shaft, fingers forward
- Capsized paddler – feel flesh, be directed
- Two hands on paddle shaft, and hip snap up

Scoop rescue

- For paddler who is incapable of assisting you in reentry
- Set up in critical – victim next to cockpit, with recuse on other side
- Flood cockpit
- Float injured paddler fully into boat – preferably face up and butt on seat, OK to do face down
- Position knees to avoid injury
- Right the kayak by push and pull paddler to front or back deck, lift with PFD

Unresponsive paddler rescue e.g. Hand-of-God

- For capsized paddler who does not do wet exit
- Very large weight differences between the two paddlers involved in the rescue, then this skill may not work
- Rapid approach
- Reach across and grab cockpit rim on far side of capsized boat
- Push capsized boat away while pulling boat up towards you to roll kayak up
- Grab and flip paddler to back or front deck to finish roll up
- Objective is to get the paddler above water
- Be prepared to manage emergency, get unconscious paddler to shore

Swimmer recovery (bow, stern)

- Bow – hug the tree
- Stern – hang on toggle, or hug tree, or
- Back deck – swim on back deck and lay directly behind paddler

Paddles, boats, handling and towing

What is the range of common paddle lengths, and what length would you recommend for your students & why?

- 205 to 225 cm for a sea kayak
- The Werner paddle sizing program on the Werner website (http://wernerpaddles.com) is a useful resource
- For sea kayakers, the taller and wider the front of your kayak is, the longer the shaft of your paddle needs to be in order for you to be able to reach into the water for an efficient forward stroke. A decade or so ago it was common for sea kayakers to use extremely long paddles (235 – 260cm long paddles in 23" beam one-person kayaks). Then about five years ago the pendulum swung to the other extreme (205 – 210cm long paddles in 23" beam one-person kayaks). The long paddle made it difficult to sprint and maintain a high angle stroke; the shorter paddle makes it hard to turn and brace in rough water. For most one-person sea kayaks in the 21" – 23" beam range, a good all-around paddle length will be about 210 cm to 220 cm. This is true regardless of the paddler's height. If you use extremely low angle forward stroke technique, add about 5cm to the above. If you use extremely high angle forward stroke technique, subtract about 5cm. For two-person sea kayaks, paddle lengths of 225 – 235cm are typical, again depending on the height and width of the kayak.

Which hull designs features favor speed, stability, maneuverability?

- Speed - Long, narrow waterline and low rocker, when a paddler has power to push the boat up to and keep it at hull speed. Narrow hulls are more efficient than wider hulls. Shorter kayaks have lower hull speeds than longer ones.
- Stability - Wider hulls and hard chines provide optimal form stability. Weight concentrated below the center of buoyancy further increases stability.
- Maneuverability - High rocker, short waterline, pan bottom, narrow to moderate width, and hard chines.

Weather cocking in kayaks

- Weather cocking is the tendency of a moving hull to turn into the wind. Although the paddler often perceives this as a problem where the bow persists in turning into the wind, the real cause is the stern sliding leeward (downwind). Adjusting the skeg downward increases the surface area in the stern to reduce leeward movement.
- In kayaks it is most often caused by a difference in pressure between the bow and stern of the kayak. When in forward motion a hull enters the most undisturbed water and creates a bow wave that

increases in size as speed increases. The low turbulence water at the bow is considered to be a "high pressure" water that provides optimal grip with the hull. Turbulence increases as the boat continues to displace water as it moves forward past the entry point, creating a "low pressure" area that begins aft of the bow and culminates in the lowest pressure at the stern in the eddies that make up the boat wake. The stabilizing forces in the low pressure area near the stern are much less when compared to the bow, and that the higher "grip" at the bow becomes a fulcrum on which the hull can pivot. For this reason, even a light wind placing equal pressure on the bow and stern is likely to move the stern much further off the line of desired line of travel.

- Any significant change to the surface area of the kayak above the water line will also change the force exerted by the wind on the kayak, and this can change the point where the kayak pivots. For example, placing a bulky PFD on deck at the stern can increase weather cocking, and placement at the bow can cause lee cocking (bow sliding downwind). So a clean deck will help the kayak perform as designed in high winds.

- Likewise, placing excessive weight in the bow or stern will change the surface area of the hull below the waterline, and this will change how the boat resists lateral movement when subject to a side force such as wind.

- See the discussion on a rudder, skeg, and trim.

Advantages and disadvantages of a rudder and skeg?

- A rudder is usually a mechanical steering system that allows a sea kayak to be used without use of the many steering techniques that are required to efficiently paddle a sea kayak without a rudder in conditions. The rudder at the stern of the boat is usually linked by a cable to foot pegs that move like a gas pedal. All of the paddler's energy can be used to propel the boat. Fully or over loaded kayaks, and kayaks with a poor handling hull design, and of improper size or excessive length can be successfully used in more adverse conditions than would be possible without a rudder. On the down side, rudders are mechanical and can fail, when deployed there is additional drag, and the paddler is not depending on or developing use of other skill dependent techniques to control the boat.

- A skeg is a fin on the bottom of the hull near the stern that is raised and lowered in and out of the water beneath the stern with a hand control. The skeg is used to prevent weather cocking. A skeg is not a rudder; it does not actively turn the boat. The kayak must be of proper size and fit, and the paddler of sufficient skill for the conditions encountered because steering and turning skills are always required to control the boat. For a skilled paddler in a good hull design, the deployed skeg prevents the kayak from turning up wind when holding a course sideways to the wind, while allowing a properly designed and trimmed kayak to turn up wind even in strong winds when the skeg is lifted. On the down side, a retractable skeg has a skeg trunk molded inside the hull which takes up storage space, the skeg and the skeg trunk add drag to the hull, even when the skeg is retracted, and the structure is susceptible to damage or jamming when launching and landing.

Trim

- Each hull has a design trim at which it performs as designed, and when off that trim the hull can become squirrelly or unpredictable. In kayaks, the boat will respond different than expected when in motion, and to strokes, and may be more difficult or impossible to control in wind and waves. Excessive weight in the stern can cause lee cocking (bow sliding downwind). A kayak's trim is the difference between the draft at the bow and stern, and this is the focus in most discussion on kayak trim.

