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**The Science of the Birchbark Canoe**
by Chuck Commanda

There are five different trees used when making a birchbark canoe:

1. White birch tree. A white birch is selected for canoes based on size, length, whether the layers hold together (do not delaminate), and thickness. If it passes these tests then it is deemed canoe worthy.

2. Cedar tree. When selecting a cedar tree it has to be knot free, twist free, and preferably solid throughout the entire log. It is beneficial that the tree can provide gunwales, ribs that gives the canoe its strength and sheathing or planking, which also strengthens the bark and gives the inside of the canoe a nice, clean, aesthetically pleasing look.

3. Spruce. Spruce trees are important because they supply the roots that bind the cedar and

bark together and sap or gum that is used to seal all holes and seems. But before the sap or gum is applied it must be mixed with animal fat to give it flexibility, especially in cold water.

4. Ash trees. Ash trees are used for cross members or thwarts. When selecting an ash tree it must be knot free, twist free, and straight as possible.

5. Ironwood tree. Iron wood trees are used for wooden nails that hold the gunwale cap in place.

We're not exactly sure when these materials began being used to make canoes, but it has to be at some time before first contact because the canoe helped newcomers to travel further up the St. Lawrence River when they arrived here around 500 years ago. Some evidence suggests the birchbark canoe was invented before trading between First Nations people of the Americas had begun some 3,500 to 5,000 years ago. Prior to the invention of the birch bark canoe dugout canoes were used. Because logs had to be waterlogged, dugouts were much heavier, making portage very cumbersome and which led to the invention of the birchbark canoe.

Birchbark was selected due to the natural oils in the bark that made it waterproof and lightweight. And there was plenty of it around especially within the territory of the Eastern Woodlands people.

Cedar was chosen because of its lightweight nature and once dry it's cellular molecules shut down and actually repelled water; plus it was very durable and lasts a long time before it decomposes.

Spruce is an important tree because it provided root to bind the bark to the wood and the sap/gum to seal up all seams and holes. I once heard my grandfather say that before spruce roots were used rawhide string was used to bind the bark to the wood, but because little critters ate the rawhide it compromised the integrity of the canoe. Therefore spruce roots became the preferred product because of its strength, availability, and the critters no longer enjoyed its bitter taste.

The preferred wood used for thwarts was ash because of its strength and for a hardwood it was surprisingly lightweight. Like cedar, ash had to be knot free, twist free, and straight.

The last tree used was the ironwood tree. Wooden nails were used to secure wood to wood where roots could not be used. When an ironwood tree was taken down it was cut to specific lengths, squared and driven into round holes making it virtually impossible to take out once driven into cedar wood.

**Note: For classroom science instruction also consider lessons on buoyancy, Archimedes' Principle, and hydrodynamic drag:**

Buoyancy, or upthrust, is an upward force exerted by a fluid that opposes the weight of an immersed object. In a column of fluid, pressure increases with depth as a result of the weight of the overlying fluid. (wiki)

Archimedes' Principle states that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces. Archimedes' principle allows the buoyancy of an object partially or fully immersed in a fluid to be calculated. The downward force on the object is simply its weight. The upward, or buoyant, force on the object is that stated by Archimedes' principle, above. Thus, the net force on the object is the difference between the magnitudes of the buoyant force and its weight. If this net force is positive, the object rises; if negative, the object sinks; and if zero, the object is neutrally buoyant - that is, it remains in place without either rising or sinking. (wiki)

The force on an object that resists its motion through a fluid is called drag. When the fluid is a gas like air, it is called aerodynamic drag or air resistance. When the fluid is a liquid like water it is called hydrodynamic drag, but never "water resistance." Fluids are characterized by their ability to flow. (wiki)