Suggested Projects

Fish/Animals

Eagles and other birds soar in front of cliffs. What air currents are they taking advantage of? What is the difference between a mechanical updraft and a thermal?

How do you think whales and dolphins breathe while they sleep while the sea is rough? Try snorkeling in a swimming pool when others are making big waves. What sleeping patterns do you think whales and dolphins must keep?

Commerical fishermen have a hard time with whales picking cod from their lines. Whales have learned the sounds of a fishing boat, and come to feed. Can you make some suggestions to discourage the whales from impacting fishermen without harming the wales?

What parts of the body do local hunters try to hit when hunting different animals? What systems are effected? What other systems are available for disabling an animal? Identify the animal's system. Observe and document the damage done by the bullets. What physiological systems did the hunters try to disable in the past with traditional weapons?

What are the favorite baits for fishing or crabbing in your area? Do people fish through the ice? What bait do they use? What depths do they fish? Does the time of day matter?

Why do caribou often head into the wind? Why do dogs turn around before laying down outside?

Collect some of the liquid that is present in the knee and ankle joints of a caribou. What is the freezing point of that fluid? Test the friction of the joint with and without this fluid. Is the fluid soluble in water or oil? Why doesn't it freeze in severe cold temperatures?

Do a food calendar for one or several local animals. What do they eat in each month or season? Birds are particularly susceptible to starvation, as they can't store up much fat and still be able to fly. What do they eat in lean times? Do you think it is good for birds to feed at the local dump?

Do any local birds or animals store food by hiding it in secret places, or do they store it in the form of fat on their body? What secret places do they use? Do you think they steal from each other?

Most animals are prey for larger species. What adaptations do animals in your area use to avoid predators? What aspects of camoflage are incorporated? What are the best materials for casting animal tracks? What are the best conditions for casting tracks?

What are the favorite lures used by local trollers for different species of salmon?

Measure around the gills of a species of fish in your area. Divide this measurement by two. This will give you the optimum stretched mesh for that fish. Measure many fish of that species, average your findings, and compare that measurement with the nets used in your area.

Make a traditional halibut hook. Set it and a modern halibut hook close together. Does one work better than the other? Is there an optimum distance from the bottom of the ocean for the hooks to be set? What is the best halibut bait?

Nets of different colors are designed to be less visible in different waters. What color nets do people in your area use? Is there a color that is preferred? Under what conditions? A preferred mesh size? How many meshes deep are the nets? What is the difference between subsistence nets and the commercial nets?

Is there bycatch from subsistence activities in your region? Can you suggest ways to reduce bycatch? Can you suggest ways to use the bycatch? Is there bycatch in commercial efforts?

What is the history of commercial fishing in your area? Did over-fishing ever occur resulting in an endangered fish population? What measures were taken to bring the fish populations back? What new technol-

ogy might endanger current fish populations? Can you make suggestions for reasonable ways to prevent overfishing now and in the future based on your research? Talk with commercial fishermen and incorporate their responses to your study.

What is a red tide? Why does it effect bivalves? Why do they become deadly poison after a red tide? Some people say you can eat bivalves in all the months that contain an "R." If this is true, why is it so? How many months does it take for bivalves to be cleansed from the effects of a red tide?

Why do pressure cooking and jarring preserve food? Are there optimum conditions and materials to use in jarring or preserving foods for winter storage?

Which boils at the highest temperatures: seal oil, Wesson oil, Crisco, moose or caribou tallow, olive oil, or other cooking oils? In making fry bread, which oils make the best bread: least greasy, right texture, color and flavor etc? (Seal oil seems to be the only animal fat that is liquid at room temperature. Is this true?)

How much good/bad cholesterol does seal oil have? How could you test this?

To this day, coastal people use an atlatl for throwing a spear at seals so they can be retrieved before they sink. Experiment with different lengths of atlatl, different lengths, weights and balance of spears. Experiment with different tips and feathers. Which is better for distance? Which is more accurate?

Old timers used to hunt birds with a sling (a bolo). Some had two weights, some three. Make one of these slings. What is the optimum weight and string length for: distance throwing, accuracy, & manageability

At the mouths of fresh water rivers, the water contains far less salt than in the open ocean. How might you measure salinity? Does specific gravity or conductivity give a more accurate test? How does the salinity or lack thereof effect the fish and animals that feed near your home? How far out into the ocean are the surrounding waters less saline because of freshwater runoff. Does this change from season to season?

What local technologies experience trouble from salt spray? What do local people do to protect those technologies? Can you devise better methods for protecting technologies, especially electronic gear from salt spray and oxidation.

What science is involved in storing fish in the hold of a ship that prevents decomposition and bruising? Can some species be held longer than others? Why? What are the temperatures and times allowable for storage of fish in the hold?

What chemical reactions are taking place in salmon that causes them to change color once they enter fresh water? What does this have to do with osmosis?

How do seagulls stay so clean when they eat in such dirty places?

What can you say about the types of places salmon spawn in local streams? Muddy bottom? Sandy? Gravel? Big rocks? Why is this so?

To what extent are local fish, birds and anmals in your area dependent on spawning and spawned out salmon for food? On fingerling salmon migrating downstream? During what months do they come downstream? What predators do they encounter on the way up and downstream?

Mountains constantly erode, sending silt and minerals to the ocean. Other than the spawning salmon, can you find evidence of any other source by which minerals are carried from the sea back to the mountains? If not, how important do you think salmon are to replenishing minerals to birds, animals and fish that live in the upriver hills and mountains?

There must be good escapement for a good harvest of salmon in the future. How does ADF determine escapement and predict the run so commercial fishermen can have a good harvest without damaging future runs? What technologies do they use? What math models?

Silver, red, chum and king salmon runs always contain a mixture of ages. There will be a few 2

year old kings, a few more 3 year olds, many 4 year olds, many 5 year olds, and a few 6 year olds in every run. The overlap protects future runs from being wiped out by a bad year. What are the ages of fish in the run in your area? Is this typical, or does it show a change from year to year? Has the optimum ratio been determined?

Ocean currents carry food and oxygen. What are the scientific principles involved in the motion of currents? How can these principles be demonstrated so those who don't understand can see them in action?

What are the scientific principles in the dissolving of necessary oxygen in the ocean?

Does sound travel better over smooth water or wavy water? Why do you think this is so?

What are some methods of converting salt water to potable fresh water?

Why do northern whalers take a black rock onto the ice in the spring in order to get drinking water?

Which oil has more calories by mass: seal oil, whale oil, walrus oil, or commercial stove oil? Make a simple calorimiter (with adult supervision) and test each one. Why do you think whale oil was a preferred oil in the1800's and early 1900's, quality or quantity?

Freshwater blackfish are important to coastal villages. One village is named after blackfish. How could it be that blackfish "come alive" after being solid frozen? What amazing features do they have that allow this? How and why do they make holes in the ice during winter?

What parasites afflict local animals? Is there any danger for people who eat these animals? Which body parts are more apt to have those parasites? How are the parasites destroyed to make the body part edible?

Migration

Many Alaskan fish, birds and animals are local, and many migrate. To what extent are the local animals dependent on the migratory ones? If the local fish, birds and animals depend on migrating prey for only two months out of the year, and the migration didn't occur, do you think the locals would survive? If you harvest some of those local animals for food, what is in their stomachs during the different seasons? There are almost 300 different birds in Alaska during the summer. Roughly 200 of them migrate, most to have their young, and others just to feed. What are the migration patterns? Why do the birds migrate? What are they leaving? What are they going to? When they leave, what triggers their departure, food, weather, predators etc?

Record the dates and numbers of migratory birds or animals that arrive and leave your area. How will you count them? Are there times of day or time of tide that determine their migration patterns? Compare your data with existing records from your community, or with the observations of local elders.

Household

How does drying fish preserve it? Test different brine solutions for salmon strips. Which do people prefer?

What are the physiological effects of a steambath? Are they all good? How do modern soaps cleanse?

Some people breathe through a piece of wood, or small bundle of grass while in the steambath. Why do they do this? What science principles are involved? Why do people use brush to slap their skin in the bath?

Why do people's glasses frost when they come in wintertime? Is there a way to prevent that from happening?

Different kinds of wood produce different kinds of heat in a steambath. Experiment with , dry spruce, wood from pallates and others. Which produces the best heat and why? What is the average temperature of the steambath? (Do not use green, pressure treated wood. It contains arsenic that has killed people in steam baths.) People who steambath often use the terms "sharp heat" and a "strong heat". What do they mean? What different kinds of wood cause these different types of heat? What happens to the temperature when water is poured on the rocks? Why is this so?

Some rocks are acceptable for steambath and some are not? (Some are actually dangerous!) What are

the qualities of each? What is their geological origin. Where do people in your village get desirable rocks?

Some people say that cedar shavings work well to repel spiders from tents and homes. If this is so, which works better, red or yellow cedar?

Why do fish spoil @ 35° and meat is able to keep for a long time at that temperature?

What is "freezer burn" on foods in a freezer, and how can it be avoided? Experiment with different methods and wraps. What is sublimation and it's relationship to this issue?

What is the difference between a decoction and a tincture in preparing local plants for medicinal use?

Traditional knowledge

How can you tell time by the big dipper during the winter nights? What are the names of the constellations as identified by the elders in your location? How are the constellations similar/different from those of Western culture and astronomy?

What is the best way to ferment seal oil? Can you invent a new way, given modern technology?

The construction of an ocean kayak is very personal. The shape of the kayak is according to the shape of the person, using body parts for measurement. Discover these measurements by talking with elders, and determine why the stability and maneuverability of a kayak is related to these body part measurements.

Which local driftwoods are most resistant to rotting? Which are the strongest? How do locals tell one wood from another in a very worn piece of driftwood? Which local beaches collect the most driftwood? Does this say anything about old town and village sites?

Apart from food, animal parts were used for many applications. Pick an animal in your area and find all the uses for the different parts. Make some of these traditional items. (Bones, hoofs, handles, clothing etc.

What animal parts were traditionally used for containers? Why were they good for those purposes?

Old timers hunted birds with an atlatl, a long stick with a notch cut in the end. A smooth flat stone was placed in the notch, and, with practice, was thrown with great accuracy. How much farther can a rock be thrown with one of these compared to a rock thrown by hand?

Aleutic hunters used to wear bentwood hats for several reasons. First they kept the elements off the hunter's head. Second, they allowed the hunter to shield his eyes from the seal's gaze, thereby avoiding spooking the seal. But thirdly, the bentwood had served as a funnel for sound. Make a bentwood hat and experiment with your ability to hear sounds with and without a bentwood hat. Make a similar hat out of fabric, paper and other materials. Experiment again with the ability to hear sounds. Why do you think hunters used a hat made of wood rather than grass, skin or fabric? Experiment with different pitches of sound, different amplitude of those sounds, and different conditions- either calm or with the wind blowing.

Traditional songs have rhythm. Do any of those rhythms follow natural rhythms like the human heart, the ocean waves, cries of birds etc?

What are the different methods of preparing grass for weaving baskets?

Why is rehydration and bending of dry driftwood difficult? Does this explain why coastal drums were larger than interior drums?