- Side-to-side balance is how level a kayak sits in the water from side to side. Packing the starboard side of a kayak more heavily than the port causes the kayak to list to the starboard, which is annoying but also can cause the kayak to turn away from the heavy side.

- When a kayak is loaded bow or stern heavy, the kayak will shift its trim towards the heavier end. Manufacturers should place the seat so that the paddler's center of gravity aligns with the kayak's center of buoyancy to keep the kayak trimmed correctly. To maintain proper trim when carrying gear, pack the kayak with equal weight distribution. When loading the boat, always try to place items of equal weight in both the fore and aft compartments of the boat, at an equal distance from the center of the boat length. Some kayaks are more forgiving than other when packing for trim. The only way to find out if your kayak handles uneven weight distribution is through testing. Until you test it, load it evenly.

Boat control relative to wind direction

- Beam – Most boats will weather cock when paddling across the wind, and capsize is more likely in open water because the stabilizing effect of waves from the bow or stern is not present. Careful leaning to windward may be necessary to balance the intermittent forces from the wind itself as well and the wind generated waves. In higher winds the paddle itself may prove challenging to manage if the wind catches the blades. The paddling is easier with a skinny blade.

- Tail – Often the most unnerving direction of paddle in relation to the wind. The boat move faster. When waves are present, the inability to see the waves and predict the motion generated by their passage is unsettling. Boat speed will continuously increase and decrease with each waves passage, and the inexperienced paddler can tire quickly paddling up the back of passing waves. In this situation most boats will have some tendency to broach, and the paddler could capsize if bracing skills are inadequate.

- Head – Although progress is slow, paddling into the wind is often the most comfortable direction of paddle in the wind. Everything that happens is in front of the paddler because the wind and waves are coming at you. Broaching is unlikely. Wind and waves may be persistent in driving into you face. Bigger waves will wash over the boat. The paddling is easier with a skinny blade.

Criteria of a tow system

- Quick release system

- Float for the lead attachment point (optional)

- Attachment hook for towing that is free of a notch that can hang-up on deck ropes

- Sufficient length to prevent collisions and handling problems when too many waves move between the boats

- Storage system that is easy to carry, and allows for quick and reliable deployment and recovery

- Floating line (optional)

- Shock absorber (optional)

How long should your towrope be and why?

- Most references recommend a tow line length of 30-35 feet for use on open water. The length keeps the kayak in tow from surfing into the back of the tow boat when traversing rough water, boat wakes, and surf areas without allowing too many waves to fit between the two boats during the tow.

Communication and safety in the coastal environment

What does the U.S. Coast Guard require for coastal kayaking?

- Life jacket
    - Readily accessible
- Efficient sound producing device
    - Audible up to ½ mile
- White navigation light
    - Ready at hand between sunset and sunrise
    - Exhibited in sufficient time to prevent collision
- Visual distress signal, sunset to sunrise:

  - Three flares (3 Night, 3 day/night, or a combination), OR
  - One Electronic Distress Light for Boats

Can we do more to increase safety at sea in a kayak?

- YES. Safety margins increase significantly when the paddler, the boat, and the gear in the boat exceed the US Coast Guard requirements for coastal kayaking.

Reasonable criteria for selecting signal devices for your system

- USCG approved for day and night
- Effective on land and on the water
- Longest effective range of visibility
- Bright, high in the air, sufficient duration of signal
- Acceptable risk to the user
- Small size
- Stores in a PFD

Will your gear deliver when you need emergency assistance?

- Operate reliably in the marine environment (waterproof)
- Be highly effective and approved for use both day and night
- Provide maximum opportunity for the operator to make first contact with emergency responders and nearby vessels
- Guide responders to your location in the most efficient and timely manner
- Convey and receive information throughout an event

Example of a practical signal and communication system for the PFD

- Fully charged, hand-held, waterproof VHF radio
  - Not required by law, however USCG recommends even the smallest vessels carry a VHF
- White, long burning, waterproof navigation light (Note: a strobe is not a navigation light)
- Marine safety whistle
- Minimum of four aerial flares approved by USCG for day and night use
  - Compact for storage in PFD
  - Greatest likelihood signal will be seen over the greatest area

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VHF

- A marine Very High Frequency (VHF) set is a combined transmitter and receiver and only operates on standard, international frequencies known as channels

- USCG recommends (but does not require) even the smallest vessels carry a fully charged, hand-held, waterproof VHF radio
- Reliable “line of sight” communication
- Channel 16 (156.8 MHz) is the international calling and distress channel
- USCG, shore stations, and other vessels monitor Channel 16 frequency 24/7
- Calls for use in emergency and safety situations
    - Distress (MAYDAY) threat of grave, imminent danger
    - Urgency (PAN-PAN) safety risk to person or vessel
    - Safety (SECURITE) safety signal to advise others

Overview of USCG approved signal devices

- A variety of red hand-held, and hand-and-pistol-launched aerial flares for day and/or night use
- Floating and handheld devices that emit orange smoke for daytime use
- Electronic SOS light for boats, for night use
- All USCG approved devices are not equal in versatility and effectiveness

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USCG approved aerial flares

- Best initial visual distress signal for all conditions
- Rocket-propelled devices launched from hand
- Bright, high, moving, spectacular, cover a large sighting area
- Approved for day and night
- Small and easy to store
- U.S. Coast Guard recommends firing two meteor aerial flares – one immediately after the other – so rescuers can confirm the sighting and the direction of the signal
- Parachute flares - a single parachute flare has an adequate burn time (25 to 30 seconds) to confirm sighting and position

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USCG approved sea-level signals

- Limited range compared to aerial flares
- Not the best choice as an initial visual distress signal
- Primary use - guide responder in to your position after visual or VHF contact is established
- Recommended options
- Hand-held flares
    - Approved for day and night

    - Pyrotechnic – heat combustion, smoke may be a problem
- Orange smoke devices
    - Approved only for day use
    - High visibility
- Electric SOS Light
    - Approved only for night use
    - Low risk, easy to manage and store

Need a more robust signal system? Why?

