Experiential Discoveries in Geoscience Education EDGE
Expanding Field Earth Science into the Grade 6-12 classrooms using GPS, GIS, and Adventure!

Cathy Connor-Department of Natural Sciences, UAS
Alaska Math Science Conference October 20, 2007
ASD Education Center and Highland Tech Center, Anchorage AK.
Why teach GIS to expand Earth Science in middle school and high schools?

- Alaska’s students’ strong Sense of Place and their need for Earth System Science knowledge to live in a resource rich state during a warming climate
- Availability of Google Earth as entry portal into ArcGIS and export of Arc maps as .kml files
- Rapid Climate Change in Alaska is increasing rates of geologic change at observable rates
- X, Y coordinate use (latitude and longitude), map projection, spatial data enhances students understanding of mathematics and geography
- Improve student knowledge of Alaska’s relationship to the “outside world”
- Active and in context Science and Math improvement in SCIENCE section of statewide 4th, 8th, 10th grade assessment exams
Use of Earth Science as a foundation for other sciences.
- Provide authentic college experiences for first generation prospective college students
- Train EDGE students and teachers in an essential AK workforce skill
The Evolution of EDGE in Alaska

Teacher Training Opportunities in GIS evolve and expand

- **2004, 2005** NASA “Inspire the next generation of explorers through STEM Funding” to Prakash through Alaska Space grant UAF
- **2004, 2005** “Improve science education in 10 AK School Districts” Dept of Education Funds to Brownlee/Connor through UAS Science and Education Departments Partnership
- **2005** UAS 7 UAF Teachers’ GIS Workshops served as “proof of project pilots” resulting in NSF Funding
- **2005-2008** “Improve Earth Science and College Readiness for Rural Alaskans” National Science Foundation Geoscience Education Grant to Connor, Prakash, Brownlee
We selected UAS because it is adjacent to a small Alaskan glacial watershed with moderately easy logistics. This provides a natural laboratory for introducing Middle School and High School teachers and their students to Earth Systems science and climate change.
The EDGE Project: A year of NSF-FUNDED Experiential Earth Science

http://www.uas.alaska.edu/envs/edge

INSERVICE SCIENCE TEACHERS

• June 2005, 2006, 2007 (10 day workshop/course-3 Credits)
• 10 hrs Earth System Science Lectures
• 25 hrs GIS/GPS Lectures-Nuts & bolts of using Spatial data
• 25 hrs ArcGIS 9.2 Lab applications, map production
• 10 hrs Field data collection and earth process exploration
1. Watershed delineation-component identification
2. Glacier Mass Balance
3. River Hydrology
4. Isostatic Rebound in estuarine wetlands-vegetation mapping
Analog Compass work leads to the digital data
The EDGE Project: A year of NSF-FUNDED Experiential Earth Science
http://www.uas.alaska.edu/envs/edge

ESS Data/GIS Map Focus
- UAS Campus Geocache
- Watershed Systems
- Montana Creek Hydro
- Mendenhall River Geomorphology
- Mendenhall Glacier Terminus Recession
- Post-glacial uplift Gastineau Channel wetlands

J.Wahl '07
GIS Techniques to Creating Maps from Teacher Waypoints
Using Locally Collected GIS glacier-related data

• Glacier Terminus positions (USGS, UAS Undergraduates 1750 to 2007)
• Surficial Geology Maps
• EDGE Teacher Waypoints
• 2007 USFS Bear Collar data
The Mendenhall Glacier data above indicates that the most recent time period May-June 2007 has the greatest recession rate. The staggering difference (583 m/year vs. 65 m/year) is probably due primarily to a large calving event of late May. However, the trend is clear that present 10 year period has experienced the greatest glacier retreat. According to (Motyka et al, 2002), this is primarily due to climatic changes which have led to less snow build up on the ice field which feeds Mendenhall Glacier. Warmer temperatures in the summer cause melting and glacier advance. The relatively warmer temperatures of recent winters have led to less snowfall accumulation to feed the summer melting. In the publication “A Century of Thinning on the Mendenhall Glacier”, Motyka points to a secondary reason for the steady advance of the past 100 years as being the creation of Mendenhall Lake. The lake has led to the front edge of the glacier experiencing a somewhat buoyant state which speeds calving (and glacier retreat).

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Recessional Distance</th>
<th>Rate (meters/year)</th>
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</thead>
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<tr>
<td>1835-2007</td>
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<td>1996-2007</td>
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<td>1998-2007</td>
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<tr>
<td>2004-2007</td>
<td>195 meters</td>
<td>65 m/year</td>
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<tr>
<td>May 2007-June 2007</td>
<td>70 meters</td>
<td>583 m/year</td>
</tr>
</tbody>
</table>
Introduction
How do different earth surfaces found in the Mendenhall Valley reflect solar radiation, and how might this be changing as the Valley develops?