In modern times, methods of storing food have changed. What principles were involved in traditional food storage? What principles are involved in modern food storage? How are they different? Experiment with some of the older methods. Is the quality of food as good after time?

Across Alaska, Native people used a tea that goes by many names, Labrador tea, Hudson Bay tea, Eskimo tea etc. Prepare this tea. Do a taste test comparing this tea with commercial teas. Blend this tea with commercial tea. Which do people prefer? Elders? Middle age? Young people? Some people

say it is a mild laxative. Is this true according to local knowedge?

It is much slower and more difficult to walk on the tundra than it is on a boardwalk. Why is this so? The same effect seems to be occuring when we walk on a soft winter trail. Is this so? What science principles are involved?

What oils work best in traditional lamps? Try traditional oils, bear, moose, seal, walrus etc. and modern oils, kerosene, stove oil, cooking oil, Crisco and motor oil, but do not try highly volatile liquids like gasoline or Blazo. What traditional wicks were used? Which is most effective and durable?

What processes of rendering did old timers used to extract fat from whales, whitefish entrails, seals etc? What are the qualities of these oils? At what temperatures are they solid/liquid? Are they high or low in good and bad cholesterol?

What clothing materials act as the best windbreak? How do modern materials compare with traditional furs?

Tanning. What percentage of traditional tanning softness comes from chemical breakdown of the fibers, and what percentage comes from physical breakdown of the fibers?

Collect caribou and moose hair. What is the difference between these hairs and seal or sea otter hair? People say that caribou hair is hollow. Is it? What is the difference between caribou hairs in different seasons? What is the difference between the outer hairs and the under hairs on a sea otter? Which body parts of a caribou have the toughest fur? The thickest fur? Why? Why were sea otter pelts so desirable in the days of heavy fur trading?

What type of stitches did the old timers use for water boots and skin boats such that they didn't leak?

What are the advantages and disadvantages of traditional sinew used for thread compared with commercial threads and dental floss? Is it easier to work the sinew if it is held together by beeswax? What was traditionally used before beeswax? How was sinew thread made? How was it woven? How was it preserved? From what part of the local animal did it come?

Why does a winter trail "set up" and become firm overnight? How do experienced hunters tell the direction an animal was traveling days earlier when there is only an indentation left on the surface of the snow? (This is an example of the same principle as the trail.)

What are the methods used to call local animals? How are the calls made? How do they work? What are the different calls that the animals respond to and why? What is the animal interested in when it comes, food, offspring, curiosity etc?

What is refraction and how does it effect spearing fish and animals under the surface of the water?

The weight and balance of a harpoon is critical. What happens if the weight is increased or decreased? Test on people of different sizes throwing the harpoon. How critical is the weight/length ratio of the harpoon to the thrower?

What animal parts were traditionally used for containers? Why were they good for those purposes?

How was cedar bark harvested, prepared and utilized in traditional culture? How does cedar bark compare with modern materials for the same purposes?

Why was the blanket toss devised? What are the simple physics of the blanket toss? What are the do's and don'ts of the activity? Why do people kick their legs in the air? Do heavier or lighter people go higher? Is there an optimum number of people holding the blanket? What happens if they toss the individual too high or too fast? What importance does the "blanket" material have? What effect does the wind have on the individual being tossed? What happens if he/she doesn't come down in the middle?

What is the difference in methods of preparing grass for weaving? What are the different traditional uses for grass?

What are the most durable natural dyes in your

area? (Some might have been trade items.) Can these dyes withstand modern detergents in washing?

What are some traditional knots? What were they used for? How do these knots compare with knots and materials of today?

What did people use before plastic sled runners, and what were the implications? Compare traditional runners and modern technology for the coefficient of friction.

How did traditional methods of firemaking work? What materials were used for drill and tinder? What science principles were involved?

Being undetected is very important during winter hunting. Test the difference in the conductivity of sound in warm or cold air. Is stalking in cold or warm weather preferable? What effect does wind have on the transmission of sound? What effect does snow on the tree branches have?

Mukluks vs. Bunny (VB) boots. They are so different, yet both are exceedingly effective in cold weather. Compare and contrast their effectiveness. How do these differences parallel traditional sod houses and modern houses with insulation and a vapor barrier? How are they different from shoe packs with felt liners?

Tools and Technology

Compare an ulu made of copper with one made of steel. Cut many fish with each. Sharpen each. Can you learn how to temper or soften steel? How did old timers cut steel without electric tools? Where did they get copper?

The fishing industry is constantly dependent on sharp tools that cut fish. There are four variables in producing a sharp knife or tool:

- the material you are cutting, basically wood or flesh.
- the hardness, or type of steel.
- the tool or instrument you are using to sharpen the blade.
- the angle at which the blade is sharpened.

Experiment with the above variables. Which types of sharpening instruments are better for wood or flesh: file, stone (there are different kinds of stones) or steels (including those impregnated with diamonds).

How does radar work in fishing boats? What materials reflect radar waves the best? Least? How did people navigate before radar?

What is the difference between a sein net and a gill net? What is the advantage of each?

Which are the strongest Alaskan wood fibers?

What kinds of Alaskan woods rot the easiest? What kinds resist rotting? What are favorable conditions for wood to rot? What are the applications of this knowledge in making traditional artifacts (sleds, boat ribs, housing and building foundations?)

Are fishing lines that are advertised as 8 lb test, 12 lb test, 20 lb test weaker or stronger than advertised? Does this vary with different brands? Tie them to a fish scale and pull until they break.

What is the science involved in a spinning reel? The drag, the gear ratio, the leverage of the handle etc?

What role does the fishing pole play in the prevention of snapping a fishing line? How is the flexibility/stiffness of a rod measured?

What factors most influence the distance a fishing rod can cast? (Weight of lure, length of line off the end of the rod, wind etc.) Do different rods cast differently? Do different lines cast differently?

To what extent does hanging a nylon net in the sun reduce it's strength and useful life? How does this compare with the traditional methods of caring for cotton nets?

Some fishnets are said to be "fishier" than others. (Fishier means they catch more fish.) Why is this? What is the difference in the twine, and the way the net is hung?

Survival

What is the science involved in human survival in the open ocean after a fishing vessel has sunk?

Why is it hard to breathe in a strong wind? What effect does Bernouli's principle have to do with this?

Why are emergency snow shelters so important in survival situations? is the greatest benefit the reflection of body heat, or protection from the wind?

What is hypothermia? How can we prevent it? Can one part of our body experience hypothermia or frostbite while the other parts are still functioning?

What modern methods of firemaking are used in your area? What kindling is used? How are fires made in wet weather?

What is snow blindness? Why is snow blindness more of a problem on a cloudy day, and what did old timers do to prevent it? Explore this in terms of reflection and wavelengths of light energy. How does this relate to the same problem with glare off the ocean?

Boats and Ships

Which metals rust more readily in the presence of salt water? Why do boat batteries have a negative ground? What are sacrificial metals and their application? Where are they on the periodic table, and how do you explain their sacrificial nature?

What is the viscosity of different oils/greases at different temperatures. Polar vs. nonpolar grease. What effect does this have on the life of equipment operated in severe cold temperatures?

What are the pros and cons of synthetic vs. mineral based oils in ocean-going equipment?

Which ship surfaces are more or less conducive to picking up ice from salt spray? Is there one surface that would make a ship safer than others? Experiment with plastics, paints, metals, wood surfaces etc.

Survey all the uses of 12 volt systems and batteries in your area, particularly in fishing boats. How do lead acid batteries work (be careful acid is dangerous!) What is the difference between an regular lead acid battery and a gel cell? What is the average battery size used in boats, 90 amp hour?115? 200? Etc. What science principles are involved in long battery life? Are there any cures for a battery that is sulfated up?

Survey the types of diesel engines used in local fishing boats. What is the science involved in diesel engines? Why are there no spark plugs in a diesel engine? What is the difference between a four stroke diesel and a Jimmy diesel?

What is the difference in operation between the newer 4 stroke outboards and the typical 2 stroke? (Get beyond gas consumption.)

What is the miscability (ability to mix) of 2 cycle engine oils at different tempertures? How much agitation is necessary to thoroughly mix gas and 2 cycle oil for an outboard at different temperatures?

Boats seem to travel faster after the sun goes down. This might be a trick of our eyes, but it might have something to do with other factors. Experiment to see if our eyes are playing tricks or whether there are other variables working to make the motor go faster. Use a GPS to get an accurate speed measurement.

Test lower unit grease from an outboard in water. How is this grease different from other greases, such as wheel bearing grease? Could wheel bearing grease or 90W oil be used in a lower unit?

What is the best method/material to repair a hole or crack in an aluminum boat?

Some gasoline additives destroy the seals on 2 cycle engines. With adult supervision, put identical seals in gasoline solutions containing Heet, Ban Ice and other additives. After a period of time, test the seals for flexibility, and durability. Are the seals damaged by the additives?

Erosion and currents

Different soils erode at different rates. Frozen and thawed soils erode at different rates. What experiments can you do with local materials to demonstrate this?

How can you tell the speed in miles per hour of a local stream, river or ocean current? If a water generator can generate 1 amp per mile per hour, how many amps could this current generate?

Can local floods be predicted? What are the variables involved in flooding? How can they be measured? Are there ways to avoid the floods by engineering or planning?

Breakup on Alaska's rivers is different every year. What conditions determine the severity of breakup? Which is the most influential?

What is permafrost? What happens to permafrost when the tundra is removed? What kinds of building foundations are used in your village and how do they relate to your findings? Which houses need more frequent leveling? What is the best foundation for a house built upon permafrost?

Many locations experience little erosion until a strong storm hits, then erosion becomes a huge issue. What severe wind and tide conditions impact your city, town or village?

Every river delta has material that is classified according to it's specific gravity. Identify the specific gravity on all locations on a sandbar and/or island. The nature of the sediment is often related to speed of current. If possible, do this measurement at the delta, mid-river and headwaters for the same river. How do the sediments relate to each other. Compare speed of current at each location.

There is a difference between a solution, like sugar in coffee, and a substance being held in suspension, like silt in a river. Explore this difference. Where on the river does the silt tend to settle out, and where is it picked up? Pour the solution and suspension through a coffee filter. Which is changed? Can you suggest a filter for drinking water for a river like the Chena, which is said to be too thick to drink and too thin to plow?

Erosion all over the west coast of the US has brought much driftwood to Alaskan beaches. Identify the local beaches that collect driftwood. Identify the types of driftwood on each beach. How many types of wood are found from local growth, and how many types are not found locally at all?

Dams in Northwest America have controlled rivers and checked erosion. Alaskan beaches have seen a change in driftwood as a result. What do old timers in your area say about the types and quantity of driftwood found on your beaches compared with what is found today?

Some Alaskan beaches (like Homer) have coal washed ashore from distant locations. Can you identify the origins of the coal on your beaches? Do locals use the coal for heating? How is it gathered? Was it used traditionally in your town or village? Compare burning that coal with burning local woods.

Scientists say the length of a river follows a mathmatical model, and never changes. If it cuts short one place, it will get longer in another in time. Do you think this so?

Tides

Tide charts give the rise and fall of tides in a general way for a given location. Alaska's shoreline is very irregular, so local tides often vary from the tide charts. To what extent is this true for your specific location.