- To manage additional risk and meet contingency plans for
    - Longer trips, remote locations
    - Coastal environments, severe conditions
    - Prospect for rapid assistance or rescue is low
- Consider carrying…
    - Additional aerial flares
    - Smoke flares and hand held flares
    - GPS
    - Personal Locator Beacon (PLB)
    - Emergency Position Indicating Radio Beacon (EPIRB)

Points to consider…

- Safety is a process, not a list
- Comply with USCG requirements
- Carry a VHF as integral to an appropriate signal and communication system
- Contingency plan on the water until it's second nature
- Practice forming plans of action to get comfortable with process and gear
- Carry a safety kit that meets your contingency plan
- Aerial flares are almost always best
- Store gear so you can always use it

Navigational skills

What is navigation?

- Process used to decide how to safely maneuver a vessel to a desired destination
- Most navigation in small kayaks can be accomplished by simple piloting from one visible known location to the next
- Requires a chart, a compass, and common sense consideration of weather, tides, and current
- Master the basics and the rest comes quickly

Distance

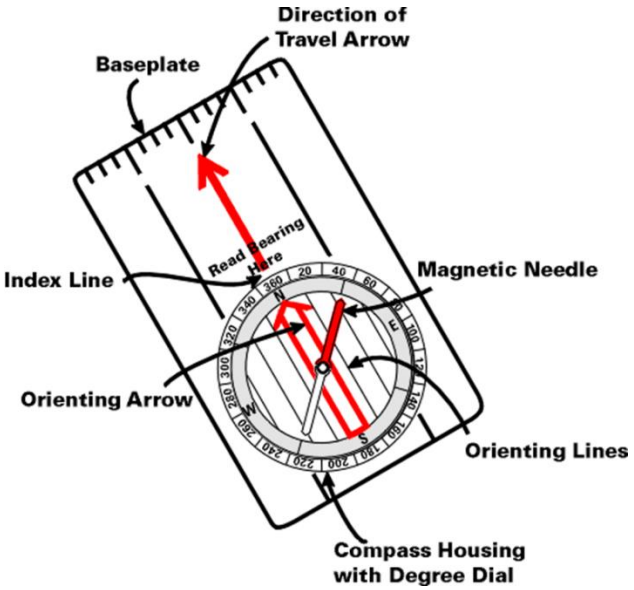
- Nautical mile (NM) is the standard unit of distance for nautical charts
- 1nm = 6076 feet = 1.15 mile
- One minute of latitude equals one nautical mile anywhere on the globe

Time and distance conversion

- One knot (kn) equals one nautical mile per hour (Kn = NM/HR)
- 1 knot = 1.151 mile per hour (Kn=1.151mph)

The compass

- Instrument containing a magnetized pointer that shows the direction of magnetic north and bearings from it
- Use to identify course, bearing, and headings
    - Course: Planned route
    - Heading: Direction vessel is pointing
    - Bearing: Direction to a distant point in degrees from north



http://www.princeton.edu/~oa/manual/mapcompass2.shtml

Plot bearings

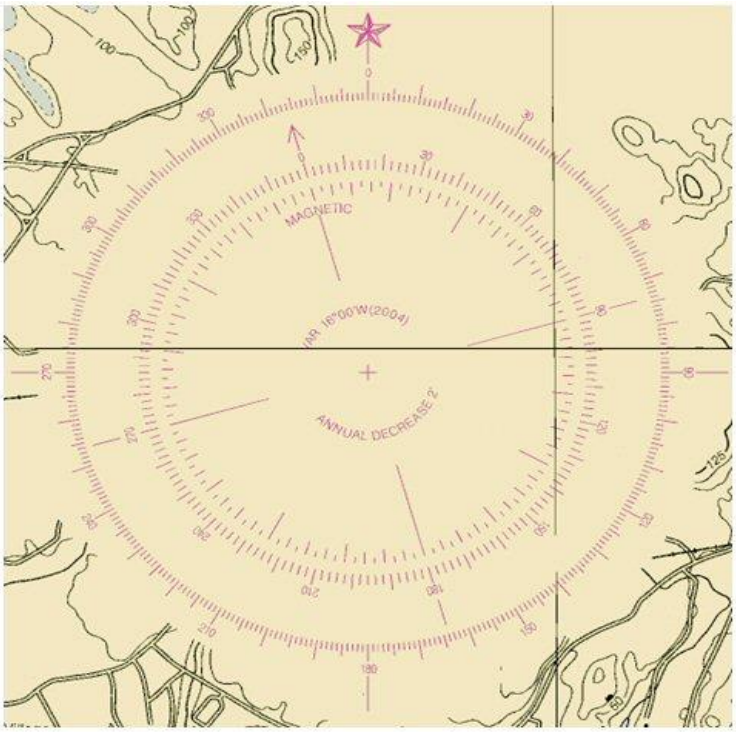
- Take a magnetic bearing on a distant feature in the field
    - Hold the compass and point the direction of travel arrow at the feature
    - Turn the compass dial until the orienting arrow and the red end of the magnetic needle align
        - "Put big red in the shed"
    - Read the bearing in degrees on the compass housing where the index line running from the direction of travel arrow intersects
- Take a Bearing from the Chart
    - Align the long edge of the compass with starting point and destination
    - Turn the compass dial until the north-south lines are parallel to the north-south lines on the map
    - True or magnetic north depending on the orientation of the chart

Adjust for variation (aka declination on large vessels)

- When going from True to Magnetic bearings, "West is Best, East is least"
- When going from Magnetic to True bearings, the opposite applies, "West is less"
- To convert between T to M
    - (True = Magnetic + Declination)
    - (Magnetic = True – Declination)
    - Use the range of 0° to 360°
    - East declination is a negative number
    - West declination is positive number
- True to Magnetic
    - With a declination of 10°E (-10°), a true bearing of 0° converts to a magnetic bearing:
        - 0°T - 10°DE = 350°M
    - A declination of 10°W (10°) a true bearing of 0° converts to a magnetic bearing:
        - 0°T + 10°DW = 10°M
- Magnetic to True
    - With a declination of 10°E (-10°), a magnetic bearing of 0° converts to a true bearing:
        - 0°M + 10°DE = 10°T
        - Compass points to Magnetic north at 10°E of True, so add east declination to magnetic to get true
    - A declination of 10°W (-10°) a magnetic bearing of 0° converts to a true bearing:
        - 0°M - 10°DW = 350°T
- http://www.ngdc.noaa.gov/geomag/
- http://www.ngdc.noaa.gov/geomag-web/
- http://www.schoolofsailing.net/true-and-magnetic.html

