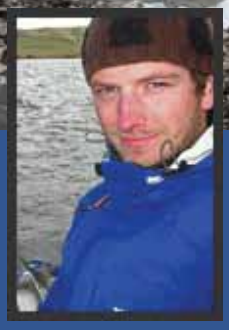
EVEREST Education Expedition

Climbers' Journal

A scientific expedition to Mount Everest featuring journal entries from Dr. David Lageson and Travis Corthouts, Montana State University Department of Earth Sciences

Use this Climbers' Journal in conjunction with the Everest Education Expedition curriculum materials www.montana.edu/Everest


Dr. David Lageson


Travis Corthouts

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Access the full online curriculum, including lesson plans, classroom activities and multimedia files at

www.montana.edu/Everest

EVEREST Education Expedition

In Spring 2012, a team of athletes and scientists embarked upon an historic expedition to commemorate the 50th anniversary of the first successful American ascent of Mount Everest.

Several of the team's climbers, led by mountaineer and author Conrad Anker, sought to retrace the steps of the first American ascent of Mount Everest via the difficult West Ridge. In 1963, two Americans (Tom Hornbein and Willi Unsoeld) became the first to successfully climb Everest's West Ridge then descend via the Southeast Ridge, thus traversing the entire mountain. This was one of the most difficult high-altitude feats in mountaineering history. It has not been repeated since 1963. Unfortunately, poor weather conditions on Everest kept the climbers from attempting the West Ridge.Therefore, the team used the Southeast Ridge route to get both up and down the mountain.

Concurrently, geologists from Montana State University conducted extensive scientific work on the mountain and shared the science of the Himalaya with students and the public.

The Everest Education Expedition, supported by Montana State University and Montana EPSCoR, placed special emphasis on bringing the excitement of science, discovery, and global adventure into classrooms across Montana and the nation.

Scientific Research

Scientific research on the geology of Mount Everest was a significant component of the Everest Education Expedition 2012, as it was with the first American expedition to Everest in 1963. Previous research in the Everest region has been limited in scope due to the obvious difficulties of conducting field work under extreme conditions of elevation and topography. The research agenda was directed towards gaining a better idea of the age of Mount Everest and rocks that comprise the massif; collecting a suite of samples to better date and describe the fossil-bearing marine limestones that form the summit pyramid of Everest; and studying the major faults that cut through Mount Everest to better understand how and when they formed (in particular, the Qomolangma and Lhotse detachment faults).

Dr. David Lageson, a Montana State University geologist, conducted several research projects while part of the expedition and was a grantee of the National Geographic Society. The expedition was sponsored by National Geographic and The North Face with support from Montana State University.

Classroom Connection

Throughout the three-month journey to Everest and back home again, Dr. Lageson and Travis Corthouts, a Montana State University geology graduate student, shared their experiences, adventures and research findings with students and teachers throughout the world.

Their story is captured here, through the photos, journal entries and videos that Dave and Travis sent back from the Himalayas. Though Conrad, Dave, Travis and all the team members have long since returned safely to their homes, your students can relive the Everest journey through this climbers' journal and accompany lesson plans, which are part of a larger educational effort called CLimate in My Backyard (CLiMB).

You can read your students the Everest dispatches by chapter, interspersing the day-to-day journal entries with lessons from the curriculum package. Or, share each day's new adventure and accompanying multimedia on the schedule that works best for your class.

All lesson plans, multimedia assets and educational resources are free online at **www.montana.edu/everest**

ENJOY THE JOURNEY!

Curriculum Overview

Through eight standards-based lessons, accompanying hands-on activities, multimedia files, and this climbers' journal, you and your students will explore the science of Mount Everest up-close and personally. From various scientific perspectives, you'll explore the biodiversity of Mount Everest and the Himalayan Mountain ecosystem.

This curriculum was designed for fifth grade but has been used in grades ranging from first through eighth. It features eight lessons, each 45 minutes to one hour long plus extensions for taking each topic further. Although the lessons can be completed in any order, it is recommended that lessons one and two be completed prior to exploring the climbers' journal. Lessons were not designed to correlate directly with the climbers' journal chapters, although teachers may choose to insert lesson plans and educational resources in at any point. The curriculum will help students:

- demonstrate the ability to design, conduct, evaluate, and communicate the results and form reasonable conclusions of scientific investigations.
- demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.
- demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
- demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.
- understand how scientific knowledge and technological developments impact communities, cultures and societies.
- understand historical developments in science and technology.