What technologies in your community are dictated by tides? (Floating docks, moorings, bouys etc) Given advances in modern technology, can you suggest a better way to deal with the issues that these address?

To what extent do high winds cause high and low tides to vary from local tide charts? Do onshore winds combined with incoming high tides threaten flooding for your community?

What food harvesting activities in your area depend on the tides?

The rise and fall of tides create unsupported shell ice. What is the difference in the strength (safety) of shell ice vs. ice supported by water? How can travelers detect shell ice, and what precautions must be taken on or around shell ice?

It is said that tides follow the rule of 12. Divide the period between high and low tide by 6. How many minutes is this? Measure the amount the tide rises or falls in that first period. Call that amount X. The rule of 12 says that the tide will rise x amount in the first period, 2x in the second, 3x in the third, 3x in the fourth, 2x in the fifth, and 1x in the sixth. This gives a total of 12 increments.
Does this hold true in your area? Contours of local lands, inlets, bays and arms sometimes cause deviations from the rule of 12. How close do the tides in your location follow the rule of 12?

Waves

Waves carry for hundreds, even thousands of miles. What characteristics of waves in water can be demonstrated? What are amiplitude and frequency? Do waves in oil travel the same as waves in water? Does the viscosity of the oil change any of the wave characteristics?

Alaskan NOAA weather instruments can tell the extent of the winter ice coverage in the Bering Sea by the reflectivity of the surface of the water/ice surfaces. How is this done?

What is surface tension, and what effect does it have on waves, their shape and formation?

One of the factors of the shape of a wave as it comes onshore is the contour of the bottom of the beach. Study waves as they come ashore in different places. Can you now predict the contour of the floor of an unknown beach with your knowledge?

Waves have several causes: wind, collisions of currents, currents over obstacles, disturbances on the ocean bottom etc. Can you build a model that creates waves of each kind?
At a distance from the source, can you tell the difference between them, or are they all shaped the same? (Realizing that amplitude will be different.)
What happens when waves not caused by wind travel in the same or different direction from the wind. How does this change the shape of the wave?

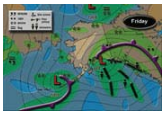
When waves pass through each other, there seems to be little change in the wave after the passing. Is this as true for waves traveling in the same direction at a different speed as waves traveling in opposite directions with a faster waver overtaking a slower one?

What is a rogue wave and how is it formed?

Eddies form when currents swirl around obstacles whether that is an island, rock outcropping or whatever. Those eddies are often good places for fishing as food settles out in the low pressure area behind the obstacle. What scientific priniciples are involved in the formation of an eddy current?

Most waves are caused by wind. What happens to the wave generation when oil is thinly spread on the water? Build a model to demonstrate this. What then can be said about the creation of waves by wind?

Traditionally, Alaskan towns and village locations were chosen for reasons like: availability of fresh water, fuel, food, good boat docking, protection from storms etc. What weather phenomina are encountered in your area and how do the contour of the land, islands, local hills etc help determine the location of local towns and villages?



Weather

All communities have signs that indicate changes in short term local weather. Some of these changes can be measured by instruments, like barometers. Old time Alaskans used to foretell weather changes by the animals. Collect local stories and compare the old methods with modern methods. Do they agree or disagree? (Many old timers say that the old signs do not work any more because of recent climate change and changes in the animals. Keep that in mind.)

Many communities have local land formations that indicate weather, like “Barometer Mountain.” What local phenomina indicate weather that wouldn’t be indicators in other communities?

Why do clouds form? Why doesn’t the water vapor spread out evenly throughout the sky rather than cluster together in clouds the way it does?

Water as a liquid is heavy. Why does water vapor rise into the air then linger at a certain elevation?

It takes a considerable amount of heat to evaporate water into a vapor. When that water vapor condenses, it releases that heat. What does this say about the transfer of heat on the face of the globe?

What do twinkling stars mean regarding the weather in the winter?

What does a ring around the moon mean, and why is this so?

What is albedo? To what extent do you think it influences the warming/cooling of the earth? Describe how melting icepacks reduce albedo and accelerate

warming trends. What is the difference in reflection and absorption of full spectrum light on light and dark surfaces?

What effect does volcanic ash, like that spewed by Redoubt in 2008-9, have on glacial melt and runoff?

Why do the river or open leads on the ocean ice produce fog? Why is fog generated? What causes it to dissipate? Can this be simulated? What is the difference between fog and clouds?

Winds and temperatures aloft are often different from the winds on the ground. Why is this? Explore inversion. What is mechanical turbulence? What is wind shear?

In the winter, why is the temperature lower right at sunrise than in the middle of the night?

What do the different types of clouds mean in terms of coming weather?

What direction do your storms come from? What direction do your high pressure areas come from?

What ocean currents collide at the Aleutian Islands and what are the weather implications of their interface?

Do the hills appear black just before the weather warms in the winter? If so, why?

What phenominon causes the tops of the hills and mountains to appear upside down during a winter cold spell?
What causes that phenominon?

People say that a red sky at night means good weather the next day. Red sky in the morning means bad weather during the day. Is this so, and why?

Old timers say if the fog goes up on a summer morning it will be cloudy all day. If the fog goes down, the sky will be clear all day. Is this so? Why?

What are “sun dogs?” What do “sun-dogs” tell you about the weather in the winter? Does it matter which side of the sun they are on?

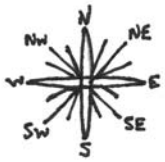
Observe the different types of snow under a microscope. What are the differences in their appearance, density and texture?

Navigation

What were the methods of ocean navigation used in the past? What are the methods today? How are they different? Are modern methods safer? What are the scientific principles involved in the modern methods?

Where are the dangerous places to navigate in your region? What navigation aids were and are now available to safely travel in shallow, rocky and hazardous channels? (Bells, bouys, lighthouses etc.)

How did the old timers tell direction in the tundra wintertime? Is this accurate compared with a compass?



Expanded Projects

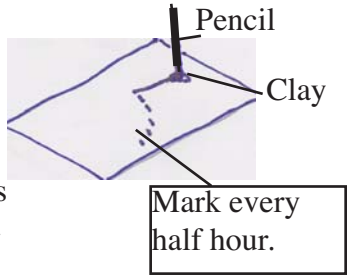
Preceding this section are almost two hundred suggested projects.
The following pages contain expanded projects that model and suggest different ways to take a simple question and expand it into a viable science project.

There is really no limit to what is possible as long as the project is safe and appropriate.

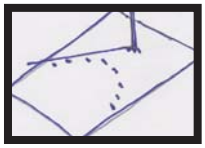
Alaskan Sundial

A sundial would seldom tell accurate time in Alaska, as the arc of the sun changes so much each day of the year. We would need a new sundial face for almost every day of the calendar to tell the correct time.
However, it is possible to tell true north and true noon using an Alaskan sundial. True noon is when the sun is at the highest point in the sky.

On a sunny day, put a large piece of paper on a flat surface. Put a pencil in a ball of clay and stand the pencil on the south side of the paper. If you can, do this experiment at the end of the local runway.



From 11 am to 3 pm, every half hour, make a mark on the paper where the tip of the shadow is. Record the time.

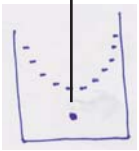


After a four hour period, connect the marks. They should follow a parabola. The point at which the parabola is the shortest is true noon at that location. That is where the sun is at it's highest point. True noon varies greatly in Alaska. On the western coast of Alaska true noon is over two hours later than noon on the clock.

Find true noon in your community.
Only locations on that same line of longitude have the same true noon. Communities east and west have a different true noon.

It is possible to tell true north (not magnetic north) by drawing a line from the base of the pencil to the shortest point on the parabola. That line points to true north.

True noon occurs when the shadow is pointing to true north, which is at the lowest point of the parabola.

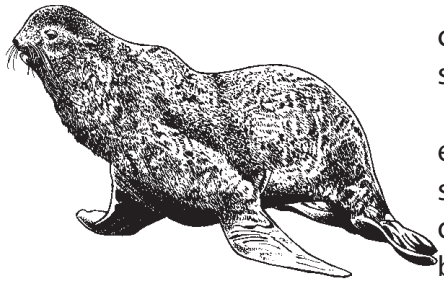


True north points towards the geographic North Pole. Magnetic north points to the magnetic pole of the earth. In Alaska, this is far east of true north.

Find true north in your community. From that you can determine true south, east and west. If you want to know the difference between true north and magnetic north, do the experiment beside the local runway. The runway numbers indicate the *magnetic* direction of the runway. Runway 07 (really 070) points 70 degrees from magnetic north. Runway 28 (really 280) points 280 degrees from magnetic north. Ask a local pilot the runway numbers on your local runway and compare true north to magnetic north. What is the angle of declination (difference between magnetic and true north)?

Do this same experiment close to the first day of every month if the sun is present to make a shadow. How does the parabola change shape through the seasons? True north and true noon will always stay the same(excepting daylight savings changes,) but the shape of the parabola will change considerably. Check

Atlatls



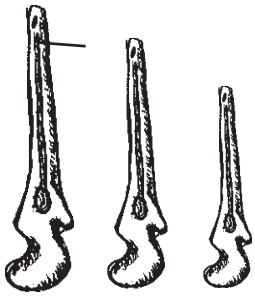
In certain seasons in certain water conditions seals sink when shot. Losing a seal is always a possibility. Even today, many people living in the mouths of Alaska's rivers spear seals rather than shoot them with guns so they can be retreived before sinking.

For centuries, people exoerimented with spears and throwing sticks called atlatls. A precise science has been developed by seal hunters to obtain the greatest distance and accuracy.

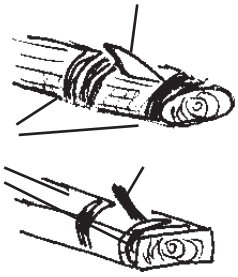
There are three variables in throwing a spear:

The hunter
The spear
The atlatl

Experiment with different atlatls. Make a long, a short and a medium length atlatl. Traditional atlatls look something like those on the left:



You can make a simple one like the one below:



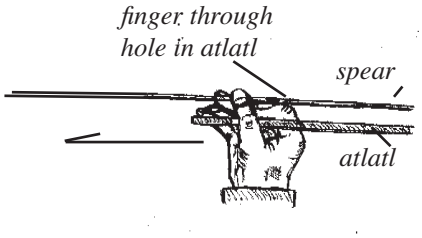
On the end of the atlatl is a pin that was traditionally made of bone or a tooth. You can make it from a nail.

Hollow the tip of the spear so the nail will seat in the end of the spear and not slip off.

What is the most effective combination of altatl length, spear length and spear design?

Experiment with different weights on the end of the spear. Put on a heavy, a medium and a light weight. (I test by wrapping with strips of lead.) Which is most effective for distance and accuracy?

With your ability to throw a spear, would you eat supper tonight or go hungry?



I have always wondered if the long slim shape of the Aleut bentwood hats was to keep the hunter from knocking his hat off when he threw a spear.

Traditionally, the length of the atlatl is from the elboe to the first knuckle. The length of the spear is from the elboe of one arm to the outstretched finger of the other arm.