Compass rose

- Compass roses on NOAA charts show two graduated scales. One is referenced to True North, the other is referenced to Magnetic North. http://www.nauticalcharts.noaa.gov/mcd/learnnc_rose.html



The marine chart

- Real world projected onto paper
- Primary purpose is to give a navigator the information needed to decide how a vessel should be maneuvered to safely reach a desired destination
- Key to determining where you've been, where you are, where you're going, and what to expect at each point along the way
- Maps emphasize land forms, surface paths and landmarks
- Charts present an accurate representation of coastline, areas beneath the water, and water movement that are critical to a navigator
- The density of symbols on a chart can be overwhelming
  - Kayak navigation for the most part relies on the most basic features
  - Get the basics and the rest comes quickly

Chart / map orientation

- Title block
  - Name, number, edition, year, Information on the area, scale, sounding units, projection, datum
- Latitude and longitude
  - Geographic coordinate grid lines frame and overlay the nautical chart
  - Longitude lines run north and south (meridians)
  - Latitude lines run east and west (parallels)

- Orientation is true north

Relief

- Depths
  - Many small numbers scattered over water
  - Expressed in feet, meters or fathoms (6 feet)
- Datum
  - Two critical references for US
    - Depths - "mean lower low water" (MLLW) which is the average of all the lowest low tides
    - Heights - Mean higher high water" (MHHW), the average of the daily highest high tides
- Contours
  - Lines that show a similar depth (6,12,18,30,60)
  - Shallow are blue
- Seabed
  - Shipwrecks
  - Danger designations outlined by dotted lines
  - Rocks that cover and uncover are shown as asterisks
  - Dangerous unknown depth, or just under the surface at chart datum are marked by plus signs, or plus with dots around them
- Shoreline
  - Intertidal areas
  - Areas submerged at some point in the tidal cycle are green
  - Natural Features of the coastline
  - Common symbol - circle around a dot
  - Towers, tanks, chimneys, churches, spires, monuments, with a label

Aids to navigation

- Nomenclature - Name, color, phase (pattern of flash), light period (cycle), height above datum, approximate range of visibility, sound
- Day – observe the location, color, shape, label, sound
- Night – observe light color, flash character, sound

Six types of Navigation Aids – Which ones are most important to kayaks?

- Lateral Marks
  - Red, nun, right (starboard) on return, even numbered
  - Green, can, left (port) on return, odd numbered
  - Numbers increase with distance from the ocean
- Danger and Cardinal buoys
  - Black, with yellow or red

Navigation lights on most marine vessels display:

- Red light on port side
- Green light on starboard side
- White at stern or masthead

Use of natural ranges (transits)

- Position on a line

- Triangulation
- Ferry progress

Tides and currents

Tides

- Tides are the vertical rise and fall of water in coastal regions
- Sun and moon exert gravitational pull on earth's water to produce tides
- Moon, smaller, closer to earth, exerts twice the influence of the sun
- Result is a bulge of water on the earth that stays below the moon, traveling the globe as the earth spins – http://oceanservice.noaa.gov/education/kits/tides/media/supp_tide06a.htm
- A second identical bulge is always present on the opposite side of the globe, caused by the centrifugal forces of the earth-moon relationship
- Two high and two low tides (semidiurnal) constantly move across the surface of the earth
- The semidiurnal tide period lasts for a period of 12 hours and 25.2 minutes from low to high tide, and then repeats back to low tide again
- Latitude, shoreline and seabed topography affect local tides by influencing the flow of the water bulge, to produce only one high and low per day and mixed tides (two tides that are not the same)

Tidal current

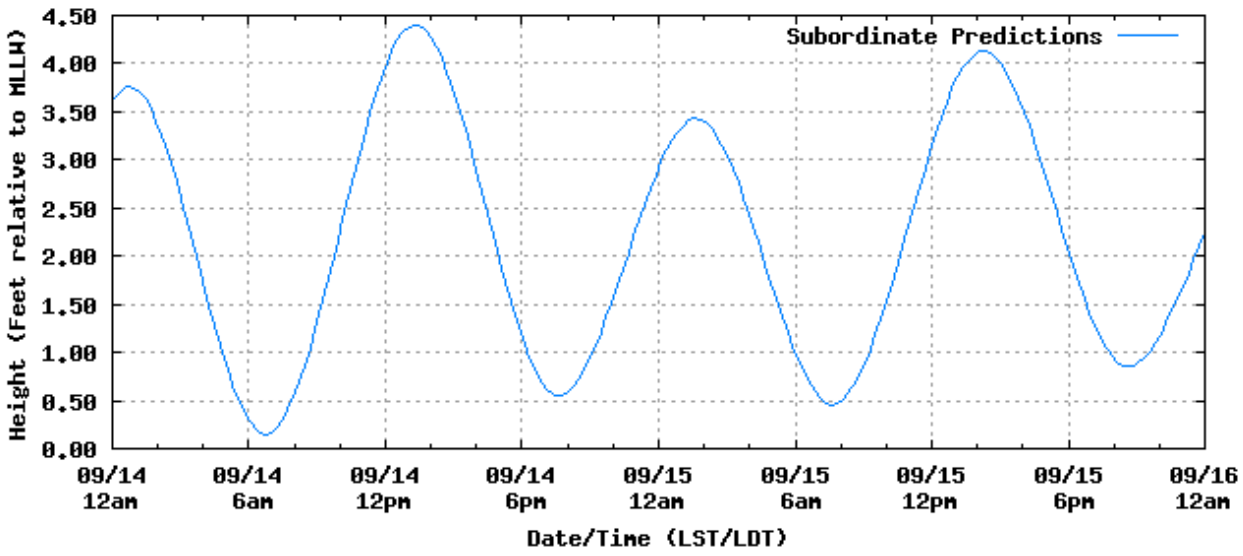
- Tidal current is a direct result of tides, caused when the tidal bulge encounters a constriction that accelerates the horizontal flow of water
- Can result in fast current on large bodies of water, standing waves, and eddies
- The larger the change in tide range (height), the more rapid the horizontal transfer of water over shoals and through constrictions
- Races occur where speed of current is accelerated by constriction (headlands, inlets)
- Over-falls occur where current flows over a shoal and collides with deep water

