

**Dealing with...**

# ACCElERATING Change

The COSEE Manual for  
Science Camps, Fairs and  
Projects



**Measuring...**

**Estimating...**



**Warming?**

**Coping with...**



**Climate  
change**

**Extrapolating...**

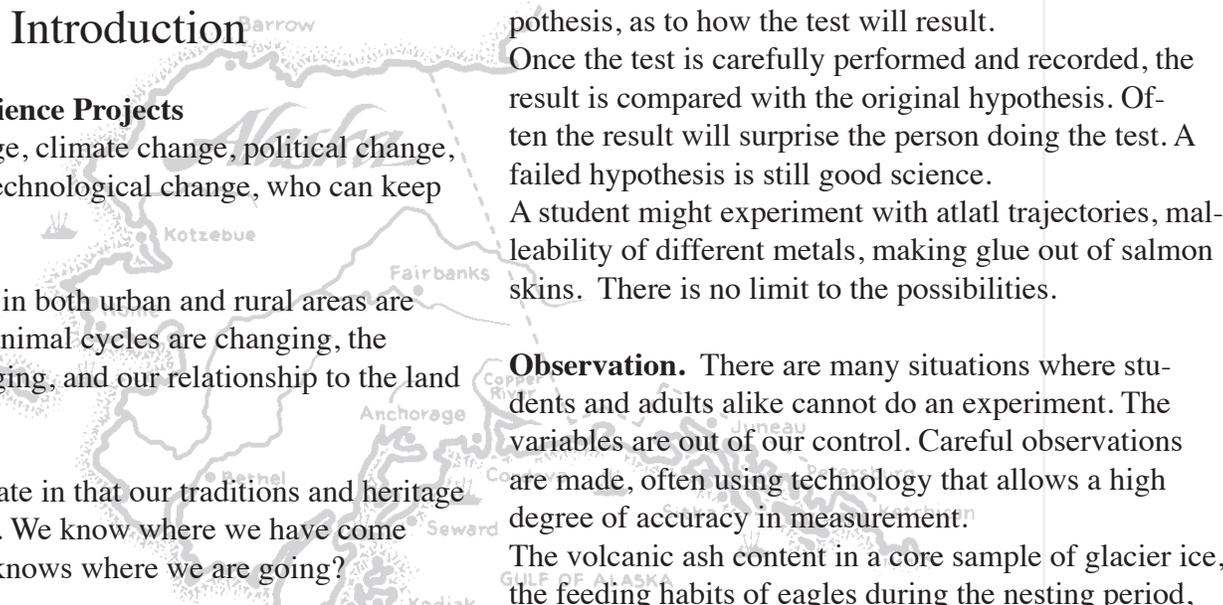
**Planning  
for...**



**Resulting  
Social change**

**Cooling?**

# Introduction



## Change and Science Projects

Economic change, climate change, political change, social change, technological change, who can keep track of it all?

Alaskan Elders, in both urban and rural areas are saying that the animal cycles are changing, the weather is changing, and our relationship to the land is changing.

Alaska is fortunate in that our traditions and heritage are near at hand. We know where we have come from, but, who knows where we are going?

While change is unsettling, it presents a wonderful opportunity for young Alaskans to work with Elders and scientists in observing, documenting, experimenting and projecting what the future will bring. Alaska has over 33,000 miles of coastline and rivers. We have opportunities to observe wildlife like no other state in the Union. We have the ultimate opportunity.

The possibilities are endless for science projects that involve young people with the questions and answers that modern change brings every day. Rural students have one advantage. When they step out of their front door, they are in Nature's laboratory. While urban students have farther to go to reach the wilderness, they have the advantage of easy access to numbers of professional advisors.

Science projects can take several forms:

**Collections.** The simplest project for younger grades are collections. Students can collect leaves, shells, teeth, animal track impressions, fish bones, or anything else that excites their interest. Students measure and record sizes, colors, things that are different and things that are similar. Collections are usually organized by a theme. They record the date and location of the item included in the collection.

**Experiments.** An experiment is simply doing a fair test.

A young person has an interest. A problem within that interest is narrowed down to a simple question. A test is devised along with a good guess, an hy-

pothesis, as to how the test will result.

Once the test is carefully performed and recorded, the result is compared with the original hypothesis. Often the result will surprise the person doing the test. A failed hypothesis is still good science.

A student might experiment with atlatl trajectories, malleability of different metals, making glue out of salmon skins. There is no limit to the possibilities.

**Observation.** There are many situations where students and adults alike cannot do an experiment. The variables are out of our control. Careful observations are made, often using technology that allows a high degree of accuracy in measurement.

The volcanic ash content in a core sample of glacier ice, the feeding habits of eagles during the nesting period, the salinity of ocean water close to a fresh water river, all can be objects of careful observation.

While the results of a single observation does not provide a valid conclusion, many consistent observations over a long period of time can often bring insight that will help make political and economic changes. For thousands of years, Alaskans have been observing, comparing, and coming to precise conclusions. What conditions contribute to disastrous river flooding at breakup? What conditions contribute to a good year for blueberries? What provokes a red tide? We don't control the variables. We can only observe and think about possibilities, coming to a conclusion after years of careful observation. Some issues merely provoke curiosity. Others are vital for survival.

COSEE Alaska supports science projects that explore the ocean, climate change, and river drainages. This includes most possible science projects in Alaska, as most of us live on the ocean or river drainages, and are watching rapid climate change as it impacts our dependence on the natural resources of the State.

Change can be threatening. Change can be exciting. Those who prosper during times of change are those who have their eyes and minds open, those who apply the wisdom and knowledge of the past to anticipate what will come in the future.

Science projects are a wonderful way to explore positive solutions.



## Camps as an Environment for Science and Culture

As educators seek more effective ways to teach students, camps have emerged as successful means of sharing information and experiences that are not possible in the regular classroom setting. Camps provide young people with the opportunity to interact with Elders and instructors in an environment that naturally promotes learning. Science and tradition blend naturally in a camp away from town.

Educators often talk about using the local environment and doing more hands-on activities. Until students and teachers break out of the classroom for extended periods of time, this will be an unfulfilled vision. At camp, there is endless opportunity for hands-on, culturally relevant activities.

In the late 1990's the Alaska Rural Systemic Initiative gathered a great number of people from around the State who were involved in organizing and running science and culture camps.

The meeting participants were like-minded people who have, through trial and error, planning and revising, conducted camps in almost every possible Alaskan setting. The purpose of the meeting was to allow participants to learn from each other and take careful notes from the experts so others could duplicate the successful practices and avoid the difficulties.

Among those describing their efforts were representatives from the following:

- Academy of Elders Camp
- Camp Water Juneau
- Alakanuk School
- ANSWER Camp
- AISES Camp Fairbanks (Gaalee'ya Spirit Camp)
- AISES Camp Afognak

## TYPES OF CAMPS

There are three possible types of camps:

- \* Camps where traditional knowledge is the primary focus.
- \* Camps where western science is the primary focus.
- \* Camps where the intent is to blend both western science and Alaskan tradition.

### Different orientations:

#### Staff

When the camp staff plans the experience, learning objectives and correct behaviors can be identified and met. A camp with a common theme like "language," "tools," "art" or "travel" is more cohesive than one with fragmented parts. Camps with this approach tend to be well organized but the burden of direction is on instructors.

#### Students

When students bring a science project to develop, instructors become facilitators. This requires a higher level of maturity on the part of the students and greater versatility on the part of the instructors. Often there are supply issues, and trips to town are necessary to get instruments or hardware. However, when students come with enthusiasm for a personal project, motivation is high and results often impressive.

#### Elders

If there are enough Elders present, a dynamic unfolds as the generations interact with each other. Elders have information for which we haven't yet learned the questions. It is important to anticipate tools and materials they might need. An Elder-coordinator paces the Elders over the schedule, creating a setting where they can be most effective. Elders *do not* manage time the same way camp directors do.



#### Synthesis

The above three orientations can exist in any combination. A camp that is staff driven might be more like school than a summer camp. A camp that consists of only student projects has many loose ends. A camp that is totally Elder driven might necessitate putting away calendars as well as watches. A healthy synthesis is best.

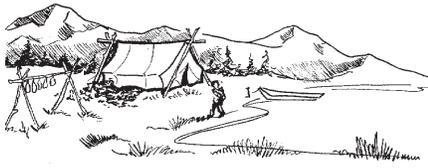
## ESTABLISHING GOALS

Starting with clearly defined goals helps maintain the camp focus and final evaluation of the camp. Without clear goals, consistency in following years is impossible.

What are the goals?

- To inform/interest students in science?
- To culturally enrich students?
- To bring students and Elders together?
- To strengthen or rekindle the Native language?

Clearly define your goals and stick with them.



## EVALUATION

A simple evaluation sheet will greatly help future planning.

Record suggestions for improvement right after camp while they are fresh in people's minds. Evaluate the camp in light of the stated goals. Three weeks after camp, most of the suggestions for improvement will be swallowed up by individual lifestyles.

## SUGGESTIONS FOR PLANNING

### Overall

#### Dates/location

- Study the weather patterns. Schedule camp dates according to the findings. Have contingency plans for inclement weather.
- Set camp dates to coincide with subsistence activities. (When do the fish usually run?)
- How long will the camp be? Shorter, smaller camps are better in the early learning years.
- Where will the camp be held? What location(s)? Is this location best considering the camp goals?
- What insurance constraints will you have to endure? Discovering that insurance doesn't cover boats under 32' will severely hamper a canoe trip.

#### Student Applications

First ask yourself:

- What age group will be served? Is the camp for

a specific type of student? Is the camp for all students?

Teaching styles differ greatly for different types of students. Students with behavior problems need more rules and structure. Motivated students function better with instructors as facilitators.

- Welcome handicap students, but ask about handicaps and medical needs ahead of time. Don't embarrass handicapped students by putting them in uncomfortable situations.
- Ask if students have medication needs that staff must supervise.
- Ask students about their personal interests.
- How will students be screened? The application process should be specific enough to determine whether a student meets the criteria or not. Sending students home for behavioral problems is expensive. Screen trouble before it arrives unless you are prepared to handle all situations.
- Should pairs of students be accepted from each village to minimize homesickness and reduce travel costs? Note: Trouble can arrive in pairs.

#### Logistics

\* How will you prepare for medical emergencies? What transportation do you have available if something happens? Is there an EMT on staff?

\* What means of communication are onsite? Telephone, CB radio, etc.?

\* How long will the camp last? Will it be an overnight camp or day camp? Day camps are easier to plan, but do not seem to be as effective.

\* Will you cook your own meals or hire someone? Food is an important link to contentment.

\* If a bear event occurs, repercussions come from many sources. An experienced local person should be present whose judgment is respected by staff and community.

\* What will be the student/instructor ratio? How many counselors will be needed? When the student/instructor ratio is low, there is less need for rules and structure. At one camp, younger students were accompanied by mothers and grandparents. It worked wonderfully, giving a real sense of family.

\* How many students will be invited? It is much easier to start with select students in small numbers and increase over the years as experience grows. Usually you can count on ten to twenty percent of the students enrolled not coming because of last minute concerns.



\* How much structure will there be? One camp scheduled every minute from getting up to bedding down. Another camp brought people together, scheduled three meals, and let it all happen.

\* What region will the students come from? How much will travel cost? If one camp follows another, can money be saved by filling chartered planes in both directions?

\* What insurance policy will cover the camp? Does it restrict water sports and activities? Some camp activities have been ruined at the last minute when the insurance regulations are discovered.

\* What awards will be given at the end of camp, and on the basis of what criteria? Students need to know at the beginning what the standards are.

\* Will you take many pictures? Photos not only help students reflect on the good times, they also help document activities to funding sources.

## Students

\* If the goal of the camp is to develop science projects, students should have several ideas in mind before coming to camp.

\* Students need a checklist of clothing and supplies to bring.

\* Students should have a very clear understanding of what the camp is about and how it will be conducted.

Failed expectations are the greatest source of discontent. There are few complaints when students know ahead of time what the living conditions and personal expectations are.



## Staff

\* If different instructors follow personal interests but do not coordinate with each other, the students receive a fragmented experience. If one instructor is teaching about northern lights, another is enthusiastic about nematodes and the Elder is trying to get the students to make a canoe, cohesion is missing. There is a difference between variety and scattered.

\* It is better to have too much scheduled than not enough. Students often surprise themselves when they discover an interest in something they've never done before. Having a diversity of experiences available is always beneficial. It is easy to edit activities. It is difficult to improvise in a remote location.

It is better to start with more structure with the option of relaxing schedule and rules than imposing

structure on a situation that is out of control. When the student/instructor ratio is high, good counselors are more valuable than gold. Good female counselors are more plentiful than good male counselors. All counselors should be treated with respect, not like 24-hour-a-day baby-sitters. They are part of the team, and should be represented at all staff meetings.

\* Planning meetings that are held at the camp location provide an important connection.

## Tools/Materials/Equipment

\* Each instructor should create a materials list for each planned activity. Every camp should have standard tools and materials. The list should develop each year. Certainly it includes tents, rope, axes, tarps, hammers, saws, and science equipment like thermometers, balances, magnifying glasses, tape measures etc.

\* Several instructors have stated that a laptop computer with CD-ROM encyclopedia would greatly benefit the students who are doing research. However, the presence of a laptop computer can spoil the "flavor" of a traditional camp. At a remote camp, a computer requires a small generator and perhaps 12v batteries and inverter.



## Rules

Using the local Native values as the basis for camp rules serves quite well. There is a greater sense of cooperation when camp authorities support the values that are the basis for the local lifestyle. Send them to students before camp, include them in the student agreement, and post them at the camp.