Another person bigger or smaller than you should try the same experiments with the same atlatl. Are the results the same for a different size hunter, or does the size of the "perfect" atlatl vary with the size and strength of the hunter? Do left handed people have an advantage or disadvantage.

Again, there are three variables:

The hunter
The atlatl
The spear

Long ago, hunters threw while sitting in a kyak. Nowadays, they stand up in the front of a large boat.

Now experiment with different spears. Try a long spear, a short one and a medium length spear.

Try a spear with feathers in the back.

Try a spear with a weight in the front.

Try a spear with feathers in the back and weight in the front.

Throw a spear ten times measuring each throw for distance.

Throw the spear ten times measuring for accuracy (How many times you can get the spear within a 10' circle from 50'.)

Which atlatl gives the greatest distance, the long, medium or short one? The best accuracy?

Compare your distance and accuracy while sitting vs. the results while standing. Use the same atlatl and spear. From which position can you throw farther? Is this true for other hunters too?

This enjoyable experiment has very important conclusions.

Traditional atlatl length

spear length elbo to fingertip

Bentwood Hats

Bentwood hats were used traditionally for seal hunting. They served several purposes. First, they protected the hunter's head from the elements. Secondly, they allowed the hunter to shield his eyes from the seal's gaze, to avoid spooking the seal. Thirdly, the bentwood hat served as a *sound funnel* amplifying the hunter's ability to hear long distances over water.

It was also important that the hat not be so big that the wind would constantly blow it off, or that it would not be in the way when the hunter threw his spear. A sombrero would not work well at all!
Most often, the had had a chin strap to keep it in place when the wind was particularly fierce.

Bentwood hats were traditionally made of cottonwood that had drifted up on the beaches.
A fascinating experiment can be done by making a several bentwood hats of different shapes, sizes and materials.

A bentwood hat can be built with adult supervision by running a green cottonwood board through a thickness planer so that it is less than a quarter of an inch in thickness.
The shape of the hat is then cut out. If a pattern is lacking, make one out of paper first, adapting until it fits.
The resulting piece of cottonwood is soaked in very warm, almost boiling water in a wide shallow pan. With tongs and gloves, the wood is removed from the pan and bent to the desired shape.
If the cottonwood is rather dehydrated, it should be cut and planed to thickness and then rehydrated for many days before cutting to shape and bending in very warm water.

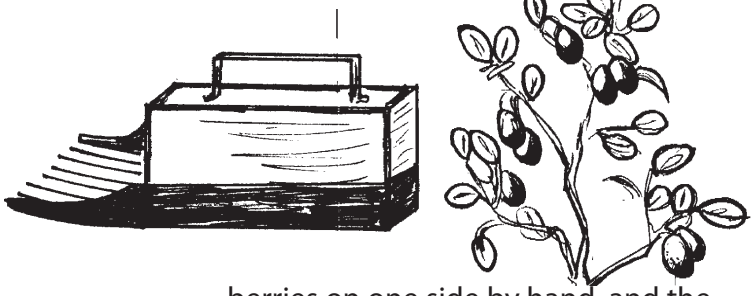
The truest test of the effectiveness of the "sound funnel" would have to be done over open water. The test can first be done with the different materials, shapes or sizes of hats by playing a recorded sound at a given volume. Wearing the hat, walk or paddle towards the sound and measure the distance where the sound is first heard.

Another way would be to conduct the experiment at a given distance, and see at what volume setting on the boom box the test person can hear the sound. (This is perhaps the easiest way.)
Again, the true test would be to experiment with the hats over open water.

This experiment has almost endless possibilities. Does sound travel better over smooth water, or rougher water? How much difference does wind make? Does the hat work well for all pitches of sound or only high or low pitch sounds?
What material serves best as a sound funnel, cloth, grass, wood, thin aluminum?

Experimentor wearing bentwood hat on beach

Berry Experiments



Berry Pickers

During the fall of every year, most Alaskans are very busy. One of the most important activities is picking berries to store for winter. For many decades steel berry pickers have been available.

They have several advantages:

- They pick berries very fast.
- They hold a quite a few berries before needing to be dumped into a bucket or other container.

They have disadvantages:

- They also pick leaves, sticks and other undesirable material, making the berries dirty.
- There is also a controversy. Some people say the berry pickers damage the blueberry bushes. Other people say they do less damage than bears, and are therefore not harmful. No one seems to think that berry pickers harm lowbush cranberry bushes.

One village will allow anyone to pick blueberries in their area, but will not allow anyone to use steel berrypickers.

It will take time, careful observation and measuring to do the following experiment, but a good scientific answer is possible.

Long term experiment

Find several patches of blueberries. With flagging, divide the blueberry patches rougly in half. Harvest the berries on one side by hand, and the other side with a berry picker. There are three ways to measure the harvest from each section: by weight, by volume or counting each berry. Recording by weight might be the most accurate.

Examples: Hand picked area=1356 grams of berries. Picker area =834 grams. The berries from the hand picked area represents 62% of the berries in the patch. Another location: Hand picked area 378 grams. Picker area 276 grams. The berries from the hand picked area thus represent 58% of the berries.

To be accurate, mark and harvest several patches in this same manner recording all data.

Do the same measurement for two more years in exactly the same spot. Does the percentage of berries decrease in the area harvested with the berry picker?

The number of berries might vary greatly from one year to another, so compare the percentage of berries picked in the two sections, metal picker vs hand picked. The question you are trying to answer is: Does a berry picker help or harm the berry production? Does the percentage of berries from the area harvested with the steel picker go up, down, or stay the same from year to year?

Some scientific experiments take many years. Bears or birds harvesting in your patch one year might throw the conclusion off.

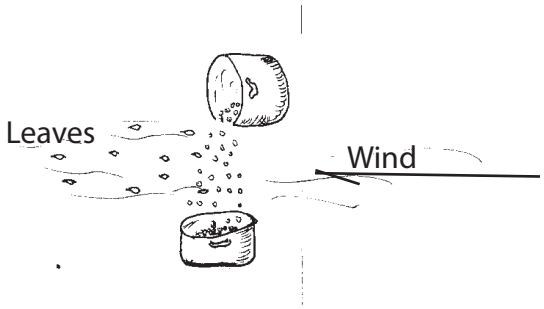
Try to pick the berries at the same time each year. When berries are over-ripe, the berry picker smashes many berries. That is why measuring by weight might be better. This is an important experiment that needs to be done. We want to care for our berry patches, and we don't want unnecessary conflict between people. This experiment will take the discussion from the realm of opinion into the realm of science.

Cleaning Berries

After the berries are picked, they must be cleaned. Some people pick berries very clean, and some pick like a brownbear (lots of rubble).

There are several ways of cleaning berries.

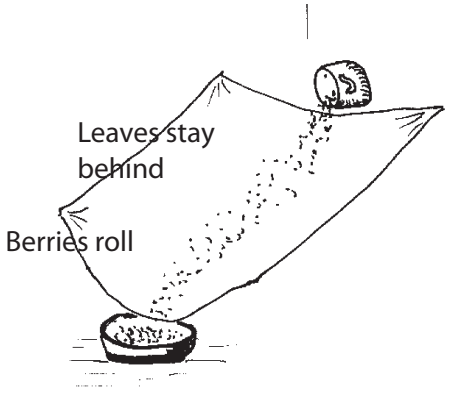
Some people go over every berry on the table, plucking stems from each berry. That's too tedious for most people.



Old timers used to pour the berries from one container to another in a strong wind. The leaves and sticks have more surface area and less weight than the berries, and therefore blow away. The berries are heavier and drop into the bottom container. The only problem is the lack of a strong wind at the critical time of cleaning. If berries sit too long, some of them smash and the wet leaves stick to the good berries. They must be cleaned by wind soon after picking.

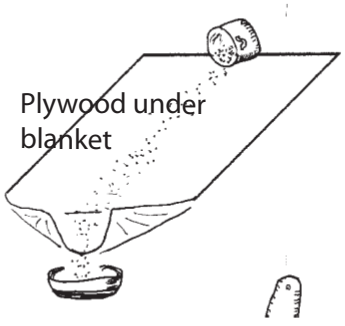
Some people drive the boat and pour the berries, creating their own wind.

Other people pour the berries from bucket to bucket in front of a strong electric fan.



Old timers also cleaned berries by pouring them down a blanket. The round berries roll and the flat leaves don't. This works well, but the pitch of the blanket often varies. If it is too steep, the leaves tumble into the bucket too.

Some people put a piece of plywood under the blanket, funneling only the bottom to channel the berries into the bucket.



Experiment

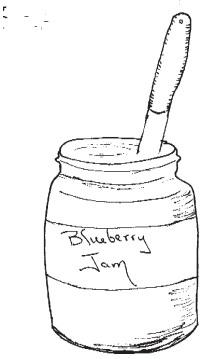
Try different methods of separating berries from the leaves and sticks by using natural wind and an electric fan. Berries that fall a long ways will damage when they hit, especially those picked later in the year. Find the optimum height.

Try rolling berries down a blanket to separate leaves. Try the blanket at different angles. Put a piece of plywood under the blanket. Does it help control the angle of incline? Does the type of blanket make any difference (wool, cotton, nylon etc)?

What spot remover takes out blueberry stains from the blankts? There are many possible experiments here.

Jam

We now use commercial pectin to make jam and jellies. However, green berries contain pectin that can take the place of the commercial product.



Obviously, there are more green berries available in the beginning of the season than there are at the end of the season.

Experiment

What percentage of berries must be green to get the same gelling effect as the commercial pectin? 5%, 10%, 25% etc

Does it help to smash the green berries, making the pecting more readily available to the jam?

While commercial pectin is relatively inexpensive, the time might come when it won't be

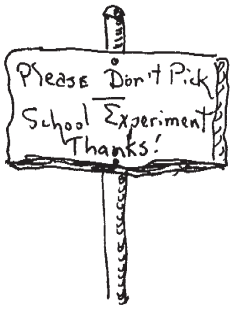
Berry Observation

If someone has done a long term observation regarding the variables involved in a good blueberry year, the information has not informed the people of the Alaskan bush. Every year, people watch for the green berries and closely observe the time when they turn blue.

An extremely valuable long term observation would be to record the date of breakup, date of last frost in the spring, date of flowers on the blueberry bushes, date of first green berries, date of most berries turning blue and date of first frost in the fall. While these dates are being recorded, the amount of rain should also be recorded. The number of rainy, cloudy and sunny days should also be taken into account.

Careful watch should be given to see if there have been bears and birds eating in the berry patch before the recorded harvest.

Mark off a section of your family's favorite berry patch, and measure the amount, or actually count the number of berries taken from a given area. Do this observation for several years and you might be the first to identify the variables necessary to have a good berry year.



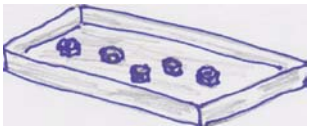
Corrosion in Salt Water

Salt water takes it's toll on different metals. Some metals are more affected than others by corrosion. While conducting science experiments in and around the ocean it is important to protect machinery and equipment. It is also important that the scientist's machinery is not inadvertently part of the experiment. So, understanding corrosion is very important to subsistence and science work on or around salt water.