Terms

- Diurnal – One high and one low tide each day (US Gulf Coast)
- Drift – speed of the current in knots
- Ebb - Period when tide level is falling, also refers to the ebb current which occurs during this period
- Ebb current –the movement of a tidal current away from shore or down a tidal stream
- Flood - Period when tide level is rising, also refers to the flood current which occurs during this period

- Flood current - The tidal current associated with the increase in the height of a tide, generally set toward the shore or up a tidal river or estuary
- Maximum current – highest velocity of the flood or ebb during one cycle
- Mean Lower Low Water (MLLW) –Low water datum on US charts that is the arithmetic mean of the lower low water heights of each tidal day observed over a specific 19-year cycle (Metonic cycle, aka the National Tidal Datum Epoch)
- Mixed – multiple tides each day with patterns of high tide followed by a low tide, followed by a higher tide and a lower tide
- Neap – gravitational force from the sun and moon are lowest at right angles to each other at the first and third quarter moon, where the sun partially cancels out the pull from the moon, resulting in the lowest tidal range
- Range – the change in height of the water between the time of high and low tide
- Semidiurnal – most of the world experiences two high and low tides each day (US east coast and Europe)
- Spring – gravitational force from the sun and moon are at maximum when the moon aligns with the sun at the period of the full and new moon, resulting in the largest tidal range
- Stand – point where the change of water height "pauses" for a brief period of time ranging from a second to a few minutes at the high and low point of the tide cycle
- Slack – a reference to a tidal current (and not the tide itself) of less than one knot velocity
- Set – direction towards which a current is flowing in degrees true
- Tide - the vertical rise and fall of water in coastal regions
- Tidal current – a current that is the direct result of tides (and not the tide itself), caused when the tidal bulge encounters a constriction that accelerates the horizontal flow of water
- Tidal range – Range in height between the high and low tide height in a tide cycle
- Tide table – show how much height to add in feet or meters from charted depth to correct for the stage of the tide at a specific time.

Tidal cycle table (Metompkin Inlet, Virginia)



Date	Day	Time	Hgt
09/14	Sun	12:47 AM	3.76 H
09/14	Sun	06:44 AM	0.15 L
09/14	Sun	01:19 PM	4.4 H
09/14	Sun	07:35 PM	0.55 L
09/15	Mon	01:39 AM	3.43 H
09/15	Mon	07:38 AM	0.46 L
09/15	Mon	02:15 PM	4.13 H
09/15	Mon	08:36 PM	0.85 L

http://tidesandcurrents.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8630901

Calculating current speed and tide height

- Estimating tidal conditions
    - Rule of Twelfths is about the rise and fall of the water levels at various stages of the tide (vertical height)
    - 50/90 Rule and Rule of Thirds are both about the current (horizontal speed)
- Rule of Thirds is a rule of thumb for estimating the distance the current has travelled for each hour with a rise or fall in the tide, expressed as a unit of AVERAGE CURRENT SPEED for each hour. From a known maximum current speed for a given area. Over the period of the first hour of the rise or fall of the tide the current will flow at 1/3 of MAXIMUM SPEED. For the second hour it will flow at 2/3 of the maximum speed, and the third hour at 3/3, at maximum speed. Hence the ubiquitous 1:2:3:3:2:1 abbreviation of the rule.
- Rule of 50/90 is a rule of thumb for estimating the instantaneous CURRENT SPEED observed at each of the six hours in the tidal period on the hour. Used to estimate current speed at a single point in time, the end of each hour of the six-hour tidal period. Counting from slack, current speed will be 50% of MAXIMUM SPEED at the end of the first hour, 90% at the end of the second hour and full

100% (maximum speed) at the end of the third hour, and back to zero with the same steps. The full rule can be stated as 0/50/90/100/90/50/0.

- Rule of Twelfths: A rule of thumb for estimating the HEIGHT of the tide at any given time. The rate of flow in a tide increases smoothly to a maximum halfway point between high and low tide, before smoothly decreasing to zero again. In the six-hour period that separates the low and the high waters, the overall level will rise/fall 1/12 of the TIDAL RANGE in the first hour, 2/12 in the second hour, 3/12 in the third hour.

RULE	Hour of Tidal Period											
	Beginning		1		2		3		4		5	End
50/90 Rule = Speed	0%		50%		90%		100%		90%		50%	0%
Rule of Thirds = Drift		1/3		2/3		3/3		3/3		2/3		1/3
Rule of Twelfths = Height		1/12		2/12		3/12		3/12		2/12		1/12

http://caskaorg.typepad.com/caska/2009/10/rules-for-tides-thirds-5090-twelfth.html

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Navigation in limited visibility environments

- Pilot when possible – paddle in sight of known landmarks
- Dead reckoning (DR) - From a known location (navigation fix), advance a line along your known course a distance based on your speed and the time traveled (Distance = Speed x Time). Current or wind can affect your DR. Before you find yourself in a situation that requires dead reckoning, know the speed you typically travel at. Mark a new point at a set interval or each time you change your course or speed. Marking a point every hour makes the multiplication easy.
- Aim off - Deliberately set a course off to one side of a destination. By setting a course off to one side, when you hit the shore, you just turn towards your destination and eventually you'll find it.
- GPS

Examples of tide and current planning

- http://tbone.biol.sc.edu/tide/
- http://tidesandcurrents.noaa.gov/
- http://www.nauticalcharts.noaa.gov/mcd/NOAAChartViewer.html

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Boat handling in current

- Paddle with edge up to current when moving from eddy into the flow (lift your bottom up to the current)
- Circles in eddy with edge up to oncoming current
- Peel-out to cross main eddy line into main flow, power out of eddy into current at 45 degree angle
    - Speed, exit high in the eddy, maintain boat speed, raise butt to the current, face your work, active paddle, stern rudder as needed to maintain ferry angle