Before camp, students should sign a commitment to abstain from verbal, physical, substance, or sexual abuse, including improper touching. Curtail verbal abuse as soon as it surfaces.

## QUESTIONS TO ASK BEFORE A CAMP

What are the rules? What behaviors are acceptable and which ones are not? What will the consequences be for negative behaviors? Who makes the rules? Are students involved?

How much technology will be involved or allowed? Computers? iPods? Cell phones?

What activities will be available? If it is a science camp, will there be Native dancing, beading and storytelling? Will accommodations be made for church services?



Will there be a Native language component in the camp? Immersion? Incidental?

How will you reconcile the difference between contemporary views of girls participating equally in all events with boys, and the traditional views of separation of certain tasks by gender?

Involve the Elders in this discussion.

Will junk food be allowed? If so, to what extent? Camps that forbid junk food have far fewer discipline and bedtime problems.

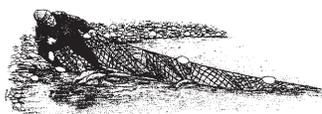
Will any kind of music be allowed? A blaring local radio station detracts from the camp experience, particularly if it is a remote camp. Do you want rap music around the campfire of a culture camp? It *has* happened. Sometimes the offenders are adults, like the cooks. This is hard to deal with after the fact. Establish the rules *ahead* of time.



## Alaska Native Values

### Kodiak Alutiiq

We are the descendants of the Sugpiak, the Real People. Understanding our environment and events that have shaped our lives and created the culture of our ancestors is vital for our children's cultural survival. The history of our people and our place in the world is a part of who we are today. Kodiak Alutiiq must learn and pass on to younger generations our understanding of our natural world: the sky, land, water, and the animals. As we meet the challenge of living in the 21st century, we must continue to live in honor of those things we value:



- \* Our Elders
- \* Our heritage language
- \* Family and the kinship of our ancestors and living relatives
- \* Ties to our homeland

- \* A subsistence lifestyle, respectful of, and sustained by the natural world
- \* Traditional arts, skills, and ingenuity
- \* Faith and a spiritual life, from ancestral beliefs to the diverse faiths of today
- \* Sharing: we welcome everyone
- \* Sense of humor
- \* Learning by doing, observing, and listening
- \* Stewardship of the animals, land, sky, and waters
- \* Trust
- \* Our people: we are responsible for each other and ourselves.
- \* Respect for self, others, and our environment is inherent in all of these values.

### Yup'ik

Every Yup'ik is responsible to all other Yup'iks for survival of our cultural spirit and the values and traditions through which it survives. Through our extended family, we retain, teach, and live our Yup'ik way. With guidance and support from Elders we must teach our children Yup'ik values:



- \* Love for children
- \* Respect for others
- \* Sharing
- \* Humility
- \* Hard work
- \* Spirituality
- \* Cooperation
- \* Family roles
- \* Knowledge of family tree
- \* Knowledge of language
- \* Hunter success
- \* Domestic skills
- \* Avoid conflict
- \* Humor
- \* Respect For nature
- \* Respect For land

By the design of our Creator we were created Yup'ik in space and time; proud, for generations to come, of the values given to us by our Creator.

### Athabascan

- \* Self-sufficiency and hard work
- \* Care and provision for the family
- \* Family relations and unity
- \* Love for children
- \* Village cooperation and responsibility to village
- \* Humor
- \* Honesty and fairness
- \* Sharing and caring
- \* Respect for Elders and others
- \* Respect for knowledge & wisdom from life experiences
- \* Respect for the land and nature
- \* Practice of Native traditions
- \* Honoring ancestors
- \* Spirituality

- \* Love for Children
- \* Hard Work
- \* Knowledge of Family Tree
- \* Avoidance of Conflict
- \* Respect for Nature
- \* Spirituality
- \* Humor
- \* Family Roles
- \* Hunter Success
- \* Domestic Skills
- \* Humility
- \* Responsibility to Tribe

Our understanding of our universe and our place in it is a belief in God and respect for all his creations.

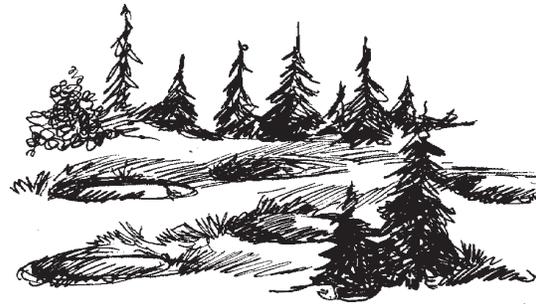
**Tlingit** (from Walter Sobeloff sharing his thoughts on Native values)

- \* Respect for self, and others, including Elders.
- \* Remember our Native traditions, our families, sharing, loyalty, pride, and loving children
- \* Responsibility
- \* Truth and wise use of words
- \* Care of subsistence areas, care of property
- \* Reverence: “We have one great word in our culture: haa shageinyaa. This was a Great Spirit above us, and today we have translated that reverence to God.”
- \* Sense of humility
- \* Care of human body
- \* Dignity; the Tlingit word for dignity is yan gaa duuneek.
- \* Peace; peace with the family, peace with the neighbors, peace with the others, and peace with the world of Nature

### **Iñupiat Ilitquasiat**

Every Iñupiaq is responsible to all other Iñupiat for the survival of our cultural spirit, and the values and traditions through which it survives. Through our extended family, we retain, teach, and live our Iñupiat way. With guidance and support from Elders, we must teach our children Iñupiaq values:

- \* Knowledge of Language
- \* Sharing
- \* Respect for Others
- \* Cooperation
- \* Respect for Elders



### **COMMUNICATION**

- \* Online registration makes enrollment painless. But parental permission slips must be hand carried by students.
- \* Staff meetings before, during, and after camp are vital. The director should meet with the Elders, other instructors, and counselors separately and jointly.
- \* Good communication is the lifeblood of camp. Before camp begins, communication with the staff, students, parents, and schools must be very clear so that responsibilities are understood. “Who, where, what, when, and how” are the key words. Reminders by e-mail or phone call are appropriate. Once school is over for the year, a major communication link is severed.
- \* Students are disappointed if their expectations of camp and their experiences are very different. Communicate clearly before the camp begins. Describe what will happen, how, and why.
- \* On travel days thorough communication is an absolute must. Marine radios, cell phones, or whatever it takes to have good clear communication will reduce stress tremendously. Responsible helpers are desperately needed on arrival day. Getting home is always easier.
- \* Talking circles and student “family groups” are very

helpful in breaking down walls between people. Journals give insights to staff that help respond to student needs.

\* Phones available in camp lessen the possibility of homesickness and gives recourse if there is an emergency. An unattended phone presents the possibility of phone abuse.

## **CAMP ORGANIZATION**

One person must oversee the whole camp. It is folly to expect that person to also be an instructor. It just doesn't work.

Camp staff is made of the director, Elders, instructors, counselors, cooks, and transportation people. Coordination among the staff is vital to the flow of the camp. Do not assume everyone will understand his/her role or pitch in to help when there is a need. Simple job descriptions make life much easier. One person in charge of transportation is usually a great help as well.

## **SUCCESS FACTORS**

While each camp has its own objectives and priorities; there are certain factors that contribute to positive results.

\* With the presence of Elders, camps have stability, depth, content, and focus. Elders are a precious resource that cannot be programmed. They don't always enjoy good health. Often the schedule calls for five Elders and only one or two are able to attend.

\* If the camp is community based, with opportunity for everyone to interact, there is great support. Some camps with road access have enjoyed the flow of community members in and out as personal schedules allowed.

\* Camps that are based in traditional activities have strong support from the communities. Camps scheduled simultaneous with subsistence activities are very successful.

\* Day camps draw from a broad base of talent in the community. Many instructors are able come for a few hours. Overnight camps have greater continuity. Both have advantages. A remote camp develops a pleasant rhythm after two or three days. If one of the leaders continually goes back and forth between camp and town, the rhythm is broken. He/she brings the pace of town to camp. It takes hours to recover.

\* Early planning allows schools, teachers, and students enough time to respond to all camp requirements before school is over in the spring. January and February are not too early to get information to teachers and school districts.

\* Weather has a tremendous effect on outdoor camps. Study local weather patterns, and plan accordingly.

\* Camp location is very important. There are some activities that are natural in the woods, and others that are natural in a laboratory. The camp location should be consistent with camp goals. If it is a wilderness camp, it should be located in the wilderness. Elders are spontaneous. They need to be in their environment. Making a boat trip to get poles or basic materials hinders traditional activities. The basics need to be handy.

\* If the students can roam away from the camp location, there is a greater need for chaperones.

\* Some form of "show & tell" at the end of camp enhances the experience for everyone.

\* Students like to take home a collection, a craft or something tangible. Memories and pictures are important, but a physical reminder of the events is significant: a basket, ulu, drum, headband etc.

\* One camp required students to earn one award after returning to the village. Under the supervision of a mentor, the camper had to present to a community group what he/she learned at the camp. This made an excellent connection between the camp, the student, and the village.

\* If one of the purposes of the camp is to develop science projects, boards should be available to organize and display student efforts and thought. Have a mini-science fair at the end of camp. A laptop, digital camera, and printer come in very handy if this is your goal. Hard evidence in the form of photos goes a long way in helping with the project.

\* There is always a giant gap between camp and the classroom. Poster boards, photos, and videos help close that gap. If one person has the responsibility of informing classroom teachers about each project, there is much greater continuity.

## **FAILURE FACTORS**

\* Poor or late planning often leads to rounding up the camp quota a couple of days before the camp. This brings a group of participants who haven't filed applications, met requirements and don't know what to expect. They arrive with boom boxes and junk food saying they weren't informed. Once school is out, screening students and applications is most difficult.

\* When students expect one type of experience and

encounter another at camp, they quickly resort to grumbling. They need to know ahead of time how much time will be spent on camp chores and compulsory activities each day.

\* Bears are a constant concern in some camp locations. Expertise and strict supervision of students are necessary to prevent incidents.

\* Often, camps attract “campfire Romeos,” a young man 18-21 who initially helps in transportation, firewood or other tasks... a good volunteer. Once he settles in, he gathers a bevy of young admirers around the campfire, and serves as a *constant* distraction until asked to leave. Sometimes the Romeo is a male counselor in a coed camp. Often he is the son of the cook or grandson of a participating Elder. Prevention is far more expedient than a cure.

\* The worst-case scenario would be to have an injured student and no way to access medical services. This hasn't happened yet, but the possibility always exists in remote camps. Safety dominates all other concerns. An EMT on staff in very remote locations seems to be most sensible.

- Often, the greatest problem comes from a student whose parent is working at the camp, either as counselor or cook. This student feels like he/she has diplomatic immunity and special privilege. This is hard to deal with once it is in motion. The parent is often as immature as the child. Prevention of this problem comes by clear warning ahead of time that all young people obey all rules and there are no favorites.

## **Future**

The learning curve would be flattened considerably if leaders of one camp attended camps in other locations to get ideas and a better perspective. This seldom happens because of the intensity of personal schedules, but would be most helpful.

Encouraging teacher participation during the summer is difficult, as many teachers need the few summer months to regenerate their energies. Offering college credit for recertification is an incentive. Teacher contact with Elders and their methods of instruction is always positive.

Many people have talked about winter camps, but there is no empirical data upon which to comment at this time.

## **CONCLUSIONS**

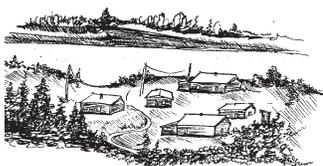
Alaska is a huge state with a diversity of people, resources, and needs. However, there is a common theme that permeates Alaska camps. We want a healthy educational experience for our young people. This includes the integration of traditional activities with modern education. It includes professional teachers and Elders working together in camps for the benefit of the students. It includes a commitment that goes beyond funding and job descriptions. It touches the essence of why we live in this great land.

# COSEE Science Fair Guidebook

## Fair Guidebook Introduction.

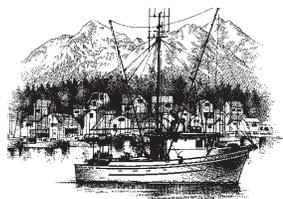
For decades, science fairs based on contemporary Western science have served well to establish the precedent in Alaska. However, starting in 1996 the Alaska Rural Systemic Initiative sponsored local and regional fairs that insisted that students do projects stemming from local communities' present or past traditions and activities. When students did projects rooted in their home towns, the quality of the projects soared. In 1999, AKRSI sponsored the first of many ongoing State Science Fairs with the same emphasis.

Local Elders were considered experts along with Western scientists. Families were immediately drawn into the school effort. Students were encouraged to find projects from their community and from their parents' way of making a living. Enthusiasm was released like an artesian well. Students found meaning in science and real life applications of what they were learning in school.



COSEE will follow that successful model- However, COSEE's focus is upon oceans, watersheds, and climate change, which, in reality, is most of what relevant Alaskan education is about.

COSEE will also work closely with the Alaska State Science fair, sponsored by the Anchorage School District, traditionally held during March or April of each year. School budgets have been tightening for many years. The challenges must be met with creativity, keep-



ing State, regional and local fairs going while adapting to new opportunities and pressures.

## Culturally relevant projects.

Any project based on activities in the student's community, whether past or present, is locally/culturally relevant. This is opposed to a project on lunar landings or alligators. Mosquitoes, yes. South Pacific dolphins, no.

## State Standards.

Cultural Standards adopted by the State of Alaska Department of Education are met when students are actively involved in developing a locally/culturally relevant science project.

Numerous State science standards are met when doing science projects.

## COSEE's Role

COSEE will do the following:

### Local

- Provide information on how to conduct a local or regional fair. This booklet is part of that effort. The COSEE Science Fair Website is another.