At a hardware store, get four nuts made from each of the following different materials:
Grade 2 soft steel, grade 8 hardened steel, galvanized, stainless steel. You probably can't find nuts of lead, copper, aluminum and other kinds of metal. Get pieces of those metals that are as close in size and shape to the nuts as possible.

Put one sample of each kind in a separate clear container of fresh water. (Perhaps a small plastic cup.) A metal container will interfere with the experiment.
Put one sample of each kind in a separate clear container of salt water.
Watch what happens to each of them in time (perhaps a month.)
Do a visual check as well as comparing the weights, before and after.

Experiment again.
Put each sample on a separate paper towel, and spray it once a day, one set of samples with fresh water, and the other with salt water. Do this for a month. This way the samples are exposed to the air as well as water.



Compare the results of the immersed samles with the sprayed ones. Is there a difference in the amount of corrosion? Do a visual check as well as comparing the weights, before and after.

Experiment again.
Put one sample of each kind of metal into a single container after weighing each one. Cover with fresh water, and weigh again after one month.
Put one sample of each kind of metal into another container after weighing each one. Cover with salt water and weigh again after one month.
Do a visual check for corrosion as well as comparing the weights, before and after.

If you are using the same nuts and pieces of metal from the first experiment, buff and clean them up well before using them in this experiment.

What conclusions can you make after doing these experiments? Talk to fishermen and seamen and get their opinions about the best metals to use on a ship. Understand that cost, strength, flexibility and other qualities of materials enter into the decision of what kind of metals are used in different applications.

Alaskan Crane Migration

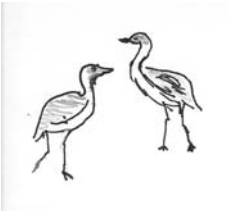
Old time Alaskans said that little birds migrate with the sandhill cranes, some of them actually hitch-hiking a ride under the cranes' wings. Many Western science people have scoffed at the mention of this, but no one has yet proven that it isn't so.

Cranes migrate to Alaska in the spring *after* the ducks, geese and swans. Many little birds arrive at the same time. Cranes are the first to leave in the fall, generally in mid August. Many people watch and hear the cranes circling in the tundra, riding upwards on the morning thermals. Small birds do fly up to and with them. That is obvious to the naked eye. However, no one has documented with binoculars or spotting scopes how the cranes and little birds interact.
The cranes live on the tundra, often far from rivers and human habitaiton making their study less than convenient.

Be the first to study this phenomina and spend time with the cranes just before they leave the coastal tundra in mid to late August.
They don't take off too early in the morning, as they use the thermals to climb, and thermals don't start bubbling until after 10 am.

How many cranes are in the flock you are watching? Do little birds accompany them? Do little birds actually hitch-hike a ride under the cranes' wings? If so, why would the cranes allow this? What do they get out of it? What kinds of "little birds" are involved in the migration? Do they and the cranes spend the summer in proximity of each other, or do they only rendezvous in the early fall?

At what locations do flocks of migrating cranes like to stop for the night? Do other groups of cranes stop in those same places on following days, or are their evening stop-overs in random locations?
Record the locations, dates and times from which they circle in the morning. There is high suspicion that their evening resting places have much to do with food, safety, and different colors in the surrounding tundra that will allow thermals to be created in the morning.



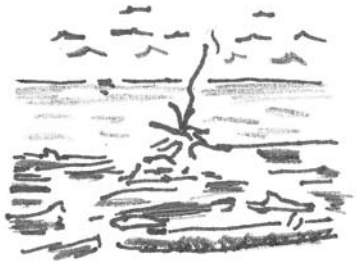
Do they time their migration to take advantage of prevailing winds? Might these patterns be influenced by climate change?

This could be a fascinating study, but would take many years to accurately document.

Driftwood Observation

Driftwood has been important to Alaskans for thousands of years. Many coastal towns and villages do not have large trees growing nearby to supply construction and firewood needs. Local people rely on ocean currents and wind to deliver their supply.
People in Kodiak talk about the traditional use of *bamboo*. Once in a long while, bamboo would drift up on shore and locals would put the bamboo to good use.

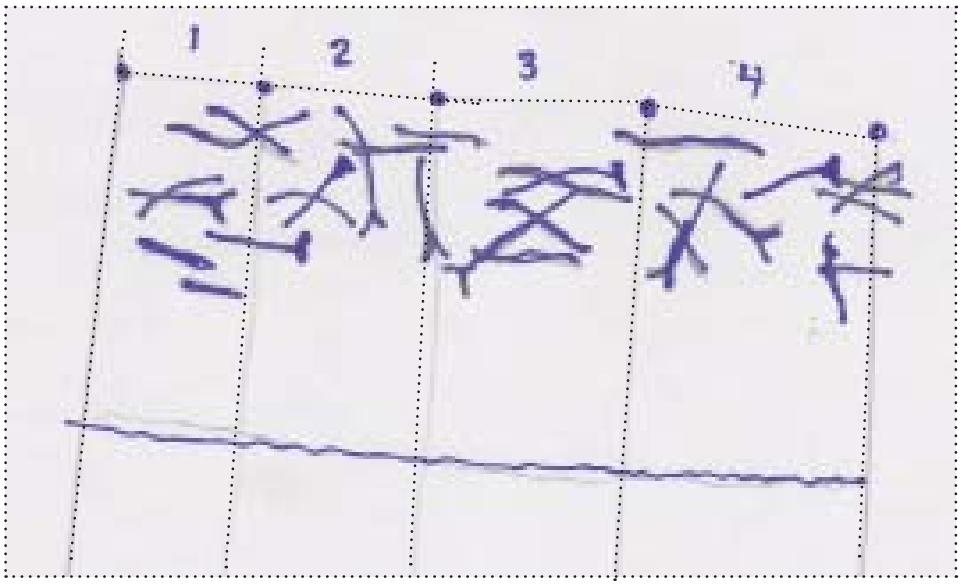
Pick a local beach that is known for catching driftwood. Some beaches are named "Catcher Beach" due to their reputation for gathering driftwood.
Mark out four sections of beach, perhaps 10' wide, that go from the waterline to the highest point. Identify all kinds of driftwood that are in each section, no matter how big the piece. If you have a hard time telling what kind of tree the sample comes from, bring a piece home and ask one of the local elders.
Record the storms and big winds for as long as you can.
Every month, go out and record the new wood that has arrived in your four sections. Probably the wood farthest back has been there for years, but new pieces should be arriving.
What storms and winds brought in new wood to that beach?



Of the samples that do not grow locally, where do you think they came from? What ocean currents do you think brought them? Do local elders notice a difference in driftwood from many years ago? Do they attribute the change to climate change? Since erosion control projects on Lower 48 rivers, there has been less driftwood on Alaskan shores. There are many possible reasons for the increase or decrease in driftwood.

Talk to seamen, particularly those who travel long distances. Do they notice a difference in ocean currents? Are the currents changing?
To what extent does your community depend on driftwood nowadays?
Might that change if the cost of heating fuel continues to rise?

What were the traditional uses for each of the types of driftwood on the local beaches?



Four Finger Time

In Alaska, during April and September, it is possible to estimate the time until sundown by using hand spans. Three hands equals three hours, two hands equal two hours, etc. This is important for travelers, hunters, hikers and all people outdoors who need to know when darkness will come.
This method is being taught in survival classes in Alaska and works quite well.

However, the path of the sun in Alaska varies greatly from summer to winter, and Alaska is so huge, the four finger rule works accurately only during the equinox, when the day and night are equal.

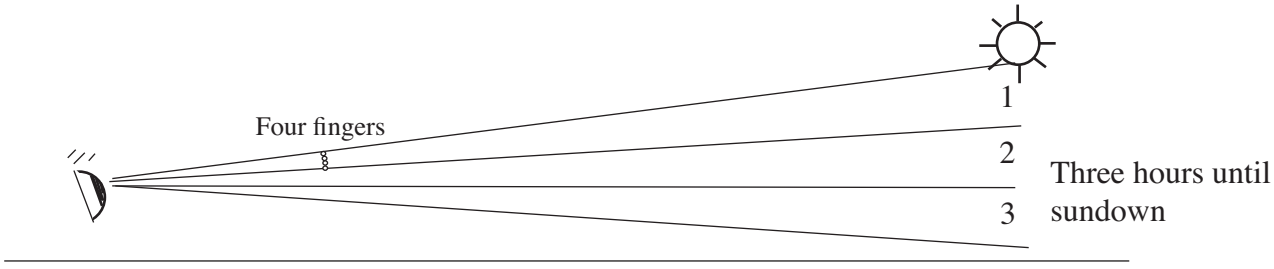
Experiment:
During the summer when days are longest, find the pattern: At noon, how many hands is the sun above the horizon?…3 pm…9 pm and through 12 midnight?
Do you find a pattern? Your specific location in Alaska will give different results from others that live north and south of you.

During the winter, when days are shortest, find the pattern. At noon, how many hands (or fingers) is the sun above the horizon?…1 pm…2 pm and through sundown?

Old timers always got up early and worked towards the sunrise because they knew how hard it is to travel once the sun is down. Nowadays, most people get a late start and find themselves running out of daylight.

It would also be good to experiment with the larger and smaller people in a class. The larger people have larger hands and smaller people have smaller hands, **but**, at the same time, their arm lengths are longer and shorter too. Is the span similar or different between the larger and smaller people when held against a distant object?

Test this by standing 100' from a wall. Line the bottom of your hand with the ground and have someone mark where the top of your hand comes on the wall. Have a person of different size do the same thing. Do your marks come in different places, or are they close to each other?

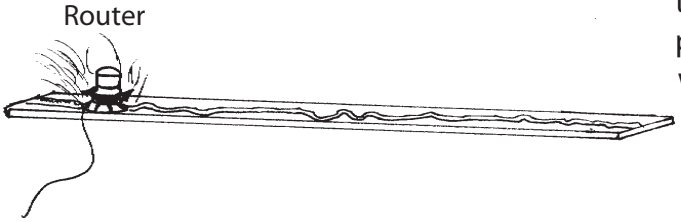


Gold Placer in a River Drainage

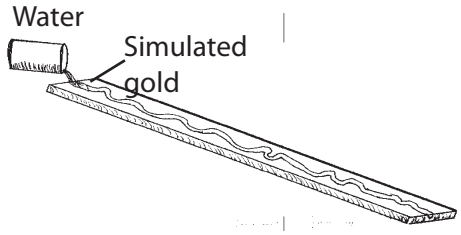
Gold follows a predictable path down a river. It will follow the straightest route possible, and it will drop out, or placer, in a somewhat predictable manner. Since it is 5-6 times heavier than most country rock, it will work it's way down to bedrock and will follow bedrock in an interesting pattern. To learn that pattern, make the following model.

Model

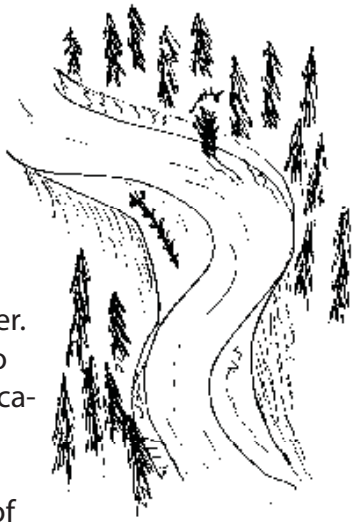
With a 2"x8"or 2"x10" board 4'-8' long, mark what you might think the pattern of a river would be in your area. With a wood router, rout the river channel about 1/2"-3/4" deep. Give it different depths in different places.



