Shipbuilding and Boat Building Workshop Outline

Instructors:

1. Tim Edwards, Executive Director, Nova Scotia Boat Builders Association
2. Ashley Morten, Allswater

This workshop will investigate how the properties of materials and ocean water influence the design and construction of marine vessels. Starting with an introduction of the importance of shipbuilding and boat building to our region, instructors Tim and Ashley (Bios can be found at the end of this document) will demonstrate why it is such an integral part of our community and economy.

In this workshop, as we explore different outcomes related to topics such as chemistry, physics and design, we will introduce activities that are easily replicable for your class, and require minimal, easy to find, low-cost materials. This is an 80-minute workshop, but can be expanded to a whole module when teaching within the school.

Key Outcomes:

- Develop an understanding of the history of shipbuilding
- Explore how the properties of buoyancy, stability and seaworthiness change depending on materials
- Investigate how materials and function relate to vessel design and construction
- Gain insight on the importance of shipbuilding in our region and how it contributes to our economy

Key vocabulary:

Gravity, buoyancy, stability, seaworthiness, Archimedes Principle, shipbuilding, craftsmanship, bow, stern, hull, hydrofoil

Curriculum Integration Document

Topic	**Description of discussion or exploration**	**questions and probes**	**resources**
Intro Activity: What is ship/boat building? *Why is this industry important to our region?* *What social and ecological issues are relevant?*	View images several different types of boats/ships View images of some boats/ships built locally What is common between a kayak and a cruise ship? What is common to these vessels? Basic and common parts of ships/boats. Bow, stern, hull, propulsion system (propeller), engine, super structure What needs to be considered in ship and boat design and build processes? (purpose, size, carrying capacity, duration of outings, type of water conditions, human loads, etc) **Society and Economy** Relevance to NS (boat building motivated by need to eat, defend, and trade). Traditional and modern mode of transportation of products and people via water. Used in urban and rural places; used in wealthy and poor societies. Efficient mode of transportation for people who can't transport other ways, mik'maw transportation (history of moving products/trade) Can easily bring help and assistance to countries impacted by war or natural disaster Regional connection: On Bra D'or Alexander Graham Bell built a hydrofoil (connect with modern-day hydrofoil boats – reduce friction)	What are different types of ships and boats? (ferries, war ships, cargo ships, drones, kayaks, ice breaker, cruise ships, submarines, tug boats, tankers, container ships, search and rescue, sail boats, canoes, fishing boats) Why are boats/ships an efficient way of transporting things across long distances? Estimate the percentage of consumables in our society that are transported by sea Why is this mode of transportation important to societies globally?	*Google maps -show regional map with local ship and boat yards, show graving docks* *Photo bank of boats from NSBA* *NSBA Boat Builder mp* *Boat Builder career pathway*

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	Where do we build ships and boats locally? **Social and Ecological challenges** Pollution, oil spills, traffic impacts migration paths for ocean mammals and turtles, anti-fouling (marine growth on bottom of the hull is transported across the world), -propellers impacting marine life, Can transport disease globally; pirates	What are the potential downsides of using our oceans and seaways to transport goods and people globally?	
Activity 2 Science: Explore how the properties of water relate to buoyancy, stability and load	**Gravity versus buoyancy** Intro activity: *Pin the ship on the water* – Students take a paper ship (several different cut-outs of vessels) and stick the ship on the water line. Where do you think the ship will float on the water line? Where is the ideal place for it to float? Why? How can we make it float higher/lower? How does this impact stability & seaworthiness? Illustrate difference between stability and seaworthiness (semi-submersibles) **Archimedes Principle:** Calculate centre of buoyancy and centre of gravity of a raft (rectangular shape)-calculate total buoyancy vs weight. What is the function of the boat? How does function relate to design? (e.g. tug boat, cruise ship) **Stability considerations**: What changes when you're out at sea (i.e. cargo, fuel burns off, load shifts when everyone moves to one side, ballast water)	Why do ships made of tonnes of steel still float? What would cause a boat to float or not float? If my propeller is sticking out of the water, how do I make it heavier? How do I make it float higher? When would we want to do that? (relate to a fish bladder) How do we indicate the level at which a vessel can safely float? (plimsoll line, draft marks) The level at which a vessel can safely float relates to what? (stability, hull integrity)	Aluminum foil, plastic bottles, straws, putty, Kleenex box, Image bank of stabilizer fins, paravanes, flome tanks, ballast tanks