See: [www.ankn.uaf.edu/COSEE](http://www.ankn.uaf.edu/COSEE)

- Provide suggestions and guidelines for finding and developing locally/culturally relevant science projects.
- Provide video and other successful helps that were developed in the past during the time of AKRSI science fairs. See the ARSI website for streaming video, or where to order DVD's. [www.ankn.uaf.edu](http://www.ankn.uaf.edu)
- Further help for COSEE affiliated school districts. If schools or districts want further help beyond what the book and website provide, COSEE staff will provide email and Skype assistance. If help beyond that is needed, COSEE staff will visit schools and spend time needed to get science fairs and projects going. Email: [alanlime06@yahoo.com](mailto:alanlime06@yahoo.com)

### Statewide

- COSEE provides guidance and direction, based on years of experience, for local and regional fairs.

- COSEE sponsor a portion of the Alaska State Science Fair, with awards and rewards for projects outstanding in the area of oceans, climate change and river drainages.
- COSEE is *not* able to provide funding for transportation, lodging or meals.

### Timing of Fairs

Traditionally in Alaska, local science fairs have been scheduled to so winners can compete in the Alaska State Science Fair in Anchorage during late March or early April. We strongly encourage attendance in the State Fair. There's nothing that boosts a student's self image like "going to State." At the same time, local needs and student enthusiasm are extremely important. If students come back from a summer camp with many projects, it would be most appropriate to have a fair in October while the ideas are still fresh. The students will have lots of time to improve the project before the State Fair.

### Who Is Involved?

#### The Student

Any student enrolled in an Alaskan school or distance education program is eligible to participate in the COSEE fair. Special encouragement is provided for COSEE affiliated school districts, but no Alaskan school is excluded.

Every effort should be made to accommodate handicapped individuals in local and State fairs.

#### Adults

This group includes:

- **Two local elders.** (Grandma and grandpa are perfectly acceptable elders.) The elders guide the student to pursue the project in a way that is acceptable in the local community. This may vary from region to region, but gives local control over standards rather than an umbrella of regulations from distant authority.
- **A certified teacher** who says the project is safe for the student and academically worthy. The teacher should be familiar with potentially dangerous projects. This may include: thin ice, hypothermia, firemaking materials, boating and firearm safety as well as handling of chemicals, experimental techniques, research involving human or nonhuman animals. The

issues must be discussed with the student previous to and during planning.

### Rules, Regulations & Requirements

Projects that will be physically present at the Alaska State Fair must follow all guidelines established by the governing authorities.

Projects that will compete in the COSEE Fairs should follow COSEE rules, regulations and requirements.

### Reasons for Rules

Students need to compete fairly in a safe environment.

No compromise for safety should ever be made.

This isn't to "cover" teachers in case a student gets hurt! This is to teach students safe practices. Many young people have the attitude "It won't happen to me." Students need to realize that disbelief in consequences does not prevent their occurrence. At the same time, the fair should not be a line-up of sterile posters and notebooks. If local elders, local experts and teachers think a project is safe, it probably is.

On the National level, the situation is different. If students from Florida brought oranges for display, insects might be carried home to California and harm crops there. The National Fair doesn't allow water in a display for that reason.

The advantage of video recording an event is that any and all materials can be displayed quite easily with no hazards to other communities.

### Rule #1.

Rule #1 has to be: Have fun! If the project doesn't inspire curiosity and scientific inquiry and have an energy of its own... don't do it!

A few less important rules follow:

### Project topics

Projects should be related to oceans, freshwater drainages, and climate change. That's what COSEE is all about. Very few projects in Alaska don't apply to oceans, drainages and climate change. The topics should be relevant to the students' lives.

### **Approval by...**

Projects for local and regional fairs must meet the signed approval of a State certified teacher that the project is physically safe and academically meaningful for the student(s). The project must also be approved by at least two local elders who determine that the project is culturally relevant, respectful of local traditions, and meaningful to the local community.

1. Projects presented for the State Cyber Fair must also meet the above criteria.
2. Projects presented in person at the State Fair must meet the COSEE requirements as well as comply with State Fair rules and guidelines.

Example: A project involving seal hunting techniques is acceptable for electronic presentation if it is deemed safe and academically meaningful by both a State certified teacher and approved by two local elders. To qualify for presentation in person at the State Fair, it must meet the State regulations for vertebrate projects (which are quite stringent.)

### **Number of students involved**

Projects can be submitted by individual students, teams of 2-3 students, or a whole class. Obviously, scoring criteria will be different for each of these categories. It hasn't yet been determined how to weight the scoring when a single student competes with a whole class, but the playing field will be leveled.

### **Judges**

All projects will be judged by two sets of judges, professional western scientists and Elders from across the state. Both sets of judges will use a different scoring rubric, and fair winners must satisfy both sets of judges. Scoring rubrics.

### **Parent and adult involvement**

Many projects win or lose based on the amount of adult involvement. Those hosting a science fair very much want parents involved in the project! They do not want fourth graders competing with overinvolved parents.

The simple rule is:  
"Words... no hands."  
That's fair!

If an adult holds the video camera, or helps the student by holding a pole while the student does the work, that's certainly OK. If a local Elder first demonstrates how to skin a fur bearing animal, and the student then does it by him/herself, that's OK.

The parent can coach, cheer, encourage and console, but the adult should *not* do the actual work or the writing.

### **National and International Fairs**

Alaska has an incredible wealth of opportunity for unique science projects. We have opportunities to do original work like no other place in the US. It would be a shame to sacrifice the intent of a good Alaskan project in order to meet requirements designed thousands of miles from here for projects that have no relevance to our lifestyle. At the same time, it is a great honor to go to Nationals. Should the project comply with National rules on the slim chance that it will go to the National Fair?

That question has difficult and personal implications.

### **Display and Safety Regulations**

Most fairs ban the following for obvious safety reasons:

- Highly flammable or hazardous chemicals or materials.
- Poisons, drugs, controlled substances, HASMAT. Project materials should meet FAA requirements for transport. Don't assume! Inquire.
- Tanks that contain combustible liquids or gases.

Display items that should require permission previous to display at a local or regional fair:

- Sharp items like knives, ulu's, porcupine quills, needles etc.
- Strong smelling items
- Dry ice
- Pressurized tanks that contain non-combustibles.
- Any apparatus producing temperatures that will cause physical burns or freezing.
- High-voltage wiring, switches, and metal parts without adequate insulation.
- Unsafe electrical connections. 110-volt AC circuits should be soldered or made with approved connectors. Connecting wires must use wire nuts and electrical tape. Cords must be UL approved.
- Bare wire and exposed knife switches may be

used only in circuits of 12 volts or less; otherwise, standard enclosed switches are required.

- Any liquid that is acid or base, i.e. above or below pH 6.5-7.5
- Lasers.
- Large vacuum tubes or dangerous ray-generating devices.
- Projects that involve live animals or people.

Any display involving the above issues should get an OK from COSEE State or local fair organizers.

Usually acceptable for Display...Cannot be operated on site:

- Projects with unshielded moving belts, pulleys, chains, and parts with tension or pinch points
- Class III and IV lasers
- Any device requiring over 120 volts

Teachers and local elders should set necessary further stipulations for display for the above projects in a local or regional fair.

### **Size of Project Space**

A project in a local fair may take up to half a table. Projects requiring more space than this should get permission previous to the fair.

### **Overall Requirements**

If the student is using human subjects under 18, the student researchers must obtain written informed consent from all subjects and their parent or guardian. The consent form should clearly state all activities. Offended parents do not enhance the quality of a project. Remember... respect.

### **Repeat project**

A student may improve on a project from a previous year, but the report from that year should accompany the second year's project so judges can see how much new work the student has done.

### **Team Projects**

There is no limit to how many students can work on a team project, but there usually can be no more than 2-3 presenters.

Each member of the team should be able to serve as spokesperson, be fully involved, and be familiar with all aspects of the project.

The main concern with team projects is that some

team members tend to be less involved. The judges will assess if all presenters were actively participating in all aspects of the project.

### **Class projects**

Science projects are extremely time consuming for teachers. A single class project makes a science fair entry possible. In local and regional fairs scoring can be weighted so a single student competing with a class will not be at a disadvantage. The quality of a class project should reflect the number of students involved.

### **Categories**

COSEE has identified three categories of projects. Remember the emphasis is on oceans, watersheds and climate change:

- Collections
- Experiments
- Scientific Observations

Consideration will also be made for differences in grade levels.

### **A Top Notch Science Project Should Include**

#### **Local Elder Guidance**

The distinguishing feature of a project in a COSEE fair is that the student has spent considerable time consulting with elders in the community. This accomplishes many objectives. It identifies the elders as valuable resources. It validates local knowledge. It links the student with his/her past. It teaches the application of local knowledge to modern science concepts. It creates bonds between the students and the elders so other information can flow between the generations. It allows the teaching of local values along with local activities. It brings the school, community and students together in a healthy fashion.

#### **A Good Display:**

Poster

A good visual display attracts and informs.

Interested spectators and judges easily assess the project and results obtained. The display should use clear and concise expressions. Headings should stand out, graphs, and diagrams should be clearly and correctly labeled.

A display board stands alone with three panels.

It may be two-stories tall, but make sure it doesn't topple over onto other projects.

The poster usually includes:

- Identification: Name, grade, school and type of project.
- Title & original question. What question lurks in the student's mind to motivate the project?
- Hypothesis. What is the student's "best guess" how this will turn out?
- Materials used. What materials were used? This gives judges an idea how the project was performed.
- Data. What facts did the student find out? Include measurements, dates and notes. The original data book with "field stains" should accompany the project.
- Procedure. What steps did the student take to do the project?
- Results, and conclusion. The conclusion might easily contradict the original hypothesis. This is perfectly good science.
- Models, photographs, or drawings are often appropriate. The display board should be logically presented, easy to read, and eye-catching. Size and safety rules must be followed.

Handwritten materials don't do well when competing with computer-generated poster board materials.

Display as much of the project as possible. Clearly mark what can and cannot be touched, but if possible, allow people to feel the fur, touch fish skin boots, try the bow & drill fire-maker, etc. Make the project as interactive as possible.

### **Judging Criteria**

The criteria by which Elders and Western science judges evaluate each project are different. Top winners satisfy both groups of judges.

### **Warning! Science vs. library project**

In the past, students have gone to the library or internet and done exhaustive hours of work, have drawn good poster boards, including graphs and visuals, and don't do well in the fairs. Those students did not realize the difference between a library project and a science project.

A real science project gets the student involved *doing* something. The student tries several ways of accomplishing a task, or tries different weights, lengths, sizes, colors etc. in pursuit of an answer. Or, the student is actively involved in careful observations of a situation that could take years of observation to derive a conclusion.

A student should go to the library or internet to broaden his/her understanding, get definitions, clarify concepts or find more examples. But the project should be based on the student's experience, not a description of someone else's efforts.

For that reason, models of "life on the moon," "save the owls" generally have not scored well, as there is little the student can interact with. The teacher needs to work with the student to turn this type of interest into a "do-able" project that will score well with both groups of judges.

Example: One student was interested in forensics. Lacking a dead body to experiment with, we helped her develop a related project on ballistics and the rate of burn of different types of gunpowders.

### **ORGANIZING A LOCAL OR REGIONAL FAIR**

If you are going to run a fair, the following reading will save considerable time and help avoid mistakes.

#### **Location**

Choose a location that is economical and easy/safe to travel to/from. Be careful that no site feels left out, but take weather, safety and amount of volunteer help into careful consideration.

Typically, the gym of a local school or National Guard Armory are used. Gyms are loud, large and impersonal. Students are used to horsing around in the gym. The gym or armory might be used for displaying projects, and another smaller room for awards and more intimate exchanges. It is hard to hear speakers in a gym, even with a sound system.

Urban centers are great locations for a fair, providing easy accommodations and transportation, but the temptation for visitors to go to movies and malls is a constant distraction from the fair.

#### **Season/Date**

This is a much-discussed topic.

- **Winners.** Winners often go on to State or Nationals. Decide if you want the local or regional fair to lead up to the Alaska State Science Fair. Obviously, your local fair should precede that fair if you want to

send winners.

- Seasons. Some teachers feel that an early winter fair is better because it draws from three seasons: the previous summer, fall and current winter. Summer camp experiences are fresh in students' minds. An April fair is usually limited to winter activities.
- The quiet period from the end of November to the second week of December has become a favorite time for many local or regional fairs.
- Many school districts are shifting to project based curricula, and find that an early fair sets the stage for all projects throughout the school year.
- Sports. Science fairs don't compete well with sporting events. Find the basketball schedule and work around it!
- Tradition. Traditionally, science fairs have been in late March or April as they lead up to the State Fair competition.
- Weather. Choose months when weather isn't too bad in your region. You don't want students weathered in or weathered out for long.

### **Preparing for the event**

- Realize that *you* determine the rules for your own fair. Borrow from others, but create your own.
- What rules guide the preparation and performance of a project?
- What rules guide the display of a project?
- What categories will the projects register under?
- What are the criteria for judging?
- School principals need to know the financial expectations placed on their budgets. Get information out early in the school year before travel funds are committed to other activities.
- Far in advance, teachers and principals need:
  - Clearly stated rules, requirements & regulations.
  - Dates, times and location.
  - Judges scoring guides.
- Speakers need time to prepare.
- The public, including parents, need to know in advance the hours the fair will be open to the public.
- All judges need to know the dates, times, location, and what is expected of them. Give them the scoring guide far ahead of the fair

so they can think about it. Spend time with Elder judges over a cup of coffee, casually informing them of the intent of the fair and what is expected of them. Give them time to think of questions. Western science judges are very familiar with such fairs. It is foreign territory for elders.