You obviously won't be pouring gold down the river, so choose a heavy material to simulate the gold. If you have black sands available, they work fine, but iron filings, or brass filings will work well too. Paint the bottom of the river. White will show black sands and iron filings. Green will show brass filings.



Put a mound of your simulated gold on the head of the routed river. Elevate the board so the water will flow, and steadily pour water over the simulated gold. Let it flow down the river into a bucket. Watch as the simulated gold placers out in different locations. Change the elevation of the board so the water flows faster or slower. What differences do you notice in the locations the simulated gold placers?



Make a couple of different "rivers" with different bends and obstacles. Before testing it, predict where the gold will placer, then test with simulated gold and water. This is a fascinating study that will give great insights.

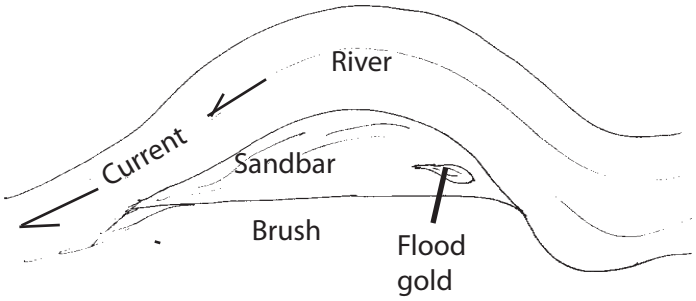
Experiment

If you are on a river with a current over 4-5 mph coming from the mountains, pan several bars in your area. Pan different locations on each bar.

Look high on the head of the bars. You would expect gold low on the bars because it is heavy, but often the current at high water will deposit flood gold on the head of the bar. This might be the only place on the bar that has gold.

Where on the bars do you find colors (small pieces of gold)? Map several sandbars, counting the colors in each place.

Look for black sand. The specific gravity of black sand is close to that of gold and they are often found together. You won't see the gold before panning, but can see streaks of black sand on many sandbars.



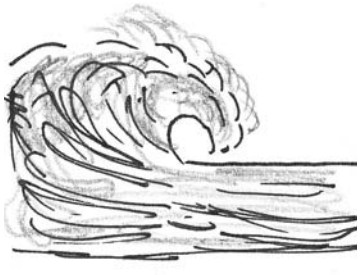
A Hobby That Could Go Somewhere

Many rivers in Alaska have gold in the sandbars, although not in paying quantities. Gold isn't hard to find, it is just hard to find paydirt. It takes approximately 40,000 little "colors" of gold to make an ounce. It is great fun to explore the sandbars.

The dream of many Alaskans is to find the paystreak the old timers overlooked. The gold is still out there, and prospecting gives a good excuse to get out in the woods and see some new country.

Be careful, once the gold-bug bites you, it is hard to stop prospecting, reading about gold and buying new contraptions to find and extract it.

Local Waves



The way in which waves break on a beach is a foctor of the contour of the beach, the size and frequency of the waves.

A beach that slopes gradually will have waves that break one way.
A beach that drops off quickly will have waves of the same height break another way.

Waves do not always come from the same direction. Make note of the direction of the waves as they come to your beach.

Make a study of the waves in your area. Are most of the waves the result of local winds and storms, or do you think they have come a long ways?

At low tide, study the contour of the beach. Watch the waves on different beaches as they break at high tide. Can you predict the way waves will break on a strange beach given your knowledge of the way they break on a familiar beach?

What is the difference in wave action when the tide is coming in compared when the tide is going out?

Measuring the Tide

The rhythm of tides has dictated the rhythm of life for coastal towns and villages since the beginning of time. Nowadays we can easily access tide charts. Tide charts give a good indication of what tide levels will be. However, a coastland with many coves, inlets and channels will NOT have the same tide readings as the tide charts. Southeast Alaska provides many opportunities to demonstrate this, but variance occurs in many other locations in Alaska.

There are several fun experiments involving measuring the tide. But it is hard to measure the height of the water, as the waves lap against the measuring stick giving approximate readings at best. To do that we have to make a tool that will help us accurately determine the actual height of the water. This experiment helps develop such a tool.

If a clear tube is corked on one end, and a small hole drilled in that cork, the level of water in the tube will remain fairly constant even if the waves rise and fall. Water can go in and out the small hole, giving an accurate measurement of the water level, but it will not go up and down quickly with the waves. The small hole will not allow the water to race in and out. The tube is open on the upper end to allow free flow of air.

Experiment: How big a hole in the cork will give a constant height of water in the tube when held against a measuring stick? How big a tube will give an accurate measurement? Does the length of the tube make a difference? Perhaps the amount of water already in the tube will influence the ebb and flow of the height of the water.

Can you improve on this measuring devise, perhaps attaching a clear sight tube to a larger container that has a hole in the bottom? A 55 gallon drum with a small hole in the bottom might give a good reading.

Compare the rates of flow of the tide against the tide chart. Do your high and low tide correspond with the tide chart? If not, what local geographical features around your home interfere with the flow of currents and cause the deviation?

What local activities depend on the tides and the knowledge of the tides?

Cork with hole

Nets and Ultraviolet Light

Many Alaskans make their living from fishing, either commercial or subsistence.
Net care is very important.

Years ago, nets were made from cotton twine. As soon as the net was removed from the water, it was hung to dry so it wouldn't rot.

Nowadays, nets are made from nylon that has a different kind of problem. There is only one thing that will rot a nylon net, and that is sunlight. The nylon decomposes in the ultraviolet rays of the sun.

Experiment.

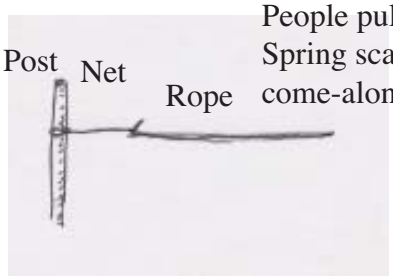
Cut a section of salmon mesh into several pieces that are 5 meshes wide.
(If they are too strong, you won't be able to break any of them.)

Hang three in direct sunlight.
Hang three in a shady place, but outdoors.
Hang three indoors.
Put three more away wet in a dark place in a plastic bag.

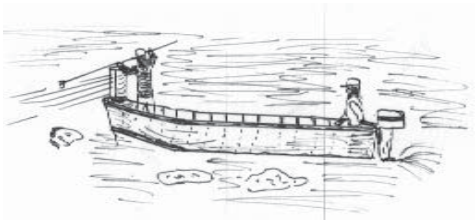
After one month, test one of each sample to see how hard it is to break.
After two months, test another of each sample to see how hard it is to break.
After three months, test the third to see how hard it is to break.

Try to tear each one with your hands. Will any tear?
A crude measurement of strength might be to tie one end of the mesh to a post and the other end to a rope and see how many people it takes to break each one.
A more accurate measurement would be to get a large spring scale and measure the point at which each one breaks.

What conclusion can you arrive at concerning the effect of direct and indirect sunlight on the mesh of a salmon net?



Spearing Fish and the Refraction of Light



For many centuries people living subsistence in Alaska have lived from the abundant supplies of fish, those that remain locally and those that migrate. There have been a variety of ways of catching fish:

- Nets and dipnets
- Fishtraps
- Spearing
- Hooks/lures

Day to day, a family's survival depended on the ability to catch fish.

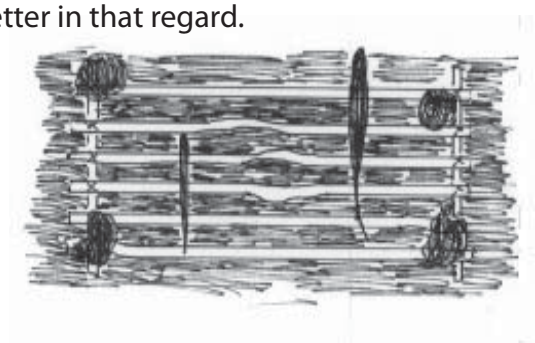
Many village people spear fish in the fall when ice is running in the river. They go out in boats at night. For lighting, they use bright 12 volt lights. Spearing fish at that time of year allows people to store the fish without having to take up freezer space.

While the river is still running ice in the fall, they also chop a wide hole in the shore ice and whitefish through the hole.

Traditionally this was an important source of fish, as fish stored at this time of year can be frozen and kept all winter.

We also spear pike as they migrate in the spring. They are camouflaged quite well against the dark creek bottom, and are almost impossible to see as they swim in the creeks.

To gain an advantage, people peel spruce poles, lash them together, and sink them with rocks. The poles are crosswise on the creek bottom. When the fish swim with or against the current, they show up clearly as they swim over the light colored poles. A white sheet or cloth held on the bottom by rocks serves the same purpose. However, if you spear too many holes in your mom's sheets, she will not be too happy. Wooden poles are better in that regard.



Years ago, before nylon nets were available, upriver people speared salmon from canoes. If king salmon were speared in the right place, just behind the brain, they quiver and die easily. If they were speared in the wrong place, the fisherman was in for a wild ride in his canoe!

Accuracy was and is important.

The challenge

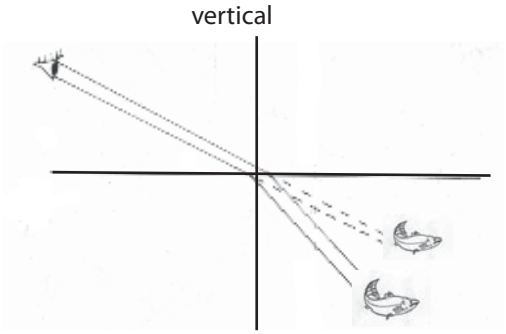
It is exciting to spear fish, but first efforts are usually frustrating. There is a science principle that must be understood before success is attained in spearing fish. The fisherman sees the fish, aims the spear well, and misses again and again. Sometimes the fish are too fast, especially the small ones. But, other times, it seems that someone is playing a trick. Old timers understand the sci-

ence principle quite well. That is why some older people can catch more fish than younger people even though the younger people are quicker and have better eyes.

Understanding…Refraction

When light passes through air, it travels in a straight line. However, when light passes from the air to the water, or water to the air, it is bent, or refracted. When light passes through any two substances of different densities, the light changes speed and is bent.

We think we see exactly where the fish is. Actually, the fish is lower than we perceive. It appears closer to the surface than it actually is. If the tip of the spear is put in the water, the tip seems to be bent. In reality, the light is bent and the spear remains straight.



The secret of spearing fish is to know how much below the image to aim the spear. The fish isn't where you think it is!

The greater the angle (from the vertical) the fish is viewed from, the more the light is bent. Spearing from directly above, the fish will appear to be in the same place, but will appear bigger and closer to the surface than it really is.