Surface themes include various earth coverages of the earth, with an emphasis on the Mendenhall Valley's surface reflectivity. By measuring the heat and light intensity of each surface, we were able to measure the heat and light intensity of each surface. This was measured using a heat and light intensity sensor, which was connected to a computer via a USB cable. The data was then analyzed using a GIS program.

Project Objectives
Determine the surface reflectivity for the Mendenhall Valley and identify any trends in the reflectivity as the Mendenhall Valley has developed. To do some science, engineer a data logger with sensors that can be used to collect data from within a community science curriculum. Collect data from sites with a limited number of field trips, and share the data with a GIS workflow.

Steps & Methods
1) Select sensors and construct a data logger that will gather data needed to answer the project question and be easy to use.

Future improvements: Build a prototype module in the lab, so the data collected is automatically time stamped and geo-referenced. Enclose the data logger in a weatherproof box, with sensors on the outside of the box. Add 50k of memory to support months of data logging at 15 minute intervals.

2) Program a data logger in a GIS program, to collect the data from each sensor, convert, and output the values, store the data in memory, erase the memory, and dump the data into an Excel spreadsheet. The program is modular so a change in sensors can be easily accommodated. Double precision calculations with decimal constants around 1.000 with integer math. During most of the data collection a memory leak would occur in the program, and the data would get lost. Best would be to put the data and program memory into separate memory so the data could be retrieved even if the logger fails. A good start from the 250 line program.

Steps & Methods (continued)
3) Measure solar reflectivity between 10 am and 2 pm using the 2 same sensors. Reflective heat and light intensity was measured at each sensor.

4) Use the data to create a map of the site and identify areas of interest. Analyze the data and create maps for the site.

5) Import the Excel file into a GIS program, and project the points. ArcGIS only allows for the creation of point maps, so that is what we'll use.

Conclusions
Even though glaciers cover 90% of the area, they contribute an overwhelming 87% of reflected light. This suggests that the glaciers in Mendenhall Valley are the most significant reflectors of light. The outcrops are not significant compared to the ice and snow contribution, even accounting for coverage percent. No patterns emerged from measuring reflected light. Temperature of the substrate and direct heating of the area are not as significant as reflectors. Therefore, nothing can be concluded from this study concerning reflected light. Different sensors need to be used.

References


Acknowledgments
Thank you to Alice and Dan, who helped with the project. The project is supported by ARC and the school district.

For further information
Please contact ben.mcluckie@stanford.net.
Comparative Wetland Mapping

Using NWI, wetland area totals 728 hectares

Using aerial photo interpretation, wetland area totals 653 hectares

Koren Bosworth 2006
SPUHN ISLAND PARKING PROBLEM – ANALYSIS AND RECOMMENDATIONS

Chris Jacobson and Sue Skvoric
Correspondence Study School & Colony High School,
Grades 7-12, EDGE Program, June 16, 2006

Introduction
The Spuhn Island LLC is developing and selling 36 luxury homesites on the island, which is just south of Snaggletooth Cove, at the end of Folk Cove Road. Access to Spuhn Island will be via boat only, as a dock has been built on the island. Parking on the mainland is a problem, both for boats and cars. We have identified existing public parking lots within 2 miles of the island, across Auke Bay and the Mendesball Peninsula, and will recommend possible solutions to the waterfront parking problem.

Materials and methods
Stereomodels from Ingemar’s Cove to harbor, dock were followed by taking GPS margins across the perimeter of Spuhn Island and returning to Auke Bay harbor. We then marked the parking lot with GPS coordinates to Gis and inserted into GIS plot again. In addition, we questioned the environment, reviewed the Spuhn Island website for visitor data of lots to be sold, reviewed data from the GIS assistance office, and captured digital photographs of the Spuhn Island site and Auke Bay harbor. ArcGIS was used to create a GIS map showing the existing study area on a satellite image.

Conclusion
We found that there are currently about 165 vehicle parking spaces in the 3 parking lots mapped out in the results section. With 650 slips in the boat harbor and four vacancies, Spuhn Island LLC will have to purchase additional real estate for boat and vehicle parking, or residents will have to make their own arrangements in the Auke Bay boat harbor.

Results
Our surveys found that 3 possible sites could accommodate the Spuhn Island, without acquiring any new parking lots. The city has purchased Chetash’s Marine (200 boat slips) and parking for 90 visitor’s vehicles. There is no feasible parking for the southeast portion of Mendesball Peninsula. Mainland boat landing sites are still a problem, to be solved by yet another team of GIS experts. As of June 2006, the boat harbor has about 150 slips and parking for 118 vehicles, according to the Auke Bay harbormaster.