- Where will visitors sleep?
- How many people are expected for meals?
- Who will take care of transportation?
- Do you have all contact numbers?
- What will you do if weather is bad: cancel or postpone?

### **Typical Schedule**

#### **Morning**

- Students arrive and set up projects.
- Students practice presentations among themselves. 30 minutes.
- Students leave projects for 30-45 minutes. Judges look at all projects, getting an overview. This is very important for judges to get an idea "How good is good?" and for judging teams to agree among themselves. Projects evaluated by different teams are then regarded in the same terms on the same scale.
- Judging starts.

#### **Afternoon**

- Judging continues.
- Students leave, and judges confer, deciding on awards. This is a good time for team/peer building activities among students. See "Judge by Tables"
- Judges deliberate, choosing "Best of Show" and Grand Prizes.

#### **Evening** There are two options:

##### **Option #1**

This makes for a shorter evening.

- After deliberation while all participants and the public are out of the room, ribbons are hung on all projects, elders ribbon on one side of the project, western science judges' ribbons on the other. Each project then gets two ribbons. Everyone is then excluded until the doors open after supper.
- After supper (potluck?)
- Doors burst open.
- Students and the public enter the fair site, looking at projects and associated ribbons.
- Awards ceremony and elder speeches. Ribbons are given for "Best of Show" and "Grand Prize." All

students are acknowledged.

- “Grand Prize” and “Best of Show” ribbons are hung on projects, and students stand by projects for pictures and questions from public for 20-30 minutes.

#### Option #2

This makes for a longer evening.

- After supper (potluck?)
- Fair site is open to the public. At this time, there are no ribbons on projects.
- Awards ceremony. All blue, red and white ribbons including “Best of Show” and “Grand Prize” are given.
- Talks by significant leaders and individuals or other scientific presentations.

If you follow this option, it is *very important* to have students display ribbons and stand beside projects after awards are presented so everyone can make the connection between projects and awards. It is a good “photo op.” People tend to think the fair is over when awards are over, so announce that projects will be on display for another 30 minutes or so.

#### **Alternate schedule.**

**Noon:** Set up projects.

- 30 minutes Students practice on each other.
- 45 minutes Judges get overview of projects
- Judging until late afternoon

#### **Supper**

- Evening activities.
- Noon the next day. Awards banquet.
- Afternoon Return home.

#### **Considerations**

The alternate schedule allows all evening for tallying the scores and deciding on best-of-show among the judges. The typical schedule gets frantic for time if there is debate among the judges. On-site meals for judges are a must. A student spends weeks and even months of a project. Each one deserves careful attention. This process should not be rushed, yet often is.

On the other hand, the alternate schedule keeps many working parents from the awards ceremony, unless activities are planned for all day, and the awards are held that night.

#### **Organizing**

The days of travel, particularly arrival, are often hectic. People arriving from other towns need contact numbers, location of lodging, schedules and event locations all in a packet.

A designated driver on the day of arrival for the fair is a must. A cell phone for the driver is a tremendous help. Travelers should have the cell number. Getting people to planes to go home is much easier than gathering them on the first day. They seem to vanish quite well with minimal assistance.

Know where the extra tables, extension cords and mops are kept. Know where the breaker boxes are. Who has the keys on the weekend? What do you do in an emergency? How can parents call students if the school office is closed?

Administrators, cooks and janitors in the building must know what is going on and how their job will be impacted.

If students and teachers do not know each other, it is good to have an ice-breaking activity that gets people acquainted right away.

Designate one person to take memorable pictures or video.

#### **Critical Dates Before the Fair**

- Permission for projects that require approval for performance of display.
- Registration. It really helps to know how many projects are involved 5... 12... 25?
- Dates and times of the Fair
- Check-in/set-up
- Opening ceremony
- Judging schedule. All students must be present at their own exhibit for questioning by the judges.
- All group activities.
- Exhibits open to the public. This is important, as “Kids tell your parents” seldom works.
- Dinner and awards ceremony
- Dismiss, take-down/cleanup

#### **Judging**

Quality judging is critically important so the students feel that their efforts have been fairly evaluated.

#### **Elder Judges**

Have several home visits with elders before the fair to insure that they understand what is expected of them. It is best to have elders from the community, as the values and details of the lifestyle are unique from region to region.

Elders don't always enjoy good health. Schedule a few back-ups in case some cannot attend.

- Edler preparation. Elder judges contribute a priceless dimension to the fair. Their presence gives honor and value.

However, since elders have little or no experience with science fairs, there are a few precautions that go a long way towards a successful fair. Asking them to judge a fair without instruction is like dropping a teacher blindfolded on the tundra.

- Grandchild. If an elder has a grandchild in the fair, try to avoid having the grandparent evaluate that student. This is only fair to the other students.
- Helper. Appoint someone who is familiar with science fairs to work with the elders. Give elders an idea of what to expect ahead of time. Tell them what the fair is for, how it will be run, why they are there and what is expected of them.
- Teams. Put the elders in teams of 2-3. If there are many projects, there might be two or three teams of elders. To provide fairness to students in judging, have each team judge a given category, like "Collections," or "Experiment."
- Identifying. Each project should have a one-word identifier like "nets." or "lamps" or "medicine." Put this on the top of the scoring sheet. (There might be two "nets" in the fair, thus the project number on the upper left.)
- Scoring. The elder scoring rubric identifies criteria. Practice and demonstrate on a simulated project before local elders evaluate all the projects. Include a copy of your local values with your elder scoring rubric. If your region doesn't have any listed or posted, this is a good opportunity to develop some.

Make sure local elders understand the scoring system of 1-5 or 1-10 and which is best and which is poorest.

This is best done on a relaxed day before the fair.

- Timing. Elders need a sense of how much time to spend on each project. One uninformed elder spent 45 minutes teaching a student how to set snares. No one told him what a science fair was or what was expected of him.
- Idea vs. work done. Elders need to understand the difference between a good idea and

a project well done. In the past, uninformed elders have overvalued a project with an important subject although the student's work was of lower quality.

- Chairs. Have chairs for elders to use during the interview. The person working with the elders can move the chairs from project to project. Be certain all elders can see and hear. As respect is shown the local elders in this way, students understand the importance of the generational link.
- Hearing. Elders' hearing must be adequate to understand the students in a large room with many noises.
- Scoring. Be sure all elders understand the criteria for scoring and how to score the project.
- Ribbons. Scoring is always hard because elders want to encourage everyone and discourage no one.

After judging, give elders a break.

While they are on break, on each elder score sheet, add the scores for each of the criteria and put the total on the top right of that scoring sheet. Don't confuse this number with project numbers! (Which should be on the top left.)

There should be a scoring sheet for each elder who evaluated each project. Staple them together, #23 with #23, #16 with #16 etc. This is where you discover whether all projects were judged or not! Make sure there are scoring sheets for every project! We have dismissed students before and found that all projects weren't judged.

Average the elders' scores for each project. You can use the totals for each one, but if one judging team had three members and another two, scores will be off. Averaging overcomes the problem.

Arrange the papers in ascending order, with the best on the right and "not-so-good" on the left.

Elders return.

Talk about the way the totals have come out. Does everyone think this is a fair rating for each project?

Take time on this part.

Revisit projects. Discuss the merits of each. Do the elders want to reevaluate a project now that the big picture is clearer? Refer to projects by name, "nets," "lamps," "deadfalls." Project numbers at this point are confusing. Don't rush this part. Give elders time. You might even have a meal at this point, giving them time for personal conversation.

Once there is consensus that the projects are in ascending/descending order, find the breaks in the scores. There is usually a large gap between the totals, like:

18, 18, 19, 20.....27,27,27,28,29,29,30.....36,36

These are often obvious natural breaks between the blue, red and white ribbons and the levels of performance. There is no given fraction that must be given of each color ribbon. Let the breaks and quality of projects determine the ribbons.

Confer with elders. Red, white and blue ribbons are sometimes unfamiliar symbols to Native elders. Telling them to group the projects. "Good," "better" and "best" might be better descriptions of the groups.

Do they think the grouping is accurate? Fair? Wait for consensus.

### **Western Science Judges**

Western science judges can be found in government agencies and local industry. Some don't relate well to students. Casually interview them before inviting them to judge. The ability to understand students and possession of compassion are often more important than scientific expertise. We aren't delving into subatomic particles and quantum theory. Try to get a balance among judges as biologists far outnumber earth and physical science people in Alaska.

Western science judges are acutely aware of how to judge a science fair, as they have personally participated in so many. Western science judges and elders tally their scores separately. In the past, judges stapled all score sheets for a given project together, averaged the scores and placed that number in the upper right corner of the top score sheet in a bright color. When that is done, they grouped the projects in three ranges: high, middle, and low. The break between the three groups is usually obvious.

The high range gets a blue ribbon, middle range a red ribbon, and low range gets a white ribbon.

Important! Because the number of ribbons required for each group is not known ahead of time, it is good to have a *surplus* of ribbons of all colors.

They are cheap and reusable. Remember, there are two sets of judges, so double or triple your supply of ribbons.

Therefore:

Each project gets two ribbons, one from the Western science judges, and one from the Elders. It is possible for a project to get one blue and one white ribbon.

All projects should be clearly labeled as to category and assigned a project number. Put a line for project number on the upper left of the scoring sheet.

Local fairs might try using Skype on the internet and judges from another community. A laptop and wireless connection could be brought from project to project. Test this for audio and other glitches before the day of the fair. A noisy location might make it unworkable.

Best of show. For the ribbons that identify "Best of Show" and "Grand Prize" western science judges and Elders should be in agreement. Sometimes this takes strong negotiating, and other times it is quickly unanimous. The discussion is always healthy, as elders get to hear what the scientists value, and the scientists better understand the elders' viewpoint. There is no fixed number of projects in this upper category. Have extra awards on hand, but don't feel compelled to give them if the quality isn't there.

When the Western Science and Elder judges have a hard time coming to agreement there are two ways to help work out the differences.

1) Revisit the projects. The judges defend their choices to the other judges, giving reasoning. Do this for all the contenders. If you can tape this portion, the discussion is priceless. Students can later hear what the judges held in high regard. Be discreet in allowing students only to hear what judges say about their personal project.

2) Usually the two teams of judges can agree on one or two projects for Best of Show or Grand Prize. If there is ultimate impasse, then the Elders can pick one, and the Western science judges another. This solution should be a last resort.

### **Scoring Criteria**

COSEE suggests scoring rubrics, but feel free to develop your own.

You might consider:

#### **A. Elders**

Elders review the projects for their alignment with traditional local values and for their contribution to the students' village/community.

- How well did the student maintain local values?
- Is the project important to local culture, city, town or village?
- Is the project of high quality, showing hard work?
- Has the student drawn upon local knowledge and experts, involving the community in the research?

## B. Western scientists

Teacher/scientists evaluate an experiment or observation:

- How well did a student explained and understand the scientific principles involved?
- How well the student followed the scientific method? (Experiment)
- Detail and accuracy of data
- Creativity and originality
- Presentation
- Conclusions
- Appearance
- Use of materials

Teacher/scientist evaluate a collection:

- Quality and variety
- Creativity
- Good presentation
- Good data. Where and when items were gathered.

Overall, judges look for well planned work. They look at how significant the project is in its scientific field and to the community. They look for thoroughness.

Judges respond favorably to students who can speak freely and confidently about their research. They are not interested in memorized speeches. They simply want to TALK with students about the research to see if the student has a good grasp of the project from start to finish. Besides asking the obvious questions, judges often ask questions outside the normal scope to test insight into research such as “Why did you pick this project?” and “What would be your next step?”

### Helpful Tips in Running a Fair

There are many ways to organize judging.

**Judge by tables.** Judging time can get quite long for students as they wait for judges to come to their projects. Have the judges interview one row of tables at a time, and tell the students in the next row of tables they are “on deck.” (not in the fair site, but close by) Other students are free until they are “on deck.”

As soon as the first row of tables has been judged, those students are dismissed and the second row of students come into the fair site to be judged. The students whose projects are on the third row are now “on deck.” All other students can be occupied

with board games, or other organized activities. This keeps students from having to stand by their projects for three hours until the last projects are judged.

It also helps to organize tables by category: experiments, observations and collections. This helps judges focus on the appropriate scoring rubrics.

**Students come to project when summoned.** This sounds a bit disorganized, but if all students are in the gym away from their projects, judges can call when the student(s) are next. This works well as long as students have not vacated the gym.

It is not realistic to expect all students to stand by the projects for long periods of time waiting for judges to come to them. The long, long wait has turned many students off to science fairs and projects. They say, “Boring” and it is.

**Practice.** After the students have setup their projects, but before the judges come to interview them, allow the students to practice on each other by doing the following:

- Divide the students into two groups, the presenters and the interviewers. Give each a piece of paper with 1 or 2 on it. Counting off 1,2,1,2... doesn't work!
- Presenters stand by their projects and interviewers spread out in front of the presenters. At a signal, the presenters share their project with the interviewers for 3-5 minutes, when the time is up, the interviewers rotate to another project.
- After this is done several times, presenters and interviewers switch positions. The rotating begins again.
- This gives each student the opportunity to share his/her project to peers several times before talking to the judges. It works *great* to kill “butterflies.”

If students aren't listening to directions, it can get a bit crazy, but the potential positive results are worth the risk.

**Unattended projects.** Upon occasion, schools have sent projects without the students. Those projects seldom win high honors, but their presence contributes to the fair. Now that we are using video presentations and Skype over the internet, it is possible for judges to talk live to students who are not physically present.

**Interaction.** If the fair is held in a larger city, groups quickly split off to do shopping or go to movies during

free time. Group ice breakers are the quickest way to initiate interaction among fair participants. Students should know how to introduce themselves in a group, giving their name, Native name (if he/she has one), name of their parents and town/village.