- Eddy turn - Power out of current into eddy
    - Speed, enter high in eddy, arching turn upstream into eddy, edge appropriate to bow rudder or bracing turn, active blade to complete turn

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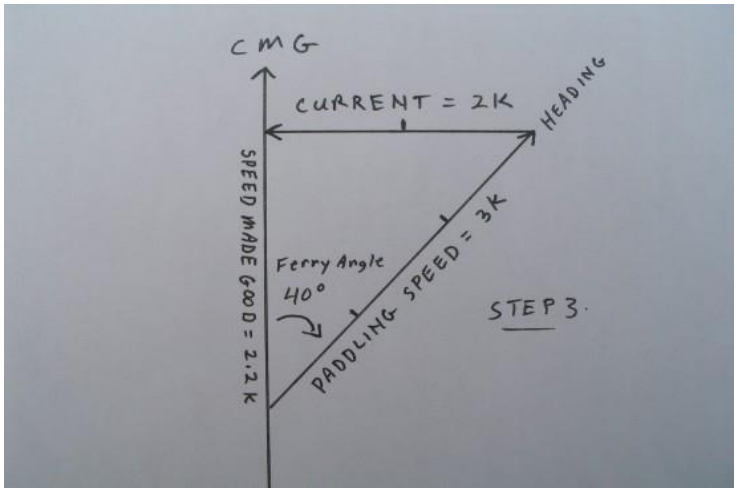
Crossing current using ferry angles

- Use a ferry angle to maintain a course when currents or wind would push you off that course. The ferry angle is the heading that you paddle into the wind or current so that you maintain your intended course while making headway
- Options for crossing current
    - Straddle slack tides
    - Use ranges to stay on course
    - Vectors - Calculate the exact angle when you cannot find a range, based on your paddling speed and the current's speed



http://tsunamirangers.com/2012/12/10/kayak-navigation-crossing-current-calculate-ferry-angle/

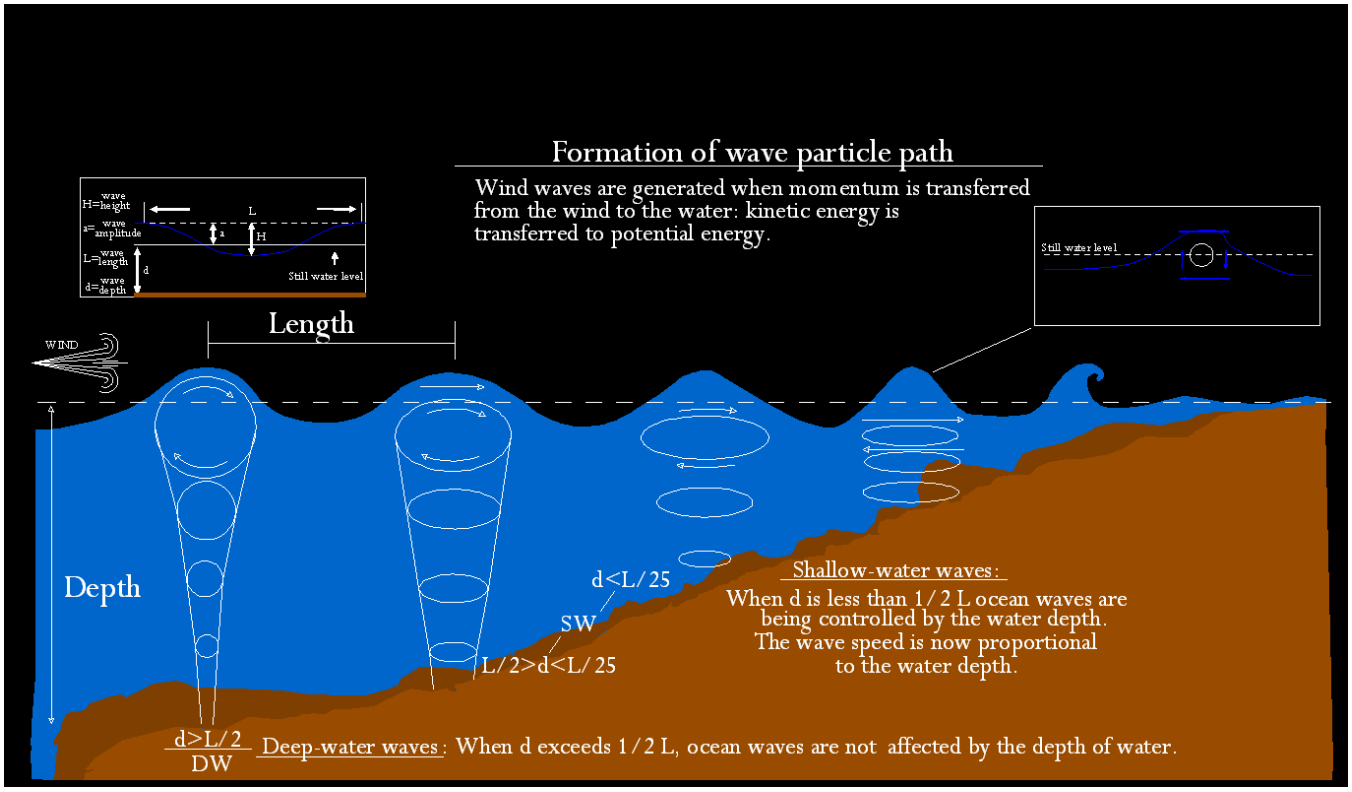
        - Ferry angle = (current speed ÷ paddling speed) x 60
    - Aim off and drift
    - Ignore current and wind (best in wind)
        - Keep the bow of your kayak pointed towards your destination and adjust your heading to keep pointing at the destination as you paddle forward. You'll experience leeway movement and your final course will look curved.
        - Works best when conditions are variable, allowing you to ignore minor course variation and focus on the "big picture".
        - Nice thing is that it is a self-correcting course and you need not calculate a proper drift angle which, if you're crossing is long, could be wrong.