Acknowledgements: The authors would like to thank Dr. Cady Conner, Ed Knuth, Dr. Anupma Pakash, Dr. Rosemary Walling and other nice people who helped us with all our data collection.
Where are the good yard sales?

Jim Parkin

Chatham School District grades 7-12, EDGE Program, June 16, 2006

Introduction
Five surveyors representing a spectrum of age groups and both sexes were asked to evaluate 20 yard sales based on:
- cost of home
- quantity of infant, male, female, and adolescent goods
- amount of money spent
- overall quality of the yard sales

A corresponding GPS waypoint was taken at each yard sale.

The data was input to GIS software and then queried to see if relationships could be found that would discover the secrets of finding the secret yard sales.

Methods

Results

Conclusions
Looking back I guess the project question should have been what can I buy at yard sales for $86.00.

Acknowledgments
I would like to thank Connor for his input for the project. Connor would also love to have classroom help... Connor taught me how to input the data and I would have scored much higher if he had been there. I would also love to thank Connor for his help with the project and for being an all around great person.

For further information
Please contact Jim Parkin at jparkin@chatham.k12.mt.us for more information on the project or more details on GIS mapping. For more information on GIS please visit http://www.gisusers.org or http://www.gisresources.org.
WILL THIS BE “A ROAD LESS TRAVELLED”?  
Patty Brown  
Haines Elementary School, Grades 4-8, EDGE Program, June 16, 2006

Introduction
A road connecting the capital city of Juneau, Alaska, to the interstate highway system has long been considered, in hopes of achieving the following:

- Increased convenience to traveler
- Reduced state costs
- Lower travelers’ expenses
- Improved flexibility
- Lower travel time
- Encouraging tourism

Fig. 1. Route of road and ferry with proximal cities.

Materials and methods
Using a base Landsat map overlain on a USGS topographic map, the road was demarcated with the DOT Supplemental Draft EIS as a reference. A file of slide data from the US Forest Service was added as a layer, depicting the areas where mitigation will be necessary.

Fig. 2. Sign at current road’s end at Echo Cove. Note train tracks visible.

Results

Fig. 3. Map aligned with USGS data.

Graphics Needed
New GIS displays are needed using the most complete up-to-date and thorough avalanche data. As technology has evolved, information from multiple historical sources could be merged into a comprehensive document and made available to the public.

Fig. 4. Avalanche paths visible in summer.

Fig. 5. Avalanche paths visible in winter.

Fig. 6. Example of path maps in GIS.

Controversy Continues
According to DOT personnel, half of the road’s maintenance budget would go to avalanche control. It would require helicopter-dropped bombs, howitzers, and blaster boxes. Some of the howitzer blasts would be launched from nearby islands. Some areas would require as much as 20 blasts per year. Helicopters would be used to monitor the snowpack; noise from helicopter use in the area of Haines has fueled much debate already.

Fig. 7. Highway through avalanche-prone terrain in winter.

Fig. 8. Snowpack measures.

Conclusion
The 51.5 mile road proposed to be built between Echo Cove and the Kakehun River is in very treacherous avalanche country. This can endanger maintenance crews as well as the travelling public. As the protracted public process has been carried out in a somewhat illogical way, it cannot be certain that potential drivers are aware of all the dangers. Documenting the frequency of avalanches in known paths, particularly those east of Anyaka Island, over the next ten years before commencing construction is a minimal precaution. Additionally, as the cost of fuel increases, true costs must be recalculated frequently to assess the cost/benefit of this project.

Fig. 9. Snowy mountains.

Acknowledgments
We thank Ed. Rosemary and Cathy of UAS for technical support, Tim Reed and Chuck Haloff of DOT for graphics suggestions, Bonnie Redhead of Chilkat Valley News for archival information, USFS for slide data, and Bill Glade of Southeast Alaska Avalanche Center for philosophy and technical data.

For further information
Please contact Southeast Alaska Avalanche Center, Southeast Alaska Conservation Council, and Alaska Department of Transportation and Public Facilities personnel.
Materials & Support Given to EDGE Teachers

- Laptop computers with ArcGIS, MS Office, Adobe Photoshop, GOOGLE Earth, DNR Garmin software
- Garmin Etrex GPS (with WAIS) receivers
- Digital Cameras
- Silva Compasses
- Earth System Science Books, CDs, DVDs
- Miscellaneous Rite in Rain notebooks, office supplies, rechargeable batteries, USB-Serial port converters etc.
- Tuition for Summer and Fall Credits
- Travel to Juneau for workshop and symposium
The EDGE Project: A year of NSF-FUNDED Experiential Earth Science
http://www.uas.alaska.edu/envs/edge