Teachers and chaperones have felt the need for more meaningful interaction among the students, developing long-term, statewide, peer relationships. The relationships will serve as a support system in college and later endeavors. While “icebreakers” seem awkward at times, they accomplish in a few minutes what might take days otherwise. Field trips or other large group activities as well as staying in the same location and sharing transportation all contribute to a sense of community. In the past, during the State Fair, we have hired professionals to do team/peer building activities with excellent results. Students come away with a sense of connectedness to other students from across the State.

Consider a stipend for both sets of judges, or at least a gift of appreciation.

### **Future Fairs**

Once COSEE explores the possibilities of a cyber fair, and works out the details, it wouldn't be surprising to if a Circumpolar Fair emerged with competitors from Russia, Greenland, Canada, Norway etc. This has been the dream since 2002.

# Appendix

Forms you might want to use:

## LIABILITY FOR EXHIBITS

Every effort will be made to protect your exhibit. However, since the Science Fair Exhibition will be open to the public, the \_\_\_\_\_ COSEE Science Fair cannot and will not accept any liability or responsibility of any nature for any theft of, or loss or damage to, any exhibit or any other property of any exhibitor. Accordingly, it is recommended that each exhibitor take product precautions to prevent any theft, loss or damage to his/her exhibit and/or other property. Each exhibitor should secure and guard his/her exhibit and/or other property at all times during the exhibition, and remove all valuable components, especially those which are easily portable, when the exhibit and/or other property is left unguarded by the exhibitor.

I have read the above paragraph, and understand and accept that the \_\_\_\_\_ Science Fair cannot and will not accept any liability or responsibility for theft or damage to any exhibit.

Single entry participant/Team member #1

\_\_\_\_\_ Date \_\_\_\_\_

Parent/legal guardian signature

\_\_\_\_\_ Date \_\_\_\_\_

Team member #2

\_\_\_\_\_ Date \_\_\_\_\_

Parent/Legal guardian signature

\_\_\_\_\_ Date \_\_\_\_\_

Team member #3

\_\_\_\_\_ Date \_\_\_\_\_

Parent/Legal guardian signature

Supervising

\_\_\_\_\_ Date \_\_\_\_\_

## Media Permission

The \_\_\_\_\_ (Date- Location) \_\_\_\_\_ Science Fair is a significant event and your presence there is newsworthy. The organization or businesses sponsoring awards at the fair may want to publicize their involvement in such an important science competition by using photographs or information about you. Your cooperation may make it possible for other promising young student to get involved in science.

You have my permission to use appropriate information about me for publicity purposes. This includes any photographs, videos, or likeness(es) that may be used by COSEE or the sponsors for the purposes of illustrations, advertising or publication in any manner. I also consent to the use of my name in connection therewith.

Single entry participant/Team member #1

\_\_\_\_\_ Date \_\_\_\_\_

Parent/legal guardian signature

\_\_\_\_\_ Date \_\_\_\_\_

Team member #2

\_\_\_\_\_ Date \_\_\_\_\_

Parent/Legal guardian signature

\_\_\_\_\_ Date \_\_\_\_\_

Team member #3

\_\_\_\_\_ Date \_\_\_\_\_

Parent/Legal guardian signature

Supervising teacher

\_\_\_\_\_ Date \_\_\_\_\_

### CONDUCT CODE

Students:

Read over carefully the following, and sign a personal commitment to this code.

During the entire time of the Science Fair, as well as during my travel to and from the fair:

1. I will not use or abuse any alcoholic beverages, nor drugs;
2. I will not engage in any verbal or physical abuse of any human being.
3. I will be respectful of myself, others, all property and rules of any other school.

These values are important to me and I am proud to sign this document, to confirm my commitment to them.

Participant signature \_\_\_\_\_ Date \_\_\_\_\_

Parent/legal guardian \_\_\_\_\_ Date \_\_\_\_\_

# COSEE State Science Fair Scoring- Elders

Team/Individual  
Student(s) Name(s) \_\_\_\_\_

Total Score \_\_\_\_\_

Name of Project \_\_\_\_\_

<b>Cultural Values</b>	The presentation by the students and display of his/her project maintains the cultural values of his/her area.	Needs more work <b>1</b>	Good <b>3</b>	Excellent <b>5</b>
<b>Quality project</b>	The student's work is well done. The project is organized and attractive. It shows good thought. The presentation is clear and confident. The discovery process is evident as used in village life.	Needs more work <b>1</b>	Good <b>3</b>	Excellent <b>5</b>
<b>Importance</b>	The project is a study of something that is important to the land, village and community.	Needs more work <b>1</b>	Good <b>3</b>	Excellent <b>5</b>
<b>Community resources</b>	There is clear evidence that the student consulted with one or more community elders, local experts and other cultural resources.	Needs more work <b>1</b>	Good <b>3</b>	Excellent <b>5</b>

Project Name \_\_\_\_\_

Total score \_\_\_\_\_

## Scoring- Collection

Project Number \_\_\_\_\_ COSEE Science Fair

Student(s) name(s) \_\_\_\_\_

Individual  
Team  
Class project

Circle  
one

<b>Quality/ Variety</b>	The collection shows interest, but there could have been more and better quality samples.	Most local samples have been collected. The samples are of good quality.	The collection is thorough. Local possibilities have been exhausted. Samples are of high quality, with all sizes, colors, types and shapes possible.
<b>Creativity/ Originality</b>	The collection shows little original thought.	There is evidence of creative thought in the gathering and presenting of the collection.	There is clear evidence of creative thought and ingenuity.
<b>Presentation</b>	Speech is too soft. There is little enthusiasm or interest.	Speech is sufficiently loud, clear, and thoughts are orderly. The display is organized and understandable.	The presentation is loud, clear, and orderly, given with enthusiasm. The display is attractive and easy to understand.
<b>Data</b>	There is no data telling where and when the samples were gathered.	There is some data telling where and when the samples were gathered.	The data is complete and easy to understand.

Team/Individual  
 Student(s) Name(s) \_\_\_\_\_

# Scoring Experiment

Total Score \_\_\_\_\_

Name of Project \_\_\_\_\_

## COSEE Science Fair

<p><b>Scientific Process</b></p>	<p>A question was asked, but not well pursued. This is more of a library project than a hands-on science project.</p>	<p>Clear hypothesis, data gathering and performance of experiment or observation. The project involved hands-on activity, organized thinking and good observation skills.</p>	<p>Exceptionally well done with insightful performance and conclusions. The student was immersed in the project, trying several methods, even unsuccessful ones. The student thoroughly explored the original question.</p>
<p><b>Data</b></p>	<p>Data is somewhat disorganized. Difficult for reader to understand the results. Data was collected, but not enough for conclusive results.</p>	<p>The data is organized and tells the reader what happened. Enough data was collected to make adequate conclusions.</p>	<p>The data is overtly organized and displayed in several ways including graphs and charts. There was enough data for conclusive results.</p>
<p><b>Creativity, originality, theme</b></p>	<p>This project has been done before, and shows no deviation from the past. Does not relate to oceans, rivers drainages, and climate change.</p>	<p>This project might have been done before, but shows insightful adaptations with original approaches. Does relate to oceans, rivers drainages, and climate change.</p>	<p>The project combines western and traditional science in a fresh way. The questions asked, methods used and conclusions drawn are freshly insightful. Directly related to oceans, rivers drainages, and climate change.</p>
<p><b>Presentation</b></p>	<p>Speech is too soft. Presenter lacks confidence, knowledge of subject and enthusiasm.</p>	<p>Speech, confidence, knowledge and enthusiasm are adequate.</p>	<p>Speech, confidence, knowledge and enthusiasm are inspirational.</p>
<p><b>Conclusions</b></p>	<p>No connection is made between the question, hypothesis &amp; data collection. A vague reference is made as to how this project could be improved.</p>	<p>Conclusions are clearly stated. An adequate description is made as to how this project could be improved.</p>	<p>The student has made insightful connections between the question, hypothesis, and data collection.</p>
<p><b>Appearance</b></p>	<p>More work is needed to make the display neat.</p>	<p>The information is displayed clearly and neatly.</p>	<p>The project commands attention, is extremely neat and easy to read.</p>
<p><b>Use of materials</b></p>	<p>Materials used were not appropriate and/or safe.</p>	<p>Materials were used appropriately.</p>	<p>Materials were used appropriately and creatively.</p>

Team/Individual  
 Student(s) Name(s) \_\_\_\_\_  
 \_\_\_\_\_  
 Name of Project \_\_\_\_\_

# Scoring Observation COSEE Science Fair

Total Score \_\_\_\_\_

<b>Purpose</b>	Observation idea is good, but seems to have no specific application	Observation has a stated long term objective related to oceans, river drainages and climate change.	Observation has a long term objective that relates to important issues related to oceans, river drainages and climate
<b>Variables</b>	Student shows little understanding of the variables involved in the observation.	Student shows a good understanding of the variables involved.	Student shows a clear understanding of the variables involved and their interaction with the study.
<b>Originality, theme</b>	This project has been done before, and shows no deviation from the past. Does not relate to oceans, rivers drainages, and climate change.	This project might have been done before, but shows insightful adaptations with original approaches. Does relate to oceans, rivers drainages, and climate change.	The questions asked, methods used and conclusions drawn are freshly insightful. Directly related to oceans, rivers drainages, and climate change.
<b>Research</b>	Student has done little research and is duplicating well established knowledge.	Student has done research, and the application of that research is evident in the students' approach	Student has done extensive research, and has built upon that research with creative questions.
<b>Observation skills</b>	Observations were made inconsistently (random times, location observed and point from which observation is made vary.	Observations were made consistently (time, location, point of observation etc) Observations were made using the best tools available (microscope, telescope, field glasses etc)	Observations were made consistently with an attention to detail expressed in precise language.
<b>Appearance</b>	More work is needed to make the display neat.	The information is displayed clearly and neatly.	The project commands attention, is extremely neat and easy to read.
<b>Recording skills</b>	Recording is done with inconsistent standards Uses subjective words like: big, good, ugly.	Recording is done with consistent standards. Records are fairly well kept.	Recording is accurate, consistent, neat and data is very usable.

Project Name \_\_\_\_\_

Total score \_\_\_\_\_

## Scoring Rubric

Project Number \_\_\_\_\_

COSEE Science Fair

Student(s) name(s) \_\_\_\_\_

Individual  
Team  
Class


# Media Permission Form

The COSEE science fair is a significant event, and your presence is newsworthy. The media, whether newspapers, radio or television might want to feature you and your project. Your cooperation will make it possible for other young people to become interested in science and science projects.

If you sign the following, you give permission for your name, project, image or likeness to be used in the media for the purpose of publicaiton, advertising, or illustration.

I consent to having my name, project, image or likeness of myself and/or project.

\_\_\_\_\_ Student \_\_\_\_\_ Date

\_\_\_\_\_ Parent/  
Legal guardian \_\_\_\_\_ Date

## Developing a Science Fair Project

There are really two ways to decide upon a science fair project. Both are useful.

The first is to go through science books and look for science principles and experiments you can do to demonstrate those principles. As you do this, you can find the application of the principles in your life.

Example: In the spring of 2009 I worked with a student who picked an experiment on the latent heat of evaporation. She had the experiment well under way when she discovered that the principle is very important in understanding how a steambath carries heat. She later saw how

clouds can carry heat from one part of the planet to another.

This type of project is usually successful, as the young person is following an experiment already tested and designed. It is hard to fail. If done well, this type of project will win honors in most science fairs.

However this type of project doesn't always carry student interest, as it didn't originate in the students' personal life. This type of project might have local applications, but the idea starts in a book written far from the student's frame of reference.



## Developing a Collection, Experiment or Observation

### COLLECTION

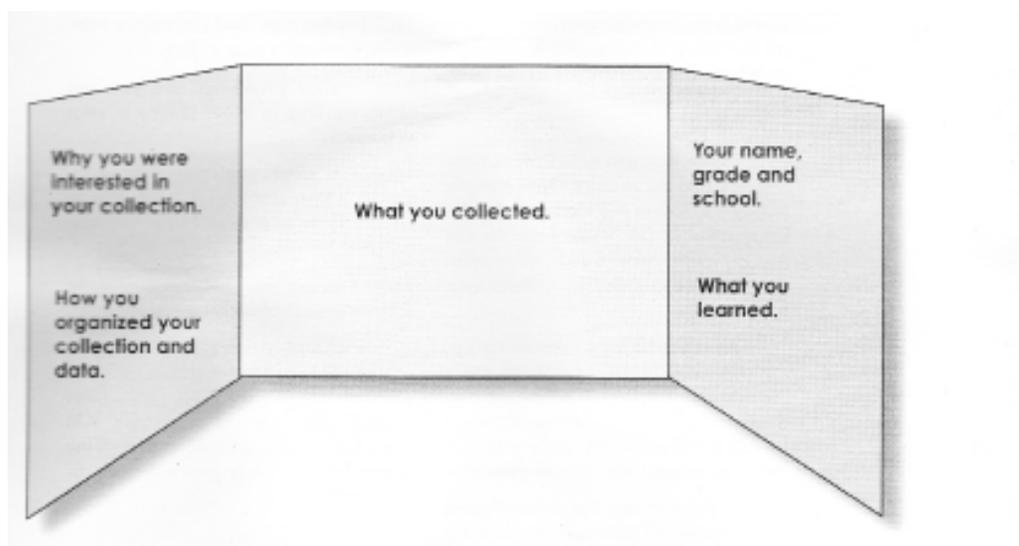
**Procedure for a collection** The student should find something of high interest to collect. Often lower grades do a collection as a class. While it is a plus to have students collect something of biological importance like leaves or insects, the most important part of a collection is to have the students learn to record where and when the item was collected, how it is similar or different from the other items, and how to classify the collection. Students are learning to visually discriminate, measure weight or dimensions, and learn how to preserve the samples. If they can't be kept long without spoiling, take pictures. How do the items look under a magnifying glass?