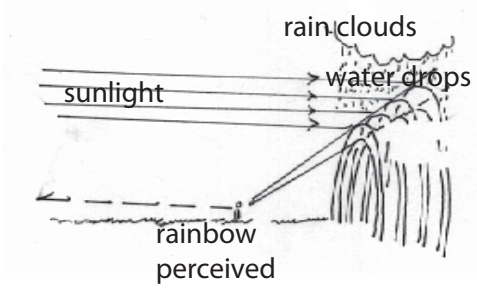
Do you think eagles and other birds of prey that catch fish need to understand this science principle too?

They must miss a few meals until they learn this science lesson.

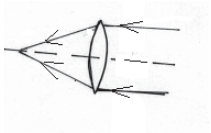
Other applications

When sunlight passes through air, and then passes through a cloud or rain, we see a rainbow as the light is refracted and reflected within the raindrops.

White light is separated into the individual colors shown in the rainbow. (Look up Snell's Law for more informaition.)



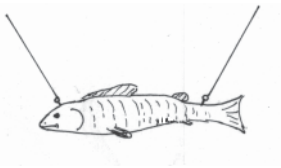
When our eyes don't focus properly, we wear glasses that also refract the light, bending it in exactly the right way so we can see clearly.



Can you think of other applications of this science principle?

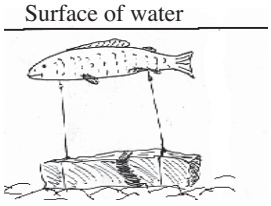
Experiment

Make a long blunt spear. Hang a wooden fish (about 18" long) in the air and practice spearing it until you get fairly accurate. Poke at the fish, do not throw the spear. Hang it by two strings so it won't spin.



With that same spear, go to clear water, the ocean, a lake or river, and put the tip of the spear in the water. Does the part of the spear that is in the water seem to bend? Attach a target to a string (perhaps the same wooden fish). Attach the string to a

weight and sink it so the target is 6" beneath the surface. Practice spearing the fish. How much below what you percieve the position of the fish do you have to aim?



Does this change with the depth of the target?

Experiment at different angles, above the target and at a short or long distance.

Imagine that, if you miss, you will have to skip your next meal.

Try the same experiment with spears of different weights and lengths. Which is best for you?

If it is winter, you can still do this experiment with a long washtub. Suspend one fish target over the tub, and sink one into the water. From different distances, test your skill, and estimate the amount of refraction.

In the above experiments, what percentage of hits can you make for the fish out of the water? For the fish in the water? Which target is easier to hit?

If you are practicing on the ocean, a river or lake, do this experiment on a sunny day, and on a cloudy day. Try it with the sun at your back, or in your face. Do it at dusk after the sun has gone down, but before dark. Try the same experiment with different kinds of light at night (flashlight, strong flashlight, Coleman lantern, torch). What differences do you notice? What conclusions can you draw from this? What are the best conditions to spear fish? What are the worst conditions? Do polaroid sunglasses help?

Ask the old timers in your town or village what kinds of fish they used to spear. What time of year did this occur? What were the best conditions for this activity (night, day, calm weather etc.?) What were the best locations? Ask them how they stored those fish. Is this activity still possible today? If possible, try it. What kinds of spear heads were used in the recent past? Were they store-bought or home-made? If they used home made spear heads, make one according to their directions.

What kinds of spear heads were used long ago?

Ask the old timers in your town or village where the fish were migrating to and where they were coming from when they were being hunted. Why are they traveling in the ocean, river or creek? What is the advantage of spearing over hooking?

Find what the Alaska Dept of Fish & Game knows about the fish in your area. Compare their knowledge with that of the local elders.

Seals Floating and Sinking

Coastal people shoot seals in the open ocean. If the water is undiluted by fresh river water, and the seal is fat, the seal will float. If the seal is shot in fresh river water, it will sink. Seals tend to float more in the winter than in the summer because of fat content.

Upriver people used to shoot beaver in the fall and spring. Grandma Charlie of Sleetmute said, "In the spring, if the leaves are as big as the beaver's ear, the beaver will sink. Before that, they float." There is no use to shoot them if they sink and drift away.

A moose or caribou shot in the water will float. A blackbear or brownbear shot in the water will sink.

What is happening? Why do some animals float and some sink?

To understand this, we only need to understand specific gravity.

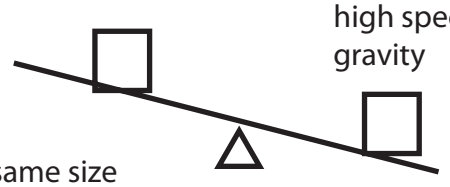
Defining and Determining Specific Gravity

What is specific gravity? Specific gravity explains the relationship of:

- How much something weighs compared to
- How much space it takes up.

low specific gravity

high specific gravity



same size
different weight

An object that has great weight and takes up little space has high specific gravity.

An object that has little weight, but takes up much space has low specific gravity. Two objects might take up the same space but have different weights. The heavier one has a greater specific gravity.

Water is one of the most common and-perhaps the most important substances in the world. To compute specific gravity, everything is compared to water. One cubic centimeter of water weighs one gram. Anything that has a volume of one cubic centimeter and weighs one gram is said to have a specific gravity of one.

Anything that has a volume of one cubic centimeter and weighs more than one gram is said to have a specific gravity of more than one. Gold has a specific gravity of over 19. That is, a cubic centimeter of gold will weigh over 19 grams. With a specific gravity of over one, the object will sink in fresh water.

Anything that has a volume of one cubic centimeter and weighs less than one gram is said to have a specific gravity of less than one. Most types of wood have a specific gravity of less than one. They float.

Animals

What determines whether a beaver floats or not? If the beaver's specific gravity is greater than one, it will sink. If it is less than one, it will float. It is that simple.

Let's say that another way. A beaver's body displaces a certain amount of water. If the beaver weighs more than that amount of water, the beaver will sink. Another beaver's body displaces a certain amount of water. If the beaver weighs less than that amount of water, it will float.

When we swim, our legs have a specific gravity of less than one. They sink. Our body, particularly our lung area, has a specific gravity of less than one, and we therefore float with our back out of the water and my legs hanging downward. If someone's average specific gravity is less than one, he/she will float.

AGAIN

The specific gravity of fresh water is said to be one.

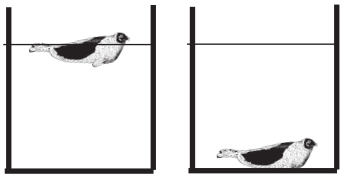
If something has a specific gravity of greater than one, it will sink in fresh water.

If it's specific gravity is less than one, it will float in fresh water.

THE APPLICATION

Why does the seal sink in fresh water? The answer is easy. It's specific gravity is greater than one. It is heavier than the water it displaces.

Why then does the seal float in salt water?



salt water

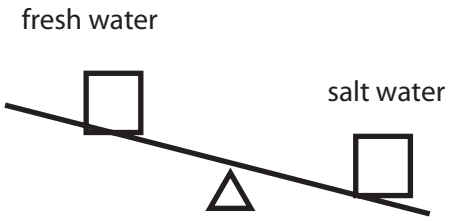
fresh water

The salt content in the ocean water makes a cubic centimeter of salt water heavier than a cubic centimeter of fresh water. It's specific gravity is greater than fresh water.

A seal has a greater specific gravity than fresh water, so it sinks. However, the specific gravity of a seal is less than the specific gravity of salt water, so the seal floats.

This science principle works consistently. Fresh water actually floats on top of salt water because it is lighter. It will float until they mix. Out beyond the mouths of Alaska's rivers in the ocean, the water on top is less salty than that on the bottom.

Warm water will also float on colder water because it's specific gravity is less. Water in any condition will float on mercury because the specific gravity of mercury is over 13. A copper penny will sink in water, but float on mercury.



Back to the moose, caribou, black and brownbears. Bears sink because their specific gravity is much greater than one. The have great muscle mass, even when they are carrying a lot of fat.

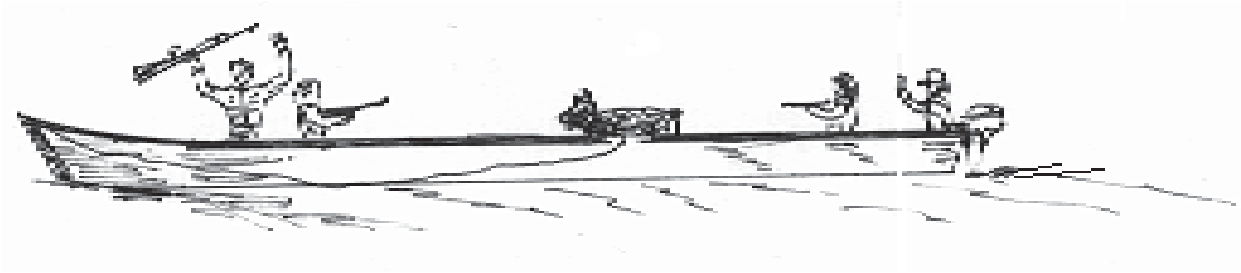
Moose and caribou float, partly because their hair is hollow, but also because their bodies aren't as dense as the bears'. The average of the specific gravity of their entire body is less than one. Their horns and bones tend to sink, but their hair and lungs keep the moose and caribou afloat.

A STORY

I heard a funny story thirty years ago. A bear was swimming across the river in front of a village. Four men hopped into a long riverboat. Knowing that the bear would sink if they shot it, they put a rope around it's neck, planning to drown it behind the boat. The pilot accelerated the boat to pull the bear under the water. However, the rope they used was tied to the front of the boat. It was shorter than the long boat. The bear came alongside the boat with the rope around it's neck, and crawled into the boat.

With two men on either side of the bear, no one dared to shoot. The pilot crashed into the bank as everyone dove out of the boat. The bear, still dripping, with the rope around it's neck, followed the two men out of the front of the boat. On the beach it met it's end. Unfortunately for the four hunters, the event took place with the whole village watching.

They knew about the bear's specific gravity, but didn't take time to estimate the rope's length. They got A in science but a D- in math that day!



Back to the Question

We could ask, "Why do the beaver sink when the leaves are as big as his ear, but not before?" The answer is: the beaver loses some of his fat after breakup while the leaves are growing. Fat has a very low specific gravity, and helps keep the beaver afloat. Beaver flotation isn't a matter of the specific gravity fresh and salt water. It's a matter of the beaver's specific gravity changing with it's fat content while it is in fresh water.

If you shoot a beaver and it sinks, it will stay on the bottom. If there isn't much current, you can see little bubbles coming up, and snag the beaver with a hook on a long pole. Old timers used to split the end of a long willow. They poked the bottom until they found the beaver. They then pushed and twisted the willow until the beaver's hair was caught in the end of the willow. They slowly drew the beaver to the surface.

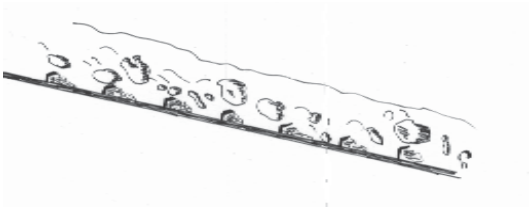
If you lose the beaver, it will float in a couple of days, as the gasses produced by decomposition will increase the size of the beaver, and therefore decrease the specific gravity to less than one. Of course, at that time, it would not be fit to eat.