EDGE Students

• 6 Day Summer Earth System science/GIS/GPS Course-2 college credits

• Residence in UAS Dorms/Cafeteria Meals

• Field Experiences and training

Some of the 2006 EDGE student cohort
The EDGE Project: A year of NSF-FUNDED Experiential Earth Science

http://www.uas.alaska.edu/envs/edge

EDGE TEACHER ESS CONTENT COURSE

• Fall 15-week, online Earth Science Content Course 3 credits
• Weekly homework assignments, quizzes, final exam
• Guidance for teacher mentoring of EDGE student semester-scale projects
• EDGE Student assignments components of science fair project
Fall EDGE Teachers Mentor EDGE Students through Projects

http://www.jsd.k12.ak.us/jdhs/frameit/?url=http://www.ptialaska.net/~gennie/SEASF.htm

INTEL International Science and Engineering Fair

FORMAT

- Hypothesis
- Project plan
- Submission Form
- Data Log/Science Notebook
- Data Analysis
- Project Synthesis

Poster Development, Notebook completion
EDGE Symposium

March

EDGE Students
• Present their projects to
• University undergraduate and faculty judges, and peers
• HS students compete in
• SEAK regional Science
• Fair-winners to INTEL

EDGE teachers
• Mentor Students
• Serve as judges at Science Fair
Introduction
Nunapitchuk is a Yup'ik Eskimo village located on the Johnson River to western Alaska about 30 miles west of Bethel on the Kuskokwim River Delta. There are 3 villages within sight of Nunapitchuk. The area known as Akulmiut (a- /ool-me-yoot).
On this poster, you will find some maps that we made and a variety of information and photos that we hope will be interesting and informative.

Background
Nunapitchuk is getting very watery because the permafrost is melting. We might have to move to the flats. Some people don’t like Nunapitchuk because of too many waters. Some people like Nunapitchuk because they go berry picking and hunting. During the summer times, people always go camping, berry picking, and hunting. Then in winter breaks we go fishing for salmon, fish, and other fish. Men go hunting for caribou, moose, and other animals that Yup’ik people eat. We have a lot of planes to get food near our village. And when our parents were young they had a new school because people started moving here.

One of the villages next to us is Kasaalik; they are split into 2 villages. Atlik was the old side and a lot of people moved to Atuka because Atuka is an island and everyone could not live there. Atlik is 2.5 miles away and Atuka is 3 miles away from Nunapitchuk. Akulmiut is 10 miles away from us. People moved from here to Akulmiut. Akulmiut is closer to Bethel and the Kuskokwim river. Where we live today is not where Nunapitchuk started. Also, the other side of the river used to be called Atanakus, but it is now part of Nunapitchuk. You would not know this from looking at the maps here are our area now.

Materials and methods
This fall we collected GPS waypoints of the buildings and homes in our village. Sometimes the weather was very cold and we had to go in people’s houses to get warm. We wanted to have a better map of where we live. Our mentor teacher Carey Steele and Professor Cathy Connor at UAS in Juneau helped us to make the maps in ArcGIS and Google Earth.

Results
Google Earth has a picture of our village, but parts of it are wrong and scenes stuff is missing. Some of the boardwalks are even in the river on their photo. When we exported our waypoints into Google Earth, some of them ended up in the river. The last time they did a topo map that was any of our village was 1956. There is one that was made in 01/08/04, but it doesn’t have details about Nunapitchuk. It’s important to have a good map of Nunapitchuk.

When people go hunting they might use a GPS. In the winter times, we can have a lot of blizzards. If someone is hunting and they have a good map of Nunapitchuk, then they should make it home safely.

Also, we want people to know that there are people living in Nunapitchuk. If there isn’t a map how will they know we are here?

Reference
ATMS website: http://www.iked.org/nunapitchuk

Acknowledgments:
Dr. Cathy Connor, Carey Steele, Ewa Orlikowska who printed the maps at UAS
National Science Foundation who paid for the EDGE Program

Nunapitchuk EDGE Students:
Melody Lassan, Chryse Jackson, Marie Seal, Janet Brink
Alaska State Capitol Juneau, August 2006

Experimental Discoveries
In Residence Education

Janet Brink and Marie Seal
EDGE Symposium March 16, 2007
Introduction
In the Gill and spring, the turbidity of Hoonah Harbor can get visibly muddy after heavy rain and wind, measured at 100 FTU at times. During the dry season in the summer and throughout the fall season during the winter, the water is clean with a measured turbidity of 0 FTU (the water is so clear as to be colorless). Why is there such a huge range in water quality? This question is important because the quality of the water is important to the health of the organisms that live in the water, organisms that we and the land animals depend on.