In villages, collections of cartridges from every caliber of gun in the community, teeth from every subsistence animal, bones from all local fish, pressed leaves from every subsistence plant, samples from every rock on the beach, or types of driftwood on the beaches are all great possibilities.

The student should organize the collection in a way that it makes sense. Can you add to the collection without disorganizing it? Is there something else to collect from another place? How can this collection grow?

How will the student store it in his/her home? How will you display the collection? Will it interest other people in that collection, or inspire them to make a collection of their own?

As an entry to a science fair, the collection poster might look something like the one below.



## EXPERIMENT

There is one type of experiment that should be banned, that is, boring ones. Experiments should be exciting!

Step one, pick a topic you are interested in.

Step two, ask a question about that project. What are you trying to find out? Make sure the experiment is do-able. An experiment is nothing more than a fair test.

**Guess.** Make a guess what you think is right.

This is your hypothesis. Do you think a monofilament net will catch more fish than a green net? Do you think green berries have more pectin than blue ones? Do you think wood splits better in cold or hot weather?

**Plan.** Plan a fair test to see whether your guess is right.

Find out all the variables, that is, the things that influence the experiment. Hold all of them constant, and adjust one of them. It's that simple.

Example: If you want to test the salinity of the ocean water in a local bay, first find get samples of fresh water, water from far out in the ocean, and water in the bay. Put the electrodes of an ohm meter in the water. The salt water should conduct electricity well, and the fresh water should not conduct electricity at all. Test the local bay water and see how well it conducts electricity.

What are the variables? The distance between the electrodes, the amount of current in the ohm meter, the amount of salt in the water and perhaps the temperature of the water. It would be good to use identical containers with identical amounts of water in each.

Perhaps you are trying to see which type of skin gives the best sound for drumming. What are the variables? Types of skin, thickness of skin, size of drum frame, how hard the drum is struck, kind of striker and tension of the drum frame. It is difficult but possible to hold these variables constant.

How will you tell what is "best?" This is diffi-

cult. To do this we have had three elder judges seated with their backs to the drummer. The drummer struck the different drums and the elders judged which drum sounded "best" to them. This is subjective, but uses local experts as the measuring devise.



A student might not be able to experiment with salmon going upstream, but the student can experiment with different methods of observing them. Old timers used to clean the bark off several poles lash them together and put them crosswise in a creek. When fish swam over the whitened poles, the fish that were otherwise invisible against the dark bottom became very visible in contrast to the light colored poles. A student might experiment with alternative ways of observing the fish. (Mom's bedsheet works well, but mom often doesn't appreciate the sacrifice.)

**Repeat and record.** No experiment is conclusive with only one test. There are so many things that can go right or wrong in one test. Some students want to do a test three times, but even that has much room for error. It might seem boring, but science fair judges like to see tests done five to ten times, with an explanation for numbers that are way off. Field notes are often messy and dirty, but the final presentation should be clean and neat.

**List.** Make a materials list. What materials were used in the experiment. If someone wanted to test your results, they could use the same materials. If you are using salmon eggs for fish bait that were cured with borax, and someone uses salmon eggs cured by some other means, your results could be challenged. A good materials list keeps the record straight.

**Conclude.** Does your experiment prove or disprove your hypothesis? Many science fair winners come from a failed hypothesis. What does the data say? What did you learn? If you were to do the experiment again, what would you do different? What new questions have arisen? What are the local applications of your findings?

There are many suggestions for experiments in this book.

The poster format below works well for experiment posters, although the challenge is to catch people's eye and impress the judges with the clarity of the presentation. Be creative!

### **OBSERVATION**

Many situations, particularly with living things or weather, are difficult to experiment with. These situations lend themselves to careful observation.

An observation over ten years might give the relationship of temperature, rainfall, the time of the last and first frost and other variables that contribute to the blueberry harvest in a given area. Many people wonder what makes a good berry year. We don't control the variables, but

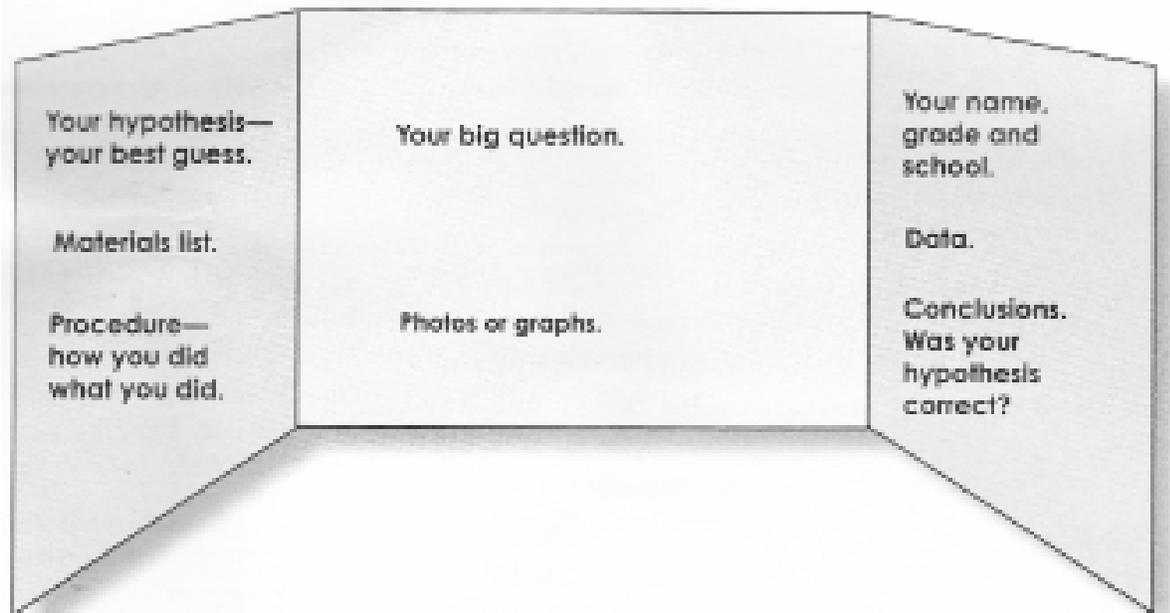
we can observe how they interact with careful observation over many years.

It is not possible for a student to do a science project over ten years. Therefore COSEE recognizes a project as adequate that is done in one year, that, if it were done over a long period of time, would give insight into a scientific conclusion.

Is there a connection between the height of fireweed and the depth of the snow the following winter?

My son-in-law observed that his snowmachine would backfire considerably after the weather turned from cold to warm and back to cold again. He couldn't figure it out, and couldn't experiment because he didn't control the weather.

After much thought and observation he realized that when weather turned from warm to cold, his tank developed frost, and the frost caused the



backfiring. He learned to keep his tank full during warm weather to keep warmer moist air out of the tank. From there he had no backfiring problems.

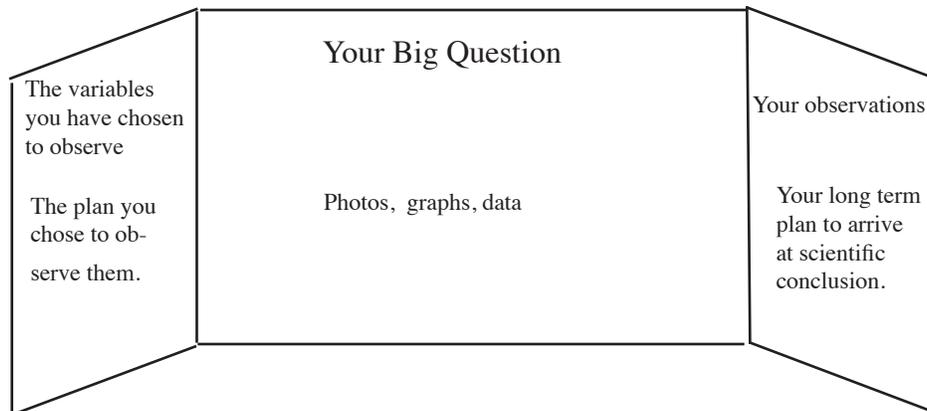
We might do an experiment regarding chickadees and what kind of food they prefer. However, we can only *observe* what locations they choose to hide and store the food they take. A good set of

binoculars and lots of patience will solve that question.



A COSEE observation project should be set up in one year as if it were to be conducted for five to ten years. There should be great attention to detail. From where were the observations made? When were they made? During consistent times of day? What details were noted? “There’s more ducks this year than last year,” is not a good observation. What date did the first ones come? What types of ducks? What was the weather and wind direction when they came? When did the migration taper off? How were the numbers of ducks determined? Were they flying high or low? How many hit the local pots?

Your poster might be organized like the one here.



# Finding and Developing a Science Fair Project

Get ideas for a project.

Go to your local sources (Local experts, elders, and instructors.)

Decide which kind of project you will do (collection, experiment, observation.)

Then:

## Collection

Find a collection that is interesting.

Find out details about your collection from local elders and experts.

Start your collection. Record where and when you got the samples.

Organize your collection. Why did you organize this way?

Look closely at your samples. How are they alike and different?

Decide how to present your collection, including an attractive poster.

## Experiment

Pick an experiment that is interesting and do-able.

Ask a clear question about your topic. Go to local elders and experts for advise.

Make a good guess what the answer to your question is. This is your hypothesis.

Plan a fair test to see if your hypothesis is correct.

Do the test several times. Record the results. This is your data.

Make a materials list that shows what you used to do the experiment.

Come to a conclusion. Was your hypothesis correct or not?

Plan your presentation including an attractive poster.

## Observation

Choose a topic you are interested in.

Find out as much as you can about your project. Go to local elders and experts.

Be sure the project is safe and culturally appropriate.

Set up the observation. Determine what you will observe, when and how. Check with local and professional experts to see if you have missed anything.

Carefully do the observation over the period of time you planned.

Record your observations.

Decide how you would continue this observation in future years.

Make an attractive poster and display.

# 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?

Commercial 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 whales?

What parts of the body do local hunters try to hit when hunting different animals? What systems are affected? 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 camouflage 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 over-fishing 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 animals 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 calorimeter (with adult supervision) and test each one. Why do you think whale oil was a preferred oil in the 1800'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 pallets 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.



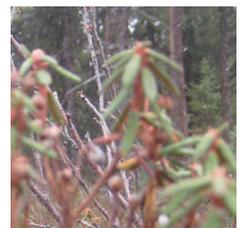
Traditional songs have rhythm. Do any of those rhythms follow natural rhythms like the human heart, the ocean waves, cries of birds etc?

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 knowledge?

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 occurring 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 use 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 its 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 Bernoulli’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 a 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 miscibility (ability to mix) of 2 cycle engine oils at different temperatures? 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 its 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 mathematical 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 amplitude 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 wave 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 principles 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 phenomena 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 phenomena 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 phenomenon causes the tops of the hills and mountains to appear upside down during a winter cold spell?

What causes that phenomenon?

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?

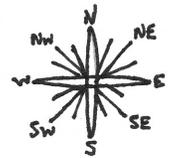
Observe the different types of snow under a microscope. What are the differences in their appearance, density and texture?

### 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.

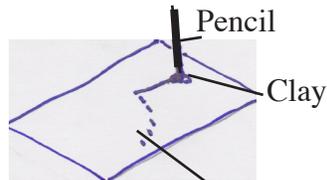
# Alaskan Sundial

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.



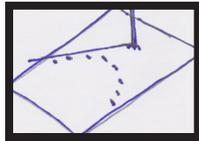
However, it is possible to tell true north and true noon using an Alaskan sundial. True noon is when the sun is at the highest point in the sky.

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.



Mark every half hour.

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 its 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.

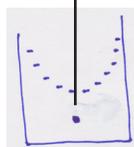
It is possible to tell true north (not magnetic north) by drawing a line from the base of the pencil to the shortest point on the parabola. That line points to true north.

True 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

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



# Atlatls

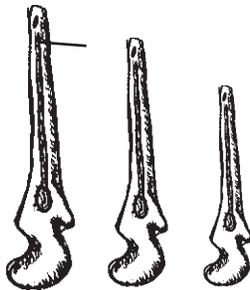
In certain seasons in certain water conditions seals sink when shot. Losing a seal is always a possibility. Even today, many people living in the mouths of Alaska's rivers spear seals rather than shoot them with guns so they can be retrieved before sinking.

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

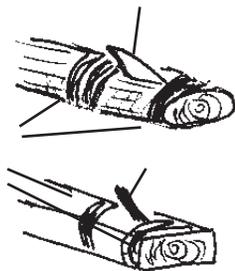
There are three variables in throwing a spear:

- 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:

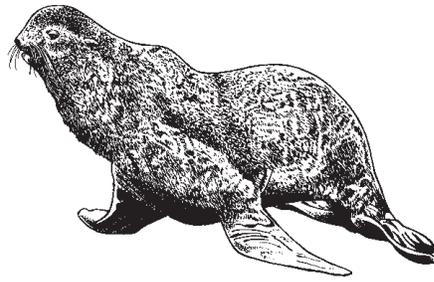


You can make a simple one like the one below:



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.

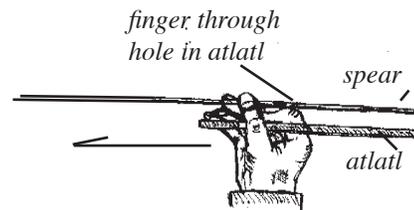


What is the most effective combination of atlatl length, spear length and spear design?