The curriculum materials were written by Kristin Dantagnan, an educator in Bozeman, Montana; Angie Hewitt Weikert, education director of early and elementary programs for the Museum of the Rockies in Bozeman; Jamie Cornish, science outreach and education specialist at Montana State University's Extended University; and Suzi Taylor, assistant director for outreach and communications for MSU Extended University.

The Everest Education Expedition is part of the CLimate In My Backyard (CLiMB) curriculum series developed by the Montana Institute on Ecosystems, Montana NSF EPSCoR and MSU Extended University.

Lesson 1: Who's on Top?

Meet climber Conrad Anker of Bozeman, Montana; Montana State University Geology Professor Dr. Dave Lageson; MSU graduate student Travis Corthouts; and the rest of the Everest Education Expedition team. Begin your journey of learning and exploration with Conrad, Dave and Travis as they leave their homes in Bozeman to climb the highest mountain in the world. Uncover the goals of the Everest Education Expedition and feel what it might be like to climb Mount Everest at extreme altitudes.

Lesson 2: Meet Mount Everest

Begin to unravel the layers of Mount Everest through geography and history. Learn where Mount Everest sits in relation to the world, to Asia, and to surrounding countries. Compare Mount Everest to the highest peak in your region. Trace the routes of the first Americans, and other mountaineers of the past, who summitted this peak, and plot the routes this expedition will take as you learn the history of the world's highest mountain.

Lesson 3: Sea Floor to Summit

Explore the rocks that lie beneath Mount Everest's summit. Simulate the formation of the Himalayan Mountains and Mount Everest while uncovering the dynamic processes of plate tectonics. Study the rocky layers that Dr. David Lageson researched on Mount Everest and investigate the geologic layers that sit below each climber's crampons (ice cleats). Discover how the ancient sea floor now sits on this extreme summit and ponder whether Mount Everest really is the tallest mountain on earth.

Lesson 4: What's the Weather?

Uncover the difference between climate and weather. Using a climate map of the world, explore climate regions around the Earth and compare your hometown climate and weather to that of Mount Everest. See how the expedition dresses for Everest's weather. Use daily online weather resources to record and graph the weather over an extended period of time both in your hometown and at the top of the world.

Lesson 5: Ice in Action

Explore glaciers and how they have shaped landscapes around them. Watch glaciers in Montana and those near Mount Everest change over several years through photographs and time lapse images. Identify parts of a glacier and compare the decline of Himalayan and American glaciers. See how Mount Everest has been shaped by ice in action in the past and how the possible absence of glaciers in the future could change this mountain and those living in its shadows forever.

Lesson 6: Everest Extremes: Biodiversity

Identify and categorize plants and animals living in the Mount Everest ecosystem with an emphasis on which species are endangered, threatened or a species of special concern. Gain a deeper understanding of and connection to the biodiversity of the Himalayan Ecosystem by studying individual species and creating a Himalayan food web. Develop an appreciation of how connected all ecosystems are including the one in your own backyard.

Lesson 7: One Mountain, Many Cultures

Mount Everest rises above a land that is home to a diverse population of indigenous cultures. This region is home to people that have lived in harmony with their environment for centuries. Discover what it is like to live in a land of extremes below the highest mountain in the world and the significance of ceremonies and prayer flags. Explore this sacred mountain and sacred mountains near you.

Lesson 8: Climb into Action!

Get involved! There are actions we can take at home, in our communities and at our schools that will help slow climate change and preserve Mount Everest and its glaciers, creatures, and people. Explore ways you affect the Earth's ecosystems and how you can make a difference using all your knowledge of Mount Everest and its cultures.