Seamanship and conditions

Waves and swell

- Ground swell are long-period waves the result of intense winds pressing on the surface of the ocean thousands of miles away from the coastline
    - Transport very little water; most of the water motion is in nearly closed elliptical paths
- Swell travels fast over a long distance in deep water until the circular energy (clockwise, top forward, bottom back) is disrupted by interaction with the ocean bottom
- Local winds over the surface of the water near shore create short-period waves that influence local waters (slower moving)
- Long-period swells accumulate energy, travel faster, and more easily cope with local wind, waves and currents (fast moving)
- Metrics – direction, height, wavelength, period, sets
- Approach shore in sets of 10 to 12 on US east coast
- Wavelength is the distance between two crests
- Period is time (correlating to the length of wave) between crests
- Height – trough to crest
    - Energy is proportional to the square of wave height
- Diffraction - waves spread out as they interact with a shoal, and the wave crest approaches the island or shore close to parallel, generating long shore currents and rips
- Refraction – edge of wave encounters an obstacle such a jetty or headland, it slows and bends to carry into the shadow of the obstacle
- Beach slope determines how abruptly a wave will break
- Swell energy converts to powerful moving water as waves break near shore
- Large waves break further out, smaller waves closer in
- Waves build as water depth approaches 1.5 times the height (water depth=½ wavelength)

- Wave speed and wave length decrease in shoaling, energy per unit area of the wave increases, wave height increases, with no change in wave period
- Waves usually curl and break when the height of the wave becomes about the same as the water depth
- Back bays, inlets, shore features, wind and tide influence in-shore sea states
- Spilling waves are most gentle – common on gradual beach, or inside of a bar
- Plunging waves (tube) – steeper beach - powerful because of abrupt energy transfer- must be avoided



www.KayakWaveology.com

Surf Zones

- Ocean swells roll in from deep water
- Steepen into waves as water shoals in the transition zone
- Circular energy is abruptly conveyed to land and converted to moving water in the impact zone
- Soup zone is result of aerated water from break

Surfing

- Actions in surf - Punch out, paddle backwards, brace, surf, roll
- Back-paddle as waves lift the back of your boat to allow the wave to slip under you

- Paddle forward to shore as the waves reaches you to surf front or top of the wave
- Trim by leaning back to slow, forward for speed on the wave
- All long boats broach
- Catch the wave in 4 strokes and transition to stern rudder
- Stern rudder with the torso and body to control broach
- Surf perpendicular to the wave is optimal
- Watch the wave develop on your beam to identify break and edge away
- Low / high brace into breaking beam waves and when broaching
- "Bongo" surfing is not good technique - out of control
- Exit the wave using a low brace turn
- Capsize immediately to lower risk of collision with another boat
- Out of your boat? Position boat between you and shore, loosely hold toggle, swim boat ashore

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Surf Launch

- Goal - paddle safely out past the impact zone
- Count waves between largest waves to learn the pattern
- Large waves encounter bottom earlier and break further out, smaller closer in
- Note the distance from the shore where waves in the set peak and break
- Count waves and identify smallest wave in the set followed by the largest wave
- Time launch to follow smallest wave, paddle out fast, stay inside the impact of the next largest wave
- Paddle fast through impact zone of the largest wave after it breaks
- Spilling waves often require only a paddle out
- Dumping waves must be timed to ride quickly through the impact zone
- Caught by a breaking wave? Roll and stay in setup, or paddle hard and convert to a brace

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Surf Landing

- Points
  - Choose the easiest landing site
  - Leverage the Rip - flatten out the surf zone

- Know where and when waves peak and break
- Largest wave breaks furthest out, follow consecutive breaks of each smaller wave to shore
- Paddle in fast through impact zone on the back of a wave

- Methods
  - Land during a window between waves
  - May be easier to land in reverse
  - Work past the impact zone by riding the back of a wave through the steep shore break
  - Don't get pulled back into the shore break when you get to shore
- Signals
  - Vertical paddle is "go"
  - Horizontal overhead is "stop"
  - Alternate raise and lower horizontal is "back"

Groups in surf

- Ideal – Leader first off and last to land
- Launch
  - Members assist other members
  - Leader is first off the beach
  - Paddler most capable of solo launch launches last
- Land
  - Most skilled paddler lands first
  - Wade into surf and catch stern of others who follow
  - Lead stays on water last ONLY WHEN they can count on strong paddler on shore

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Wind over current and waves

- Wind against current – rough sea, steep chop
- Wind with current – calmer surface
- Wind against waves – flattening

Examples of swell and surf forecasting resources and interpretation

- NOAA - http://www.weather.gov/forecastmaps
- http://www.opc.ncep.noaa.gov/Atl_tab.shtml
- Magic Seaweed App

- Windfinder App

Open water paddling

Environment

- Substantial exposures
- Less opportunity for bailout
- Weather and conditions can change quickly
- Must be self sufficient
- Comfort in large seas and swell is required
- Good boat handling and bracing skills
- Rolling skills in rough water recommended

Leadership - CLAP

- Communication
  - Can't exercise leadership without communication, so everyone is acts as individuals
- Line of Sight
  - It is hard to lead a group that cannot see you, or whom you cannot see, so line of sight to everyone in your group is important. There actually is a difference between the two as well
- Avoidance
  - Seamanship - avoidance of risk is easier than managing an accident
- Position
  - A leader must be in position to communicate risk to the other members, have line of sight if there is a problem, and physically help within a reasonable amount of time with rescues, towing or any other method of avoidance where the group runs into trouble

Group set up on open water

- Instructor leads best from the side
  - See all
  - Go forward or drop back as needed
- Lead kayaker
  - Knows where to go
  - Navigates
  - Sets suitable pace
- Sweep
  - Last paddler at all times – no one is lost

- Strong, skilled and equipped for rescues
- First aid kit

- Pack
  - Gather toward center
  - Not pass, wander, or fall behind

- Priority in an incident
  - Self, group, individuals, gear

- Incident
  - Who manages? Establish before setting out
  - What does group do? Raft or pair, maintain station

Signals

- Help (swimmer)
  - Wave paddle straight up and side to side overhead
- Gather
  - Paddle straight up overhead
- Left / Right
  - Point with paddle in direction of travel
  - Angle down
- Stop
  - Paddle overhead in horizontal position
- Backwards
  - Horizontal paddle, alternately moving each blade up and down
- OK or OK?
  - Fist on head
- Paddle hard
  - Cranking motion with hands
- Left / right
  - Point
- Stop / back paddle
  - Arms in X overhead