A seal that sinks in fresh water will also float in a few days, but the meat around the chest and stomach will not be good to eat.

Other applications

1) Gold mines usually separate gold from the other rocks by a two step process. First they screen and size the material. Then they use the very high specific gravity of gold to separate it from the other rocks. Water and the ore are kept in motion down the sluice box. Gold and black sand will always settle to the bottom before the other materials because of their very high specific gravity.

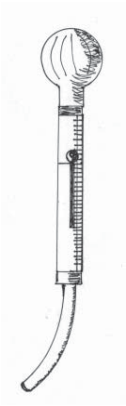
"Country rock" that accompanies gold



has a specific gravity of 2.5 to 3.5. It quickly goes to the top while gold and other heavy metals go to the bottom of the sluice box, jig or recovery system. The country rock is washed away and the gold and black sand remain.

2) A battery tester for a 12 volt automotive battery tests the specific gravity of the acid in the battery. The acid in a charged battery has a greater specific gravity than the acid of a discharged battery. The float in

the tester will float higher in the acid of a charged battery than a discharged battery.



3) The tester for anti-freeze in a car or truck works the same as the battery tester. It doesn't test at what temperature the anti-freeze becomes solid. It only measures the specific gravity of the anti-freeze.

From a built in chart based on the manufacturer's experiments, the tester indicates the freezing point of the fluid.

Experiments, Projects and Questions

- Test 8-10 different small objects for their ability to float in fresh water. Put a mark on the waterline of the objects that float. Put as much salt or sugar into the water as will dissolve. Test each of the objects again. Do they float higher or lower? Do some that sank previously now float?
- Try floating the same objects in other

liquids. Do they float higher or lower? (Liquid laundry detergent, pancake syrup, shampoo, rubbing alcohol, cooking oil etc.)

- Does cooking oil float on water, or water on cooking oil?

- Weigh a liter of fresh water. In the same container, weigh an identical amount of ocean water. Can you determine the difference on your scale or balance, or is the difference too small to be detected?

- Put food coloring into very warm water. Can you pour the colored warm water into a container of cold water gently enough to see the hot water float on the cold water? Do this again with colored warm water into salt water. Is there a difference?
- If there a lake is free of ice, take the temperature of the water at the surface and again at the bottom. Is there a difference? How could you explain this in terms of specific gravity?
- In the winter, is it warmer at higher elevations than on the river or ocean? (If there is no wind) Why is this? Why do you think moose migrate from the rivers up to the mountains in October.
- On a very cold day, take the temperature on the river. Go quickly to a high point and record the temperature. What is the difference? How could you explain this regarding specific gravity of colder and warmer air?
- If your class or family goes on a trip to a location with a swimming pool, test each student or family member to see who can float the highest, and who sinks the deepest. What conclusions can you draw about flotation and body types?
- Do you think someone would float higher or sink deeper in the Great Salt Lake in Utah than they do in the ocean? Why?
- Ask the old timers in your area what animals float and what ones sink and if that changes with seasons. If you live where a river flows into the ocean, ask them about the animals in both fresh and salt water. How do people catch seals in fresh water? How do they keep from losing them?
- Test different animal's fur for flotation. Which ones float and which ones sink?

To compute the specific gravity of an irregular object that sinks, first weigh it (in grams.) Then put water into a graduated cylinder up to an even measurement (in ml). Submerse the object. How much did the

water level rise in the cylinder? That represents the volume of the object. Divide the volume ml by the weight grams. That is the specific gravity of the object.

Feel different heavier-than-water objects, estimate their specific gravity, then measure by the above method. How close did you come?

Now devise a method for measuring the specific gravity of objects that float.

[1] However, by modeling safe behavior, students will learn to respect and properly handle these common but dangerous materials.

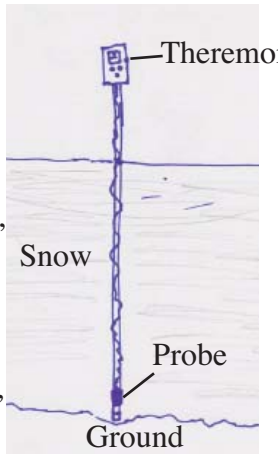
Insulative Qualities of Snow

Everyone knows that snow has insulative qualities, but few know the extent to which it does insulate.
A very interesting test can be done with an indoor/outdoor thermometer.
Tape the "outdoor" sensor onto the tip of a 36" yard stick (1"). Tape the indoor portion on the top of the stick. (36")

When the outdoor temperature has changed 20 degrees up or down, push the stick into 3' of snow. After 10 minutes, read the difference between the indoor and outdoor temperatures. Do this in several sample locations and record the results.
If the snow isn't 36" deep, do the test at 12" or 24" depths consistently in all locations. Obviously the depth of the snow will influence the insulative qualities.

There are several variables that cannot be controlled. The rate of change of the outdoor temperature and the texture of the snow will effect the difference in the readings. If it took two days to change twenty degrees, the difference in temperature above and below the snow will be less than if it took two hours to change twenty degrees. Soft fluffy snow will insulate better than hard packed drifted snow. However, when this experiment is done carefully, and good records are kept, it provides very interesting results.

Another way to do this test is to leave the "outdoor" portion of the thermometer close to the ground, and let the snow accumulate during the winter. Record the temperature and snow depth every day. (However, it is not known to what extent the conducting wire on the "outdoor" portion will conduct heat and interfere with the result.)



Many small animals, including mice, tunnel under the snow and use the insulative qualities to keep their homes and highways warm.

Solution vs. Suspension

Many Alaskan rivers contain large amounts of river and glacial silt. Of the Chena River it is said, "It's too thick to drink and too thin to plow." Many of our islands and riverbanks are made of silt that has been moved and redeposited for thousands and thousands of years.

When a substance is dissolved in a liquid, like sugar in coffee, the substance remains in the liquid. It is a solution. When a substance floats around in a liquid, held there by current or turbulence, it is a suspension. It will eventually settle and clear if the water is still.

The Yukon is a mighty river, yet ocean boats cannot enter the mouth. Why? Too much silt has been deposited in the mouth. We often talk about the Y-K Delta. A delta is the land formed by the deposit of silt in a river mouth. The river current slows as it bucks the tides, and the silt falls out of suspension. The Kuskokwim River also has a large delta, but nothing like the Yukon.

Experiment: Dissolving

Heat water in a clear pyrex container. Pour in measured amounts of sugar while stirring until it can hold no more sugar. It is now saturated with sugar. Pour the liquid off the top into another container.

As long as the water is kept at that temperature, all the sugar remains in solution.

Now cool the sugar water. What happens? What conclusions can you draw about the ability of water to hold dissolved sugar? Heat it again. Does the sugar again dissolve?

Can you taste the difference in the amount of sugar dissolved in the hot and cold water?

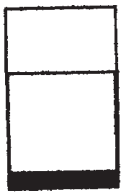
Pass the water containing dissolved sugar through a coffee filter. Is the sugar filtered out? By taste, compare filtered sugar water with unfiltered sugar water.

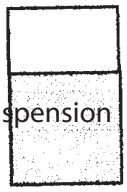
Try some of the above activities with salt. Is sugar the only substance that will dissolve in water?

Experiment: Suspension

Collect river water from a silty river. Let the water sit overnight. What happens to the silt? Stir it up again. Let it settle. What conclusions do you draw?

Heat the water in a clear container and keep heated with an alcohol lamp or other heat source. Let the silt settle. Does the temperature of the water influence the amount of silt that can be held in suspension? Or is the amount of silt influenced only by the motion of the liquid?


Sediment



it

Pass silty water through a coffee filter. Let the filtered water settle for a while. How much of the silt passes through the filter? Can you see the silt in the filter?

Boil silty water. Does the silt settle faster in boiled water than in cold water that hasn't been boiled?

If you are able, obtain silt samples from the upper, middle and lower parts of a large river. What is the difference in amounts of silt and size of particles? How can you explain this?

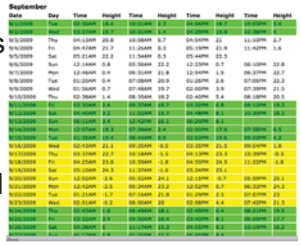
Your Conclusions:

From the above experiments, what can you say is the difference between a solution (being dissolved in a liquid,) and a suspension?

How are river deltas formed?

Tides and the Rule of 12

As the sun and moon pull at the surface of the earth, the ocean's level rises and falls with the force of their gravitational pull.



In some locations, the tides are great. In other locations they are rather small. The changing of the combined forces of the sun and moon insure that no two tides are the same.

A careful study of tides shows that they don't rise and fall at the same speed. They follow a curve, starting gradually then changing rapidly, then slowing down before the next tide starts.

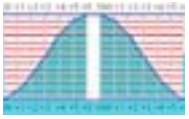
Careful measurement shows that they follow "the rule of twelve."
Divide the time from high tide to low tide into six time periods. They won't be quite an hour each.

One way of figuring the rule of twelve:
In the first period, the tide will rise a given amount. Measure that amount.
Call that **x.**
In the second period the tide will rise **2x**.
In the third period, the tide will rise **3x**.
In the fourth period, the tide will also rise **3x**.
In the fifth period the rate of change slows to **2x**.
In the sixth period, the rate of change slows to **1x**.

Depending on the difference between high and low tide, **x** will vary each tide change. Divide the difference between high and low tide by 12 to find **x** for a given tide period.

Another way to figure the rule of twelve:
Find the difference between high and low tide from a chart.
Again, divide the time between high and low tide into six portions, that will be almost an hour each.
In the first period the tide will rise 1/12th of the total.
In the second period the tide will rise 2/12ths of the total
In the third period the tide will rise 3/12ths of the total.
In the fourth period, the tide will rise 3/12ths of the total.
In the fifth period the tide will rise 2/12ths of the total.
In the sixth period the tide will rise 1/12th of the total.

In the first way of figuring the rule of 12, you start with the amount of rise in the first hour by measuring the tide yourself. From there you can compute the rise in each time period and the total rise from high to low tide.
In the second way of figuring the rule of 12 you start with the difference between high and low tide from a chart and compute the rise in each time period.



Tests with students have shown that the rule of 12 doesn't work precisely in locations where there are coves and bays. It takes the water time to fill up or drain the coves and inlets, but the rule of twelve is a good approximation.

On a tide chart from the internet, what is **x** this morning between high and low tide? In:
Juneau
Haines
Kodiak
Ketchikan
Sitka

If you live in a different community, find **x** for your community during that tide period.

On your birthday this year, what is **x** between the high and low tide in the afternoon? In:

Juneau
Haines
Kodiak
Ketchikan
Sitka

What community or location has the greatest difference between high and low tides in Alaska?
What would **x** be for that community from the greatest tide change? Graph that.

Cargo ships and fishermen all need to know the tides. Hikers and subsistence people do too. The more we know about tides and their ebb and flow in our area, the more intelligently we can make decisions about our lives and activities. Unsuspecting beachcombers have been trapped on rocks away far from shore because they didn't pay attention to the rule of 12.

Measure and graph the tides in your area for a week. Does the rule of 12 work in your location, or does local topography cause tides to deviate from the rule?

Coves and inlets in SE Alaska. Tides rise and fall differently than on the open ocean.