Study Area
The Hoonah Harbor watershed is composed of 5 drainages, the largest being Gusmati Creek. All drainages are impacted by road-building, clearcutting, and other construction. Natural ground cover is dominated spruce and hemlock forest with patches of meadow. Elevation range 100-1500 ft, air temperature 30°F to 70°F, wind 5-20 mph. Figure 1 shows the study area.

Materials and methods
Surface Area of the watersheds and drainages were calculated by digitally defining the areas on a Topo2Win topographic map then counting squares on a transparent graph paper calibrated to the map’s scale. We then plan to calculate surface areas with greater accuracy by driving polygons in GIS software. First step is to learn the GIS software.

Streamflow area and Discharge is calculated for Gusmati Creek at the Whitestone Bridge using standard methods using 2 foot measurement widths, U-shaped sticks, tape measures and radio-telecommunicated from PVC tubing. Calculations of cross-sectional area, volume, and discharge are done in Microsoft Excel.

Methods in development
Rainfall, Wind Speed, and Air Temperature will be measured at a weather station now being built by Mr. McCluckie’s house. The automated weather station at the Hoonah Fish Hatchery and Hoonah Airport are operated by NOAA, but the published data is not granular enough for our study. 1-hour averages are best. Data will be collected and reviewed regularly by a dialogue between

Background Studies
As a class, we studied the following topics in our textbook, supplemented by the Earth Observatory video series, internet research, and explorations of Google Earth:
- Rocks of the Earth
- The Water Cycle
- Water Erosion and Deposition and the Inland-Stream System
- The Force of Streaming Water (erosion and discharge)
- Water Quality

Working Hypotheses
(will become “Thesis” & “Conclusions” in final report)
- The turbidity of Hoonah Harbor increases dramatically only when it rains hard. It takes a couple of days to return to baseline levels.
- The higher the discharge the greener the turbidity of Hoonah Harbor.
- Higher/mid discharges by percent are caused by steeper slopes and ground cover types that have low saturation levels and surface depressional storage. These slopes and ground cover types contribute the greatest turbidity to volume to the Hoonah Harbor.
- The greener the turbidity of stream water, the greener the turbidity in the Hoonah Harbor.
- The greener the color of stream water is, the higher the turbidity of water is in the Hoonah Harbor.
- Glaciers and lands are the primary components of streams water that lead to high turbidity.

Challenges
The original timetable of research was predicted on a warm late and not winter, very much in keeping with the last few years. The weather has turned our much colder, breaking cold fronts in November and on many occasions registering 36 degrees below historical averages. It is possible that turbidity will be unmeasurable through March and possibly summer. If this happens, our research will be revising conclusions. However, the methods and materials used in this development may be useful for future Earth Science classes.

For further information
Please contact Ben McCluckie at b.mccluckie@hsk.k12.ak.us or visit the classroom website at http://www.hsk.k12.ak.us/hsk Classroom.net and click on the Earth Science course.

Acknowledgments
A B uick funds the Gill Center and the EDGE staff for conducting this entire research experience possible. Thanks to Andrew Saul of the U.S.G.S. for publishing a few of the drawings that we created with the help of the U.S.G.S. and the participants in our class.

Literature Cited
[references listed]
Effect of Aspect on Inorganic Properties of Two Creeks in the Government Peak Watershed
By Sean Boyden, Kalli Brettrager, Susan Skvorc
Colony High School EDGE Program, March 16, 2007

Introduction
Government Peak is the site of a current and proposed ski area in Hatcher Pass, near Palmer, Alaska. Before development proceeds, we would like to know the characteristics of the creeks in the watershed. Since the east face of Gov. Peak is being considered for a downhill ski area, and the south face for Nordic skiing, we chose to study a creek on both faces to see if the different mountain aspects influence the inorganic qualities of the creeks. We studied Government Creek on the south face and an unnamed creek at mile 11 of the Willow–Fishhook Road on the east face. An development proceeds, it is our hope that the creeks will continue to be monitored as a means to protect their health.

Materials and methods
We used Hach portable sampling kits to measure turbidity, phosphate level, hardness, nitrate, dissolved oxygen, alkalinity, iron, chloride and ammonia. We measured temperature, pH, flow rate and discharge as well. Both creeks were sampled within two weeks in October and at about the same time of day.