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	What are some of the things we do to stabilize a ship (stabilizer fins, paravanes, flome tanks, ballast water). What are the ecological issues relating to this? **Vessel shape consideration:** Hull shape and stability, - activity – show shapes/silhouettes of boats and guess what it's function is based on the shape Examine the vessel shapes and discuss what considerations effect the shape of the hull? Load (how much will it carry inside/on top, live load, people/liquid, holding tanks, the load of the ships parts), water types (tropical, polar), swell size, people on board (needs to ride more smoothly), purpose/function (i.e. ice breakers need to be ice strengthened; search & rescue need speed and durability) **Fundamental forces** – what happens when load doesn't inform shape and load carrying? View images of Blue Nose II (hogging and sagging)	Centre of buoyancy versus centre of gravity – (e.g. Tofino whale watch capsize) How does the type of water (i.e. ocean, fresh, cold, warm) relate to this? If I have cargo to carry, where should I place it on my boat? Low, high? How do I load it for stability? If I have a propeller system, where should I put it? If I have a superstructure, or a heavy battery/engine, where should I put it? What else do we care about on a boat? (how it goes through waves, paint, appearance) What types of careers would do this work?	
Activity 3 Materials: Design models	Discuss traditional boats and materials (i.e. first boat was a log; Paddle Boards on lake Titikaka made of papyrus; Kontiki boats made of balsa wood). How can we make this log more stable (using just the materials around you). Demonstrate the evolution in	What do we need to consider with materials when building boats/ships? (density of materials, water impermeable, durability, pliability) What materials can make vessels more durable? What	Recyclable materials Show images or models of traditional vessels (including Dory, Viking longboat, dugout canoes)

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	thinking from the log (water bottle), to the hollowed out log (water bottle with hole on top) to stabilized log (water bottle with hole and water in bottom and stabilizer fins to stabilize) **Activity: Materials that float.** Choose something that doesn't float and make it float (e.g. Kleenex box – by taking out the Kleenex, ball of aluminum foil, by unwrapping it; paper clips – by attaching to straws they will float; sponges mimic the balsa wood – they absorb until they reach equilibrium -best with scrubbies on top). Consider how materials relate to the purpose and function of the vessel (i.e warships vs kayaks vs RHIBs – rigid inflatable boats i.e. zodiacs)	materials can make vessels lighter/more agile? What types of careers relate to this? (materials engineers, naval architects and marine engineers)	To show advances in materials engineering, show video of America's cup 2013 https://www.youtube.com/watch?v=a49jy9ba4FQ and team Oracle https://www.youtube.com/watch?v=9C4ziUwjdAw
Activity 4a Engineering: Build a Hull	**Build a hull & a superstructure** Choose a boat type and using materials available, build a hull and superstructure (i.e. living quarters) that will float, that can support a pre-determined load requirement, and that remains stable and buoyant in turbulent water. Calculate centre of buoyancy. Calculate where plimsoll line should be. Test in water tanks	Share the story of Vasa (ship) that sank due to two rows of guns.	
Discussion	**Craftsmanship** – trades, boat building,	Why do we automate some parts of the job with robots, i.e.	Boat Builder Career Pathway Shipbuilding Career pathway

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	-technology, led navigation, systems integration, welding machines, automation of shipyards, hybrid propulsion, Recall Bell's hydrofoil - Hydrodynamics adds in another force which is lift (Newton's third law of equal and opposite forces that create stability). How does modern ship/boat building take this into consideration?	welding? (tedious, accuracy, safety) What types of skills and competencies are needed? (science, math, creativity, teamwork)	

Instructor Bios

Tim Edwards

Tim Edwards is a Professional Engineer and a Member of the Royal Institution of Naval Architects. He has been working in the marine industry since 1973. Before coming to Canada in 1979, Tim worked at the UK Admiralty (submarines) and Appledore shipyard in North Devon. Tim's engineering work in support of naval and commercial ships and submarines continued in Canada until 1991 when he was Vice-President of Eyretechnics Limited's Atlantic Region office in Dartmouth, Nova Scotia – employing 42 engineers, technicians and draftsmen. Later that year, Tim was appointed to manage a Marine R&D Centre at the Technical University of Nova Scotia (now part of Dalhousie University). It was during his 7 years at TUNS that Tim spearheaded the formation of the Nova Scotia Boatbuilders Association (NSBA). In 1998 Tim was appointed Executive Director of the NSBA – a position he still holds today. Tim's diverse marine business development background, together with his passion for the continuing professionalization and growth of Nova Scotia's boatbuilding industry, has resulted in strong NSBA membership and an impressive list of initiatives over the past 18 years that are continuing to help promote, train, advise, and represent the sector.

Ashley Morton

Ashley Morton is a Professional Electrical Engineer who has been designing electrical systems for ships and boats his entire professional life. He received his engineering degree from the University of Toronto in 2003. He has worked at shipyards in five countries, and is now employed at Allswater Marine Consultants in Bedford. He is currently the Technical Lead for the design of a major tidal power platform to be installed in the Bay of Fundy in 2017. Mr. Morton speaks English, French & Norwegian. In his spare time, he referees rugby and advocates for improved public transportation.