- Universal SOS
    - Paddle vertical high overhead

Pre-Brief

- Day overview
- Area, charts, planned route, rest stops, expected times
- Assignments (lead, second, sweep, teams, launch and landings)
- Boats OK?
- Conditions (water temp, tides, current (direction and speed), sea & waves, weather, wind)
- Communication (radios, channels, hand signals)
- Emergency services – USCG, DNR, police – Where from? Time until rescue after call?
- Events – what to with a swimmer, rescues, group actions (raft, maintain station)
- Emergency-rescues and group response
- Food and water
- Gear (who has what? personal safety, group safety, radio, charts, first aid)
- Group paddling practices
- Limitations or medical conditions

Float plan

- A plan that tells others where you are going to go float (paddle, canoe, kayak, etc.). It provides information on group size, type of gear and color of gear used, special signaling devices to be anticipating and other pertinent information that would aid someone out in the field looking for you
- Group's itinerary (where are you going? how long will you be there? when and where will you return?), description (number in party? type and color of boats and PFDs? other telltale visual factors), and what type and color (where critical) of accessories do you have (tents, tarps, other large visual elements? Knowing what means you have for signaling is also very useful (for example: PLBs, signal flares, VFH radio, cell phone)? All these factors will make it easier for rescuers to coordinate a search and save valuable time locating you.
- Vehicles including year, make, model, color and license.
- Most float plans begin by including a roster of all members of the party: their names, age, and gender and phone number. Part of the search and rescue procedure may be to contact each member's number to learn if that person has made any contact or if any additional information may be helpful.
- A description of the gear each person has is important, too. It is very helpful to know the type and color of the watercraft (yellow, single sea kayaks, for example) as well as the color of each one's life jacket. This is helpful in direct spotting or through questioning others in the area. Not knowing the color of the boats means extra time checking every craft in the search area.
- Your trip itinerary is a key element in the plan. Where you departed from may be quite obvious, but include it anyway. Also record the anticipated time you will be in route, where you plan to camp. All

plans need to be flexible so make sure any possible alternate routes are listed as well. A daily list of potential take-outs would be a big help to SAR units, especially if all the other information has been accurate.

- www.maineseakayakguides.com

Leave No Trace Principles

- Plan Ahead and Prepare
- Travel and Camp on Durable Surfaces
- Dispose of Waste Properly
- Leave What You Find
- Minimize Campfire Impacts
- Respect Wildlife
- Be Considerate of Other Visitors

Cold Water

- ONE RULE: Dress for emersion
- Underdressing for a hot day on cold water will not protect you from prolonged emersion
- Overheat? You can lower your effort, and use the water to cool yourself
- 5-50-50 rule - a paddler has about five minutes to swim 50 yards in 50 degree water, and he has 50/50 chance of surviving
- 1-10-1 rule - an unprotected swimmer will suffer cold shock for about one minute, then have about 10 minutes until he can no longer function until finally succumbing to hypothermia an hour later assuming he doesn't drown before then

Hypothermia

- Dangerously low body temperature, below 95 °F.
- People with hypothermia typically experience gradual loss of mental acuity and physical ability, so they may be unaware that they need emergency medical treatment.
- Symptoms - Mumbles, fumbles , grumbles, stumbles
- Treatment
    - Move the person out of the cold. If going indoors isn't possible, protect the person from the wind, cover the head, and insulate the individual from the cold ground.
    - Remove wet clothing. Replace wet things with a warm, dry covering.
    - Don't apply direct heat. Don't massage or rub the person.
    - Don't use hot water, a heating pad or a heating lamp to warm the person. Instead, apply warm compresses to the center of the body — head, neck, chest and groin. Don't attempt to warm the arms and legs. Heat applied to the arms and legs forces cold blood back toward the heart, lungs and brain, causing the core body temperature to drop. This can be fatal.

- Don't give the person alcohol. Offer warm nonalcoholic drinks, unless the person is vomiting.

Cold water emersion and shock

- First priority in the first 2 minutes after immersion in cold water is to rule out / manage cold water shock. Calm things down, immediately work to prevent or minimize the loss of functional disability and progression to hyperthermia. Cold shock is the first priority because it occurs immediately upon immersion in cold water (can occur at higher temps, but expected at or below 50 degree F), and the response can last up to 2 minutes.
- The cold-shock response is characterized by a gasp reflex, hyperventilation, difficulty holding breath, tachycardia, and hypertension. Panic in this situation can quickly lead to drowning from inhaling water when gasping or hyperventilating, and the additional stress can lead to cardiac arrest. (http://www.uscg.mil/pvs/docs/coldwater1.pdf)

Weather Data

WDIR Wind direction (the direction the wind is coming from in degrees clockwise from true N) during the same period used for WSPD.

WSPD Wind speed (m/s) averaged over an eight-minute period for buoys and a two-minute period for land stations. Reported Hourly.

GST Peak 5 or 8 second gust speed (m/s) measured during the eight-minute or two-minute period.

WVHT Significant wave height (meters) is calculated as the average of the highest one-third of all of the wave heights during the 20-minute sampling period.

APD Average wave period (seconds) of all waves during the 20-minute period.

MWD The direction from which the waves at the dominant period (DPD) are coming. The units are degrees from true North, increasing clockwise, with North as 0 (zero) degrees and East as 90 degrees.

Beaufort Wind Force	Wind Speed (Knots)	WMO* Wind Classification	Wave Height (ft.)	Sea Conditions
0	Less than 1	Calm		Sea surface is smooth and mirror-like.
1	1-3	Light Air		Scaly ripples without foam crests.
2	4-6	Light Breeze		Small wavelets with glassy appearing crests and no breaking.
3	7-10	Gentle Breeze		Large wavelets, crests begin to break and whitecaps are scattered whitecaps.
4	11-16	Moderate Breeze	1-4	Small waves becoming longer and whitecaps are numerous.
5	17-21	Fresh Breeze	4-8	Moderate waves take longer form and there are many whitecaps and some spray.

6	22-27	Strong Breeze	8-13	Larger waves form and whitecaps are common, along with more spray.
7	28-33	Near Gale	13-20	The sea heaps up and white foam streaks off breakers.

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