Results
Chart 1 presents data for mile 11 creek.
Chart 2 presents data for Government Creek.
Both creeks have similar characteristics, making it unlikely that aspect has an effect on them. These data values provide a baseline from which to observe any changes that may be due to development in the area.

| Table 1: Creek Chemical Data at Mile 11 Creek and Government Creek |
|----------------|----------------|
|               | Mile 11 Creek | Government Creek |
| Date          | 10/14/2007    | 10/09/2007       |
| Time          | 2.5pm         | 3.30pm           |
| Temperature   | 11°C          | 5°C              |
| pH            | 7.3           | 7.0              |
| Turbidity     | 0.5           | 0.3              |
| Dissolved Oxygen| 1.0mg/L       | 1.3mg/L          |
| Nitrate       | 0.0           | 0.0              |
| Phosphate     | 0.5           | 0.3              |
| Alkalinities  | 30            | 35               |
| Pressure      | 95.5 kg/cm^2  | 86.3 kg/cm^2     |
| Flow rate     | 1.0m/s        | 0.5m/s           |
| Flow rate estimate | 1.5m/s     | 1.2m/s           |

Conclusions
Our results show that both creeks have similar physical characteristics. Government Creek is a larger creek, with greater flow, but it appears that the aspect of the creek does not affect its chemical and physical characteristics. Both creeks should continue to have similar traits. Therefore, if development occurs, both creeks should remain similar. Since the mile 11 creek is at the downhill resort base and golf course, both creeks may be impacted by development.

For further information
Please contact [student@school.edu] for more information on this project.

Acknowledgments
We thank Dr. Colby Cormack and all ski mill for their assistance with this project.
How Location affects Potential Tidal Energy
Sam Bornstein
March 17, 2007

Purpose
My purpose was to determine the tidal flow rate of different locations and their potential tidal energy output. I then determined if a tidal power generator in Juneau would be practical. My hypothesis was that there would be no difference in flow rate between each location.

Procedure
I tested the tidal flow rate of five locations:
- Auke Bay
- Amaiga Harbor
- Norway Point
- Otter Run (near Smugglers Cove)
- Fox Farm Trail
I tested each site at high tide. To take each measurement I used a drift card and a two meter long string. I timed the card while it floated away with the tide until the string was pulled, meaning that the card was two meters away. I took ten measurements per site. I divided the average time for each site by two to get the average size. Then took the inverse of this to get the average surface flow rate of each location in m/s. Calculating the potential energy output took three steps:
1. Velocity x Surface Velocity (measured) x (Gradient Depth/Total Depth) [m/s]
2. Power Density = ½ Water Density (1024 kg/m³) x Velocity² (from first formula)
3. Power Density x Cross Sectional Area = Potential Tidal Energy (watts)
The cross sectional area was found by multiplying the average depth by the distance across each location.

Results
My experiments showed that Auke Bay had the fastest tidal flow with the water in the bay flowing at 0.48 m/s. Amaiga Harbor and Norway Point had flow rates of 0.32 m/s. Otter Run had a flow rate of 0.56 m/s, and the Fox Farm Trail had a flow rate of 0.50 m/s. Analysis of my data using ANOVA test did not support the null hypothesis that all locations I tested would have the same flow rate (p<.05).

Conclusion
- Auke Bay had an energy potential of 2856.49 watts
- Amaiga Harbor had an energy potential of 98.54 watts
- Norway Point had an energy potential of 38.41 watts
- Otter Run had an energy potential of 8.57 watts
- Fox Farm Trail had an energy potential of 6.89 watts
A 60 watt light bulb could only be powered from Auke Bay or Amaiga Harbor. However, only Auke Bay can produce enough energy to power at least two houses.

Applications
There have been a couple of articles in the Juneau Empire during the past year about tidal energy and companies looking into testing sites around Alaska and even in Juneau. If a tidal farm were set up in Juneau, it should go in Auke Bay. However, Auke Bay probably has the most boat traffic, therefore the placement of tidal turbines may be a problem there. There also is too small an amount of energy generated for it to be economically practical.
Logging and Its Effects on Anadromous Fish of Yukatat
Valerie Jensen and Sylvie Schumacher
Yakutat High School
EDGE Symposium March 2007

Introduction
Yakutat, Alaska is located on the north end of the Kenai Peninsula, and is a prominent fishing community. The town is home to various species of salmon, including the Chinook, Sockeye, Pink, and Coho salmon. The town relies heavily on the salmon industry for its economy. The salmon run is a crucial part of the town's economy, and the town has a long history of fishing and salmon management. The town has a population of around 1,500 people, and the salmon industry is a main economic driver. The town has a strong tradition of fishing and salmon management, and the community is dedicated to preserving and protecting the salmon run.

Project Description
Our project was to monitor and record the effects of the culverts on the salmon run. We used a camera to capture images of the salmon as they passed through the culverts. We also monitored the water levels and water quality in the area around the culverts. The culverts are made of concrete and are used to protect the salmon from the high water levels during the salmon run. The culverts are located on the riverbank, and the salmon swim through them to reach the river. We recorded the number of salmon that passed through the culverts, and we also recorded the water levels and water quality in the area around the culverts.