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 elbow to the first knuckle. The length of the spear is from the elbow 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 kayak. 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 hat 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 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.

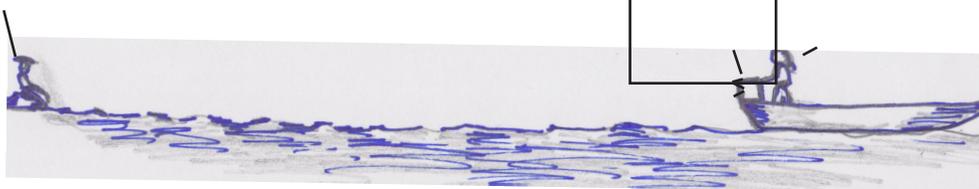


Another way would be to conduct the experiment at a given distance, and see at what volume setting on the boom box the test person can hear the sound. (This is perhaps the easiest way.)

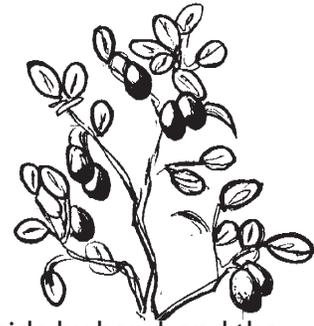
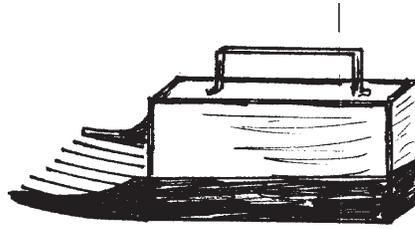
Again, the true test would be to experiment with the hats over open water.

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?

Experimenter 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 berry pickers.

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 roughly 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?

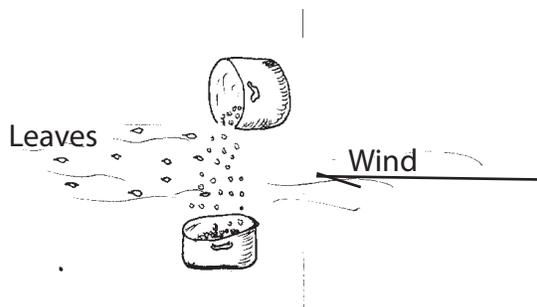
Some scientific experiments take many years. Bears or birds harvesting in your patch one year might throw the conclusion off.

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 brown bear (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.

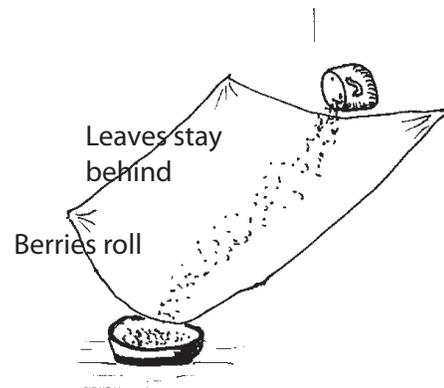


Old timers used to pour the berries from one container to another in a strong wind. The leaves and sticks have more surface area and less weight than the berries, and therefore blow away. The berries are heavier and drop into the bottom container. The only problem is the lack of a strong wind at the 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.

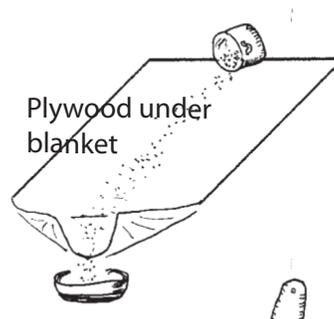
Some people drive the boat and pour the berries, creating their own wind.

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 blankets? 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 pectin 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 its 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.

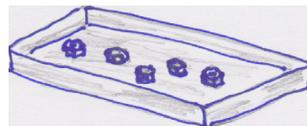
Put one sample of each kind in a separate clear container of salt water.

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 samples 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 habitation making their study less than convenient.

Be the first to study this phenomena 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

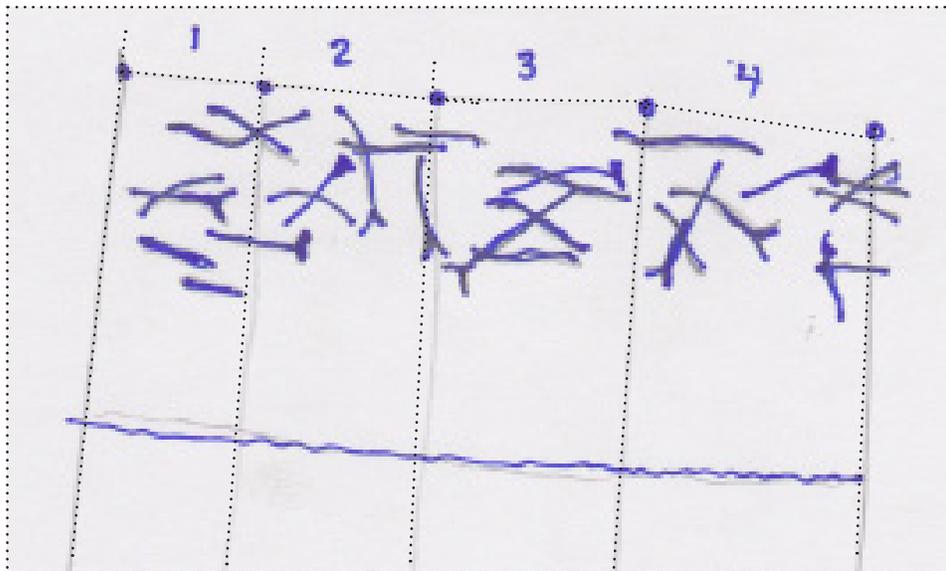
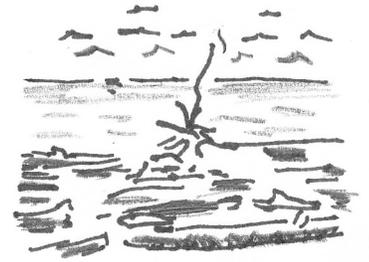
difference in driftwood from many years ago? Do they attribute the change to climate change? Since erosion control projects on Lower 48 rivers, there has been less driftwood on Alaskan shores. There are many possible reasons for the increase or decrease in driftwood.

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?

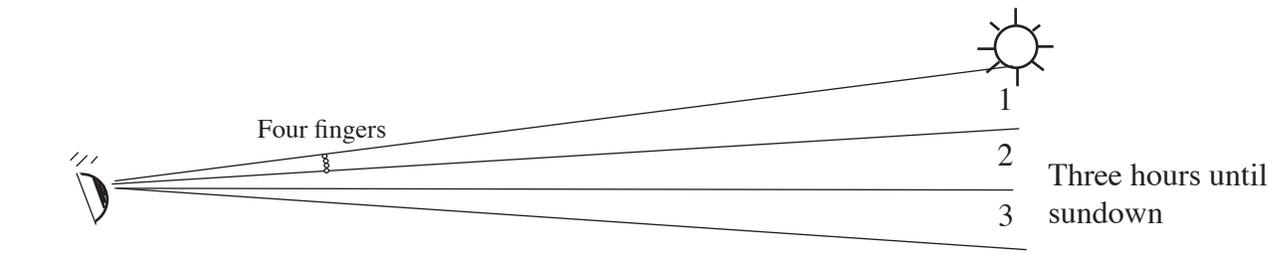
Do you find a pattern? Your specific location in Alaska will give different results from others that live north and south of you.

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?

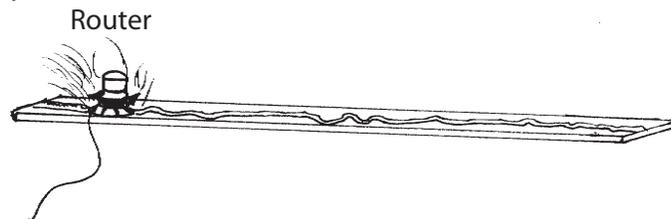


# Gold Placer in a River Drainage

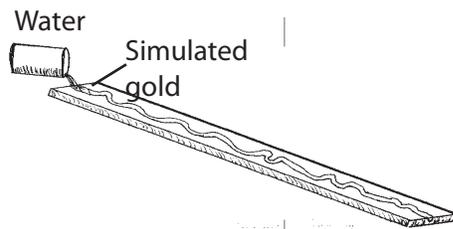
Gold follows a predictable path down a river. It will follow the straightest route possible, and it will drop out, or placer, in a somewhat predictable manner. Since it is 5-6 times heavier than most country rock, it will work its way down to bedrock and will follow bedrock in an interesting pattern.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

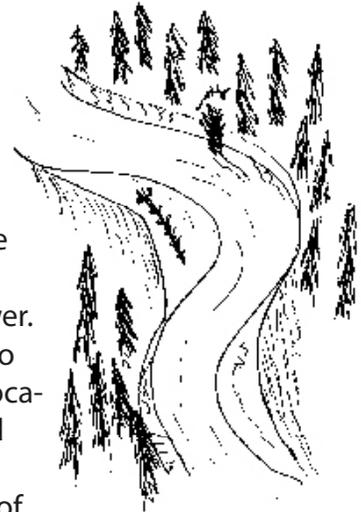


You obviously won't be pouring gold down the river, so choose a heavy material to simulate the gold. If you have black sands available, they work fine, but iron filings, or brass filings will work well too. Paint the bottom of the river. White will show black sands and iron filings. Green will show brass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

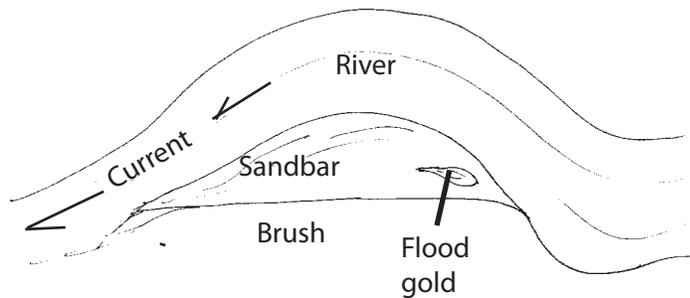
## EXPERIMENT

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 factor 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.

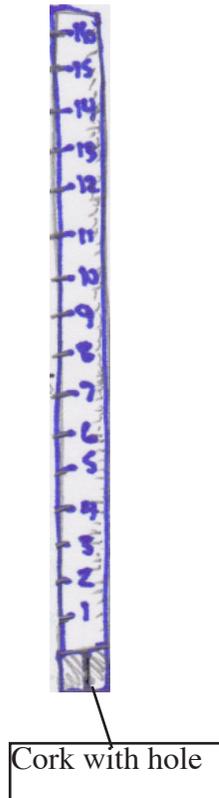
If a clear tube is corked on one end, and a small hole drilled in that cork, the level of water in the tube will remain fairly constant even if the waves rise and fall. Water can go in and out the small hole, giving an accurate measurement of the water level, but it will not go up and down quickly with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



# 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.

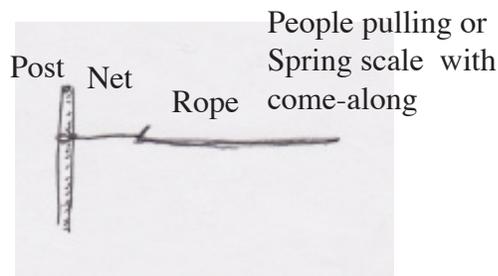
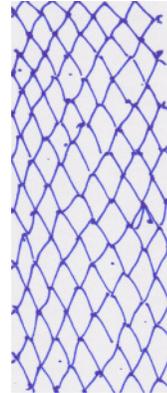
After one month, test one of each sample to see how hard it is to break.  
After two months, test another of each sample to see how hard it is to break.  
After three months, test the third to see how hard it is to break.

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

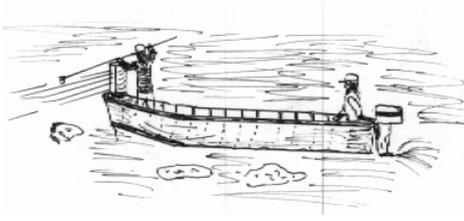
each one.

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

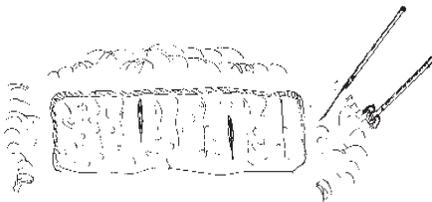


For many centuries people living subsistence in Alaska have lived from the abundant supplies of fish, those that remain locally and those that migrate. There have been a variety of ways of catching fish:

- 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.



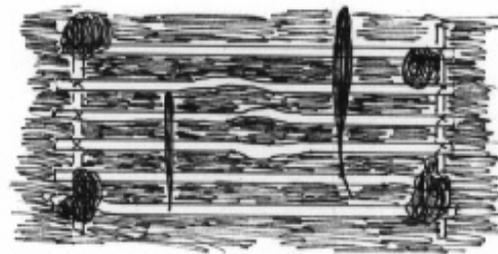
While the river is still running ice in the fall, they also chop a wide hole in the shore ice and whitefish through the hole.

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

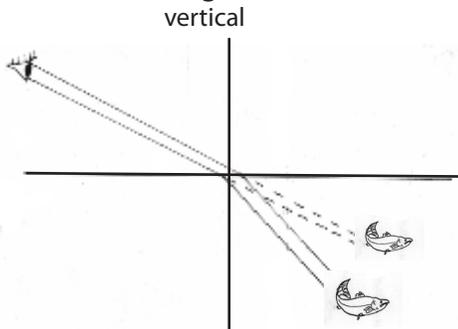
It is exciting to spear fish, but first efforts are usually frustrating. There is a science principle that must be understood before success is attained in spearing fish. The fisherman sees the fish, aims the spear well, and misses again and again. Sometimes the fish are too fast, especially the small 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?