Chapter 1: The Journey Begins

March 23, 2012
Kathmandu, Nepal
by Travis Corthouts

Yesterday, Dave, Conrad, Cory and I made it to Kathmandu and we arrived at the Yak & Yeti hotel by 2pm. Our ride from the airport was awesome, there are no traffic laws. Cars and motorcycles go anywhere, at one point there was opposing traffic on either side of our car. Total orchestrated chaos. Once we got to the Yak & Yeti we were immediately thrown into the mix of organizing gear with the rest of the team. After we finished re-packing our gear, most of it was flown by helicopter to some place we trek through on our way to Base Camp.

All of the climbers except Dave, Conrad, Cory and I, flew to Lukla this morning to begin their trek to Base Camp; we will fly out tomorrow. In an hour from right now we get picked up by an embassy car to go meet the U.S. Ambassador. I'll finish up this dispatch when we get back...

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We just got back from the embassy and it was very cool. Lots of security and the building was amazing. It's entirely made of granite and it's smack in the middle of third world chaos. Once we entered I honestly thought I was back in the States as everything inside was so "American" in design and feel. Unfortunately we didn't get to meet the ambassador, just his closest staff as well as the public relations staff.

March 24, 2012
Monjo, Nepal
by Travis Corthouts

We flew out of Kathmandu today on a 45 minute puddle jumper flight to Lukla, which involved a thrilling landing because the airstrip sits on a hillside in a steep valley and the runway is tilted about 20 degrees uphill. So, about 35 mins into the flight the pilot started diving steeper and steeper; clouds and hillsides were passing by the windows; the engine was screaming. Cory turned to tell me to look down the aisle and out the cockpit windshield. I did, and seconds later the white stripes of the runway appeared and we were diving right at them! The plane fishtailed a couple times and then the pilot ripped the yoke back in perfect time for the plane to right itself and match the pitch of the runway for a perfect landing! The passengers clapped and cheered. We unloaded; our porters were right there to grab all our bags; then we hit the trail.

Airport in Lukla. *Photo by Dave Lageson.*

It's the end of the day now and we're staying at a teahouse for the night. A teahouse is basically a bed and breakfast except you're way up in the mountains, the amenities are fewer and the hospitality and food is great; the Sherpa people are so generous. We sit in their kitchen while they serve us an endless supply of tea/coffee and whatever food we want, all made by scratch and cooked on a log fed stove.
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Chapter 1: The journey begins

March 25, 2012
Namche Bazaar, Nepal
by Travis Corthouts

Day two of our trek took us past several settlements and everywhere along the trail were prayer flags, prayer wheels and plenty of other auspicious markers, which you have to go around the left side of, or else it's bad luck. The weather is very nice. It's a bit brisk in the morning, but by noon I've been hiking in a t-shirt and shorts. We gained little elevation for most of the day, but in late afternoon we made a steep ascent up to Namche Bazaar, which is a very neat settlement nestled in a bowl shaped part of the valley wall. Today's hike ended here in Namche Bazaar at 11,500 ft (3505 m), where we met up with the rest of the team who was taking a rest day.

Photo by Travis Corthouts

Prayer flags.

Namche Bazaar. *Photo by Travis Corthouts.*

MULTIMEDIA

Watch a Google Earth fly-over of the Everest Base Camp trek at: http://youtu.be/AT3xYkRcY4g

March 26, 2012
Phortse, Nepal
by Travis Corthouts

Today was an amazing day, we got a great view of Everest and Ama Dablam and we hiked as high as 13,000 ft (3962 m) at one point on our trek. The day ended in Phortse, 12,500 ft (3810 m), where Conrad and his wife Jennifer are well known. They funded a new library and are currently building a facility for Conrad's Khumbu Climbing Center. Tonight we're staying at a teahouse owned by Panuru, the sirdar for our expedition, (the sirdar is the head Sherpa).

The scenery here is amazing, but one thing I must say is the scale of the landscape is astonishing and the valley walls are so steep! The trails contour along the mountainsides and when you look down to the valley floor it appears to be straight down. This presents a problem as your eyes are drawn to the peaks above and not on the trail in front of you. There have been a few missing person signs along the trail and Conrad says these are people who miss stepped and… see ya! He says he's heard of multiple occurrences like this. I've made a personal rule to stop whenever I'm taking a picture or looking up.