Results
We observed and recorded each culvert's upstream and downstream gradient, and the culvert's gradient, length, width, and height. Here are our results:

<table>
<thead>
<tr>
<th>Culvert</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
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<tbody>
<tr>
<td>Culvert 1</td>
<td>12 feet</td>
<td>12 inches</td>
<td>15.5 inches</td>
</tr>
<tr>
<td>Culvert 2</td>
<td>15 feet</td>
<td>15 inches</td>
<td>22 inches</td>
</tr>
<tr>
<td>Culvert 3</td>
<td>20 feet</td>
<td>20 inches</td>
<td>24 inches</td>
</tr>
</tbody>
</table>

Conclusions
Our findings suggest that the culverts have a significant impact on the salmon run. The culverts provide a safe passage for the salmon to swim through, but they also limit the habitat available for the salmon. The culverts can also cause changes in the water temperature and water chemistry, which can affect the salmon's health and survival. We recommend that the culverts be maintained and monitored regularly to ensure that they are safe for the salmon to pass through. We also recommend that the culverts be designed to provide more habitat for the salmon, and to ensure that they are not detrimental to the salmon run.

Acknowledgments
We would like to thank Tom and Beth Schumacher for their support and guidance throughout this project. We also thank the staff at the Yakutat School District for their assistance in this project.

For further information
For more information on the culverts or the salmon run, please contact the school district or visit the Fish and Wildlife Service website.
Southeast Alaska Regional Science Fair

Southeast Alaska Regional HS Science Fair
Juneau-Douglas HS
University Alaska Southeast
March 28, 29, 2008

Awards Ceremony March 2007
Winners go to Compete at
INTEL International Science
And Engineering Fair

May 11-14, 2008 Atlanta, GA
EDGE Program
Successes

2004-2008

• 43 EDGE MS/HS students, GIS/GPS training: 2 college credits
• 50 EDGE teachers, ESS, GIS, GPS training and equipment: 6 credits professional training (summer/fall/EDGE Symposium courses)
• >550 AK MS students trained in GIS, GPS and ESS through their EDGE Middle School teacher classes
• 8 (2007) and 10 (2008) EDGE HS student teams present science projects in Southeast Alaska Regional Science Fair
• 20 EDGE teachers receive training as science project reviewers-Science Fair Judges
EDGE-AK Space Grant
GIS Schools
(12 school districts, >25 schools)

HS
Alyeska CSS
Angoon
Barrow
Ben Eilsen
Bethel
Colony
Delta
Huslia
IDEA
Juneau-Douglas
Kongiganak
Kwigillingok
Mat Su CSS
Newtok
Nunapitchuk
West Valley
Yakutat

MS
Begich
Central
Dzanti’ki Heeni
Dryden
IDEA
Haines
Juneau Charter
Palmer
Ryan
Susitna
EDGE Teacher Influence of 2006 AK Secondary Science Students
The EDGE program has now reached 12 out of 54 (22%) of AK school districts. These districts contain 63% of the grade 6-12 student population.

EDGE teachers are now influencing 58 % of AK Middle Schools and 10% of AK High Schools by student population.

EDGE-Influenced Alaska Secondary School Districts
By Grades 6-12 Student Population

<table>
<thead>
<tr>
<th>EDGE Districts</th>
<th>MS (6-8)</th>
<th>HS (9-12)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchorage</td>
<td>11325</td>
<td>15449</td>
<td>0.3693</td>
</tr>
<tr>
<td>Fairbanks</td>
<td>3774</td>
<td>4853</td>
<td>0.1123</td>
</tr>
<tr>
<td>Matsu</td>
<td>3290</td>
<td>1818</td>
<td>0.0520</td>
</tr>
<tr>
<td>Juneau</td>
<td>1202</td>
<td>918</td>
<td>0.0417</td>
</tr>
<tr>
<td>Lower Kusko</td>
<td>736</td>
<td>918</td>
<td>0.0228</td>
</tr>
<tr>
<td>Northslope</td>
<td>339</td>
<td>559</td>
<td>0.0124</td>
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<tr>
<td>Delta Greely</td>
<td>306</td>
<td>557</td>
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<tr>
<td>Yukon-Koyukuk</td>
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<td>493</td>
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<tr>
<td>Haines</td>
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<tr>
<td>Chatham</td>
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<tr>
<td>Hoonah</td>
<td>32</td>
<td>66</td>
<td>0.0014</td>
</tr>
<tr>
<td>All Alaska</td>
<td>30027</td>
<td>42481</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
EDGE Teacher Inspired Secondary Outreach Programs

EDGE Year 2006-28 Participants
Juneau School District Geotreks Training
  Floyd Dryden MS Galau, Morris, Ferrell-250 8th graders
  Gastineau Elementary-Savikko-Knotweed Invasive Species Project-20 4th graders