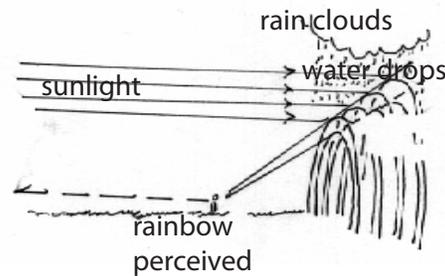
They must miss a few meals until they learn this science lesson.

### OTHER APPLICATIONS

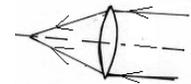
When sunlight passes through air, and then passes through a cloud or rain, we see a rain-

bow 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 information.)



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?

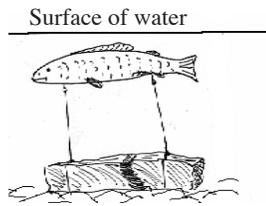
### EXPERIMENT

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 perceive 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?

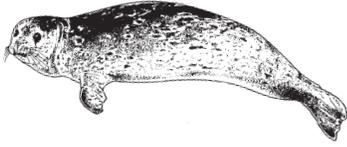
Ask the old timers in your town or village what kinds of fish they used to spear. What time of year did this occur? What were the best conditions for this activity (night, day, calm weather etc.?) What were the best locations? Ask them how they stored those fish. Is this activity still possible today? 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.

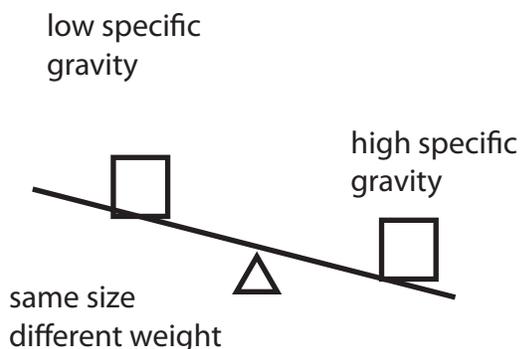
What is happening? Why do some animals float and some sink?

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.



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.

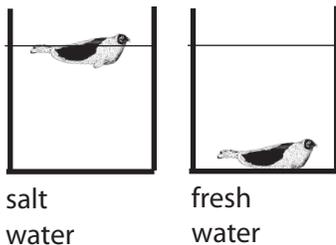
If it's specific gravity is less than one, it will float in fresh water.

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?



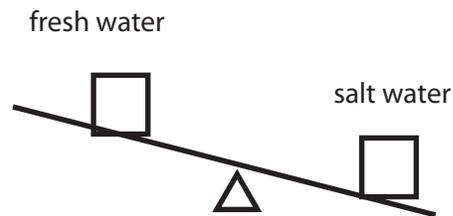
The salt content in the ocean water makes a cubic centimeter of salt water heavier than a cubic centimeter of fresh water. It's specific gravity is greater than fresh water.

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 brown bears. Bears sink because their specific gravity is much greater than one. They have great muscle mass, even when they are carrying a lot of fat.

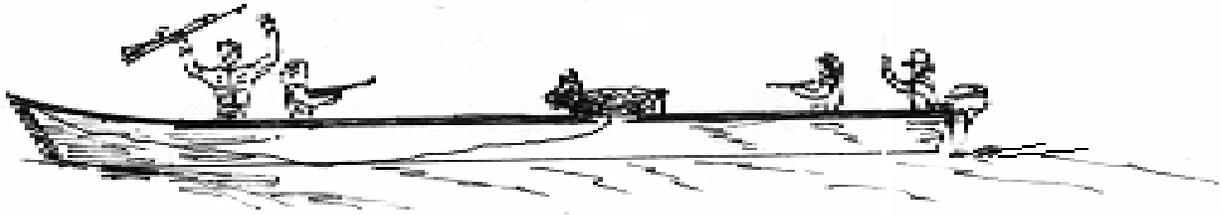
Moose and caribou float, partly because their hair is hollow, but also because their bodies aren't as dense as the bears'. The average of the specific gravity of their entire body is less than one. Their horns and bones tend to sink, but their hair and lungs keep the moose and caribou afloat.

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 its 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 its 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 its neck, followed the two men out of the front of the boat. On the beach it met its 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 its 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.

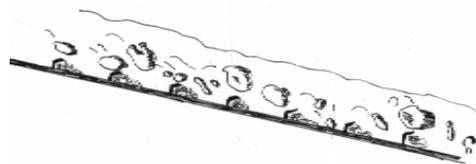
A seal that sinks in fresh water will also float in a few days, but the meat around the chest and stomach will not be good to eat.

#### 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



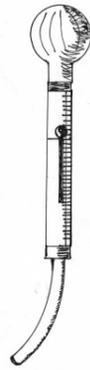
has a specific gravity of 2.5 to 3.5. It quickly goes to the top while gold and other heavy metals go to the bottom of the sluice box, jig or recovery system. The country rock is washed away and the gold and black sand remain.

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). Submerge 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.

<sup>1</sup> 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”)

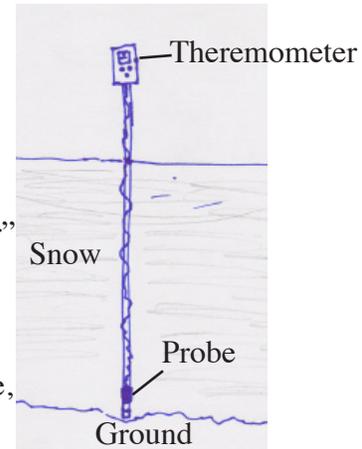
When the outdoor temperature has changed 20 degrees up or down, push the stick into 3’ of snow. After 10 minutes, read the difference between the indoor and outdoor temperatures. Do this in several sample locations and record the results. If the snow isn’t 36” deep, do the test at 12” or 24” depths consistently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

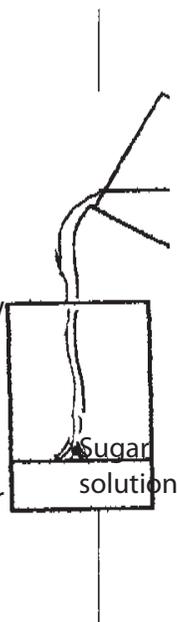
Many Alaskan rivers contain large amounts of river and glacial silt. Of the Chena River it is said, "It's too thick to drink and too thin to plow." Many of our islands and riverbanks are made of silt that has been moved and redeposited for thousands and thousands of years.

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?

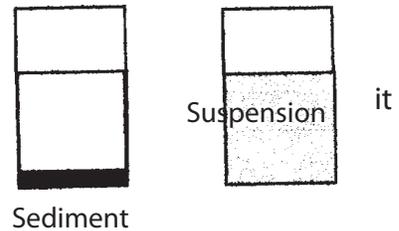
Pass the water containing dissolved sugar through a coffee filter. Is the sugar filtered out? By taste, compare filtered sugar water with unfiltered sugar water.

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?



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.

September							
Date	Day	Time	Height	Time	Height	Time	Height
9/2/2009	Thu	01:23AM	20.8	10:56AM	0.1	04:00PM	21
9/3/2009	Fri	01:17AM	21.7	11:26AM	0.1	03:19PM	21.9
9/4/2009	Sat	01:10AM	22.2	11:56AM	0.1	02:39PM	22.5
9/5/2009	Sun	12:45AM	0.8	01:36AM	22.2	12:20PM	0.7
9/6/2009	Mon	12:36AM	0.6	01:31AM	21.8	12:00PM	0.8
9/7/2009	Tue	01:20AM	0.4	01:26AM	20.9	01:20PM	0.6
9/8/2009	Wed	01:16AM	0.2	01:24AM	19.7	02:00PM	0.3
9/9/2009	Thu	02:38AM	1.4	01:35AM	18.2	02:40PM	0.4
9/10/2009	Fri	03:00AM	2.6	01:46AM	16.6	03:20PM	0.5
9/11/2009	Sat	03:22AM	3.8	01:57AM	15.0	04:00PM	0.6
9/12/2009	Sun	03:44AM	5.0	02:08AM	13.4	04:40PM	0.7
9/13/2009	Mon	04:06AM	6.2	02:19AM	11.8	05:20PM	0.8
9/14/2009	Tue	04:28AM	7.4	02:30AM	10.2	06:00PM	0.9
9/15/2009	Wed	04:50AM	8.6	02:41AM	8.6	06:40PM	1.0
9/16/2009	Thu	05:12AM	9.8	02:52AM	7.0	07:20PM	1.1
9/17/2009	Fri	05:34AM	11.0	03:03AM	5.4	08:00PM	1.2
9/18/2009	Sat	05:56AM	12.2	03:14AM	3.8	08:40PM	1.3
9/19/2009	Sun	06:18AM	13.4	03:25AM	2.2	09:20PM	1.4
9/20/2009	Mon	06:40AM	14.6	03:36AM	0.6	10:00PM	1.5
9/21/2009	Tue	07:02AM	15.8	03:47AM	0	10:40PM	1.6
9/22/2009	Wed	07:24AM	17.0	03:58AM	1.4	11:20PM	1.7
9/23/2009	Thu	07:46AM	18.2	04:09AM	2.8	12:00PM	1.8
9/24/2009	Fri	08:08AM	19.4	04:20AM	4.2	12:40PM	1.9
9/25/2009	Sat	08:30AM	20.6	04:31AM	5.6	01:20PM	2.0
9/26/2009	Sun	08:52AM	21.8	04:42AM	7.0	02:00PM	2.1
9/27/2009	Mon	09:14AM	23.0	04:53AM	8.4	02:40PM	2.2
9/28/2009	Tue	09:36AM	24.2	05:04AM	9.8	03:20PM	2.3
9/29/2009	Wed	09:58AM	25.4	05:15AM	11.2	04:00PM	2.4
9/30/2009	Thu	10:20AM	26.6	05:26AM	12.6	04:40PM	2.5

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.

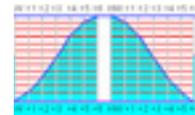
In the fourth period, the tide will rise 3/12ths of the total.

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.



# Resources

There are many resources that will help teachers and students:

## *Science Fairs are Fun*

A 7 minute video to motivate students based on the ARSI effort in the past.

## *To Show What We Know*

An inspiring video for teachers and students alike, showing how projects can develop from camps and everyday life.

## *Passing On*

An excellent video showing the importance of incorporating local elders and local experts in all that we do in the schools.

## *Culturally Responsive Science Curriculum.*

An excellent guide for those developing science curriculum based on the local environment.

## *Village Science*

## *Northern Science*

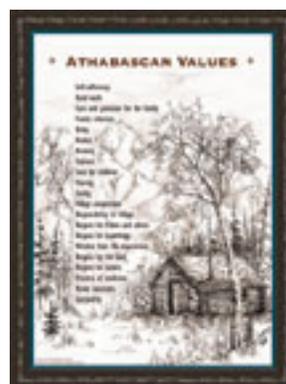
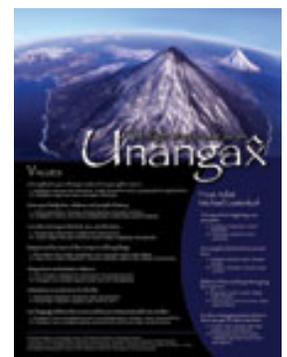
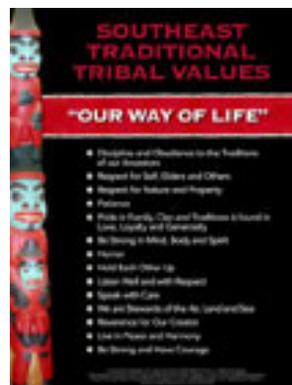
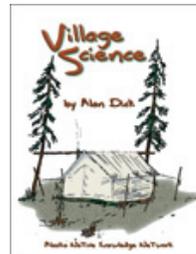
## *Village Math*

These three works written by Alan Dick for ARSI are free downloads from the ANKN website, and for years have helped teachers and students to see science in the local environment. While their birthplace was interior Alaska, the principle are the same throughout the State.

Village Science and Village Math are also available in hard copy.

## *Traditional Values posters*

These posters help students understand that social standards have been in place for thousands of years, helping people get along and survive.



# Conclusion

The old timers in Alaska were always experimenting with new ways to hunt, trap, travel and preserve food. As modern technology and materials arrived in the villages, people experimented more and more, adapting the new ways to the subsistence lifestyle. Hunting, fishing and food gathering of all kinds are made simpler with technologies like GPS, camo clothing, vacuum sealing etc.

Currently, no one really can keep up with all the changes in science. The playing field is open and there's lots of room for new players. There is no need for anyone to sit on the bench. Alaskans have a unique opportunity, not only to witness, but also to participate in the evaluation of the rapid changes and the effects on our communities.

Climate change sounds like a huge subject, but it is only a part of the evolving dynamic that we face.

If you have done a collection, you have learned basic science skills. If you did an experiment, you have developed abilities that will be with you for the rest of your life. If you took on a project where you had to do a detailed observation, you have developed habits, and thinking patterns that will serve you again and again as you pursue lifetime interests.

Whether you become a career scientist or just as a practical person who wants accurate conclusions, you're a winner.

There is a natural high that comes from a good project. There is no end to questions that can be asked and explored. There are not enough hours in the day to pursue them all. I often tell my grandchildren, "If you're busy doing the do's, you don't have time for the don'ts." Well, a good science project is one of the do's!

If you have caught the spirit of this book, you are in for some great adventures, most of them right in your own town or village.

Your partner in curiosity,

Alan Dick

**A scientist is someone who doesn't stop asking silly questions.**