Photo by Travis Corthouts

Chapter 1: The journey begins

March 27, 2012
Phortse, Khumbu Valley, Nepal
by Dr. Dave Lageson

Today is a rest day to acclimate to the high elevations of the upper Khumbu Valley. Phortse is located at an elevation of 12,500 ft (3810 m) on a bench between the Imja Khola and Dudh Koshi Rivers, the former carrying melt water from the Khumbu Glacier on the Everest massif.

The weather is clear and sunny in the mornings with beautiful views of enormous mountains like Thamserku (21, 679 ft or 6608 m) and Kangtega (21,932 ft or 6685 m) across the valley from us. With a short hike we can see the stunning peak called Ama Dablam (22, 493 ft or 6856 m), which means "Mother's Necklace." The "necklace" is a perched glacier that lies high on this beautifully sculpted glacial horn. In the afternoon, clouds move up the Khumbu Valley from the south and we become shrouded in wind-driven mist.

The bedrock geology consists of augen gneiss and schist with occasional tight, isoclinal folds, cut by veins of white, muscovite-rich pegmatite. Foliation in these rocks dips very steeply to the north. The thing that strikes me most dramatically is the incredibly "newness" of the landscape.

Dr. Lageson with a gneissic fold. *Photo by Travis Corthouts.*

The Greater Himalaya are rising so rapidly that many of the smaller tributaries to the main rivers have not had enough time to cut sizeable canyons. The valley slopes are incised by narrow slot canyons that steeply rise to wider glacial valleys. Erosion seems to be having a hard time keeping up with tectonic uplift. But then again, high rates of erosion along the southern face of the Greater Himalaya work in concert with convergence of the Indian and Eurasian plates to enhance regional uplift.

Ama Dablam. *Photo by Travis Corthouts.*

Regardless, this is a landscape on the move and the direction is unquestionably upwards! The thing that is hard to put into words is the incredible scale of everything – the mountains, valleys, glaciers and rivers are simply enormous!

As a footnote, an earthquake a few months ago cracked many of the masonry and stone structures in the Khumbu, testimony of the tectonic stresses at work beneath Earth's greatest mountain range!

MULTIMEDIA

Dr. Lageson explains how the Himalaya can be so tall:

http://youtu.be/3mzcPdKo-Sk

March 28, 2012
Phortse, Khumbu Valley, Nepal
by Dr. Dave Lageson

Today we trekked to a fantastic Buddhist monastery at Tengboche on the east side of the Imja Khola River. The trek was not long, about two hours, but involved a very steep descent to the river followed by a steep climb up to the monastery. Thamserku and Kangtega tower above Tengboche – the relief is enormous! The monastery is perched on what appears to be a remnant of an enormous glacial moraine; cuts along the trail revealed poorly sorted silt, sand and huge boulders – typical of a moraine. Tengboche offers an incredible panorama of Everest, Nuptse, Lhotse and Ama Dablam. Today was clear and sunny in the morning, as seems to be the norm, with a huge banner of snow blowing off the summit of Everest. We are in the process of marching to Everest Base Camp and slowly acclimating to the elevation. It is critical to go slow and acclimate well to avoid altitude sickness.

Tomorrow we leave Phortse and trek to Pangboche, where we will stay for another couple of days before moving ever closer to Everest Base Camp. Our ETA at Base Camp is April first!

Chapter 1: The journey begins

March 30, 2012
Pangboche, Khumbu Valley, Nepal
By Dr. Dave Lageson

Trekked to Pangboche in the morning; this leg of the trek was fantastic! After a steep climb above Phortse, the trail contours along cliffs with stone stairs and incredible relief above the river. This is no place to stumble! An incredible view of Everest is presented as one rounds a corner about half way to Pangboche

In the afternoon we had two blessings known as Pujas – great experience! One of the blessings was from the Lama Geshe and he gave each Everest climber a personally signed card to carry to the summit.

April 4, 2012
Everest Base Camp
by Dr. Dave Lageson

· We have been in Everest Base Camp (EBC) since April 1st and are getting settled in.

· Sitting in my tent writing this during a typical afternoon snow flurry; warm and cozy thanks to my North Face expedition tent!

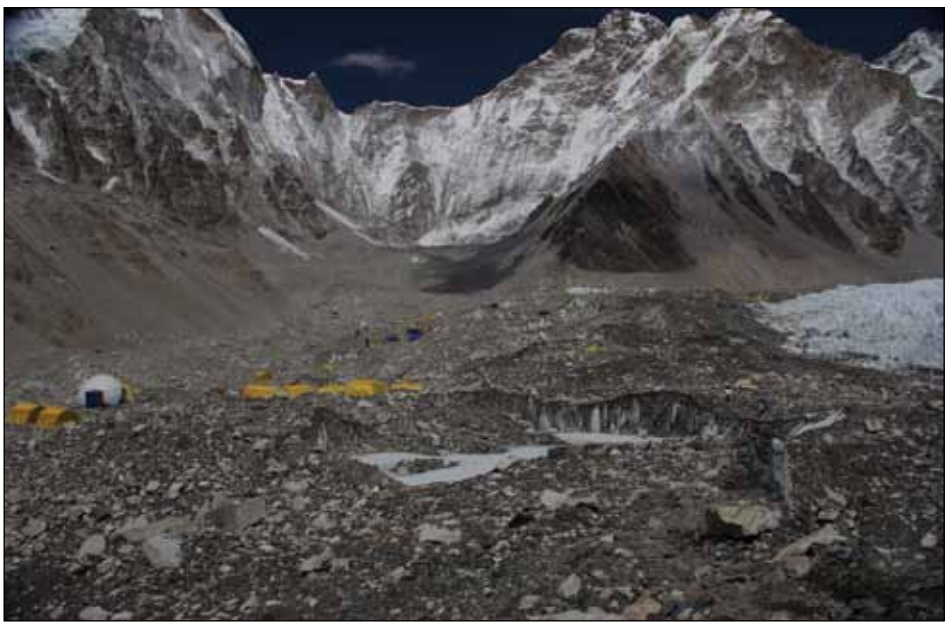
· We are having difficulties communicating back to MSU because the cell tower at Gorak Shep is not cooperating and our satellite-dish system has some bugs to work out, but Travis is working hard to overcome these issues soon.

· EBC sits on the glacier so one can hear creaking during the quiet hours of the night, punctuated by rock falls on the steep face of the lateral moraine that lies adjacent to us; we also see and hear frequent avalanches off the incredibly steep mountains that surround the Khumbu Glacier at the base of the icefall (Nuptse, Khumbutse and Pumori).

· EBC is becoming more populated as climbing teams slowly trickle in; Everest ER, the medical clinic at EBC, is in the process of becoming operational now, which is a huge asset to all at EBC.

· Two of our climbing Sherpas have staked out Camp II in the Western Cwm* above the Khumbu Icefall. Our first ascents of the icefall may come in a week or so. In the meantime, we are further acclimating by hiking up to Pumori Camp 1.

*cwm is pronounced "coom"



Everest Base Camp. *Photos by Travis Corthouts.*

Chapter 2: Our new home

April 7, 2012
Everest Base Camp
By Travis Corthouts

Today was a rest day for most of the group. The weather was pretty nice, about 45°F and sunny with patchy clouds. Currently most of the group, including me, is sick with a head cold, Dave is starting to show signs as well. Fighting a cold at 17,500 ft (5334 m) is tough because white blood cells don't repopulate very efficiently at high elevations. Pause! Just as I finished that sentence, a loud crack then bang happened outside the tent. I went out with Cory and Anjin to watch a huge avalanche tear down the side of Lhotse onto the Khumbu Glacier. This sort of event is common at Base Camp and you hear several happen every day; though this one was the biggest I've seen yet. Most are caused by seracs (ice blocks/towers), collapsing which then trigger the avalanche. Avalanches and icefall are a major contributor to a glacier's net gain of mass.

Tomorrow Dave and I will go to Gorak Shep to install the Trimble NetR9 base station which will be used to correct elevation data for our measurement of Everest. Also, tomorrow morning we have our final Puja ceremony.

April 8, 2012
Everest Base Camp,
By Travis Corthouts

Greetings from Everest Base Camp. Today is beautiful, about 50°F, with the sun blazing down on our fragile skin; sunscreen and covering up any exposed skin is a critical task every day. Today is a "camp day" which essentially means rest and taking care of tasks like laundry, showering, perfecting solar panel alignment (so we have a good power source), cleaning/organizing, etc. I personally hope to take a quick trip into the lower Khumbu and then get caught up on photo/video work.

Yesterday was an auspicious day for the native Sherpa population and it was likewise the day for our Base Camp Puja; a very well know Lama came from down valley to perform the ceremony. All of our climbing/guide Sherpas were in attendance and all members of the team put forth several pieces of climbing equipment to be blessed. With smoke from burning juniper and all climbing gear and persons settled around the Base Camp Chorten (a shrine), the Puja began. The Lama preceded by reading prayers and flicking holy water into the air. A bowl of rice circulated throughout the ceremony and we all threw rice to the Chorten as an offering. Halfway through, Sherpas tied prayer flags to the mast jutting from the Chorten and then extended them for over a hundred feet in the four cardinal directions, tying them off where they naturally met the ground. The Montana State University, National Geographic Society and American flag were also hung from the mast. We united in a chant as the Lama's blessings came to a close and we all stood to congratulate one another with hugs and handshakes. Platters of soda, beer, chang (rice beer) and food were passed around as we all celebrated the expedition. A bowl of tsampa circulated and we each took some and smeared the flour across each other's faces as good fortune. As we settled down, the Lama placed Khatas over each of us and then with a sharpie, wrote a blessing on our helmets.

I left the celebration a little early so I

Puja Ceremony. *Photos by Travis Corthouts.*

Chapter 2: Our new home

could prepare GPS equipment for installation in a tea house at Gorak Shep; which is where Dave and I planned to trek to after lunch. This equipment can't be installed at Base Camp because it needs constant power and Base Camp is on a moving glacier and the equipment must be installed in a static location. The Trimble NetR9 base station will take GPS data 24/7 and in doing so, refine its location so precisely that its data can then be used to differentially correct data collected by the receivers taken to the summit by Sherpa Jangbu and Danuru. This will allow decimeter accuracy (4 inches) of our elevation measurement of Mt. Everest.

Gorak Shep. *Photo by Travis Corthouts.*

On our two hour trek to Gorak Shep Dave and I both felt a bit weak from the cold that we, and most of the team, has contracted now. The owner of the tea house we chose is related to the sirdar (head Sherpa) of our expedition; which facilitated the whole operation. For $500USD we were allowed to install the antenna to the roof and run a cable from there, through a window to the main base station receiver; which I mounted to a wall in the kitchen. I wasn't able to settle the matter of how the receiver would get power because all the owner could offer was a car battery charged by a solar panel. So tomorrow I'm trekking back down to install an inverter directly to the battery which will then provide a typical AC outlet for the NetR9 to plug into. After installation Dave started his trek back to Base Camp and I stayed to run some tests on the receiver to make sure it was running right. I left Gorak Shep two hours later and arrived at Base Camp just as it got dark; in time for a great meal of pasta parmesan, steamed green beans, fried spinach/veggie balls and pear slices for dessert.

Receiver mounted on teahouse roof.

Travis with the Trimble receiver to collect GPS data. *Photos by Travis Corthouts.*

Chapter 2: Our new home

April 12, 2012
Everest Base Camp
By Dr. Dave Lageson

Yesterday, several members of the climbing team participated in an "icefall" training session on the Khumbu Glacier. A short hike from Everest Base Camp (EBC) took us to magical place of ice towers, ice walls and ice spires. We practiced with crampons and ascenders, rappelling, and crevasse rescue techniques. It was a good refresher and a lot of fun to work on some basic mountaineering skills in the Khumbu "ice garden."

Tomorrow, about half the team leaves for our first "rotation" through the Khumbu Icefall. They will leave in the pre-dawn hours and climb through the icefall to Camp 1, where they will spend the rest of the day and the night. The next day, they will hike up the Western Cwm to Camp 2 where they will spend two nights before returning to EBC. The rest of