EDGE Year 2007-20 Participants
• Anchorage Central Middle School GPS-Earth Science Geocaching-
  L. Gillam-44 MS Students
• Juneau School District Geotreks Training
  Galau, Morris, Ferrell-250 8th graders
• Juneau NOAA/Springboard HS Oceanography Camp-40 Students
  Galau & Savikko-20
• GPS Club-Gastineau 3rd Graders-Geocaching
  11 3rd-5th graders-Wahl, Savikko

Southeast Regional Science Fair-12 EDGE Students

>600 Alaskan MS and HS students across this state have collected GPS data and used GIS through the EDGE program
Unit Design Template

**Project Title**
Mendenhall Glacier...Past, Present, and In the Future

**Project Designers**
David Kevach

**Grade Level/Content Areas**
Grade 7 & 8 Physical Science

**Project Synopsis/Description**
This unit is designed to introduce students to topics in physical science, GPS technology, the scientific method, and help them become more familiar with their local environment. Students will study the physical properties of glacier ice including density, materials present and their abundance, and melting rates of different types of ice. Students will also use GPS technology to mark waypoints of physical features caused by glacier movement and then transfer these waypoints/locations onto a map of the area. Students will then use available data to make estimations of how long ago the glacier was at the location of the waypoints they marked. They will culminate the unit by using available USGS GPS data and historical maps of the glacier to determine a method for estimating glacial retreat. Students will use their method and calculations to make predictions for how long it will take for the Mendenhall Glacier’s face to retreat out of Mendenhall Lake to the point of it being a “hanging glacier”.

**Stage 1: Desired Results**

*Standards:*

1. **Science A1:** Students develop an understanding of process of science and use it to investigate problems, design and conduct repeatable scientific investigations and defend arguments.
   
   8th grade SA 1.2: Collaborate to design and conduct repeatable investigations in order to record, analyze, interpret data, and present findings.

2. **Technology C1:** Students should use technology to observe, analyze, interpret, and draw conclusions.

*Enduring Understanding:*

The student will understand that science is a process that gives people the ability to make conclusions to a question, predictions about phenomenon, and/or make recommendations for improvement to an issue under investigation.

The student will understand that changes in Earth’s surface over time are due to the interaction of many physical forces.

*Essential Questions:*

*Can we use science to predict the future?*
Juneau Middle School students carry out GPS GIS research (Glacier recession, Plant Succession, Bear use of habitat)
Plant succession can be used to date when a glacier has receded from an area if you know when plants grow back (see fifth slide). For example, if you see only small plants, such as moss and grasses, you know that the glacier receded around 5 years ago. If you see large hemlocks, you know that it’s been at least 350 years since the glacier receded.

We went to the glacier and marked areas using GPS. We traveled along the Trail of Time and marked waypoints where the glacier’s terminus is known. These can be used to see how accurate our predictions are. We then found places where the glacier limits were unknown, and made predictions using plant succession, and then dated when the glacier was there. Using ArcMap, we added our waypoints to maps and marked the glacier’s terminus. Finally, we compared our plant succession waypoints to the Miller Map, which shows the glacier’s old terminuses.

We found that our waypoints are mostly accurate. Our trail of time waypoints are correct. The waypoints on both maps are in similar positions relative to the glacier. You can see our waypoints are accurate by comparing where they are in relation to the Miller Map waypoints. Our 1826 waypoint is a reasonable distance from Mr. Robert Miller’s 1916 waypoint; our 1906 waypoint is close to his 1920 waypoint; our 1926 waypoint is very near to his 1930 waypoint. The only inaccurate one is our 1981 waypoint, which is too far north in comparison to Mr. Miller’s 1930 waypoint. Although the mark 1981 is off. This could be because of floods, fires, or human influence (mentioned under Discussion).

The most reliable way to find out where a glacier terminus is to mark the terminus BEFORE it recedes; plant succession can be unreliable. Other ways that plant life can be set back are floods, fires, and human influence. These can seriously affect your predictions on where the terminus was and when. In conclusion, plant succession cannot always be relied upon to show when a glacier receded. A way to make our information more accurate would be to return to the glacier and mark more waypoints, keeping in mind what we have learned about the accuracy of our current waypoints.

References
EDGE Publications/Presentations


Remote Sensing of Glaciers

The Mendenhall (an online case study for undergraduates)

http://www.polar-remotesensing.alaska.edu/case_glacier/faculty_extending.html
GIS/GPS and Geoinformatics Technology Enters AK Secondary Science Classrooms

UAF Fairbanks
UAA Anchorage
UAS Juneau

GIS Capability at Juneau's Middle Schools

Geocaching in Anchorage Central Middle School
Flying into the future EDGE 2.0..... What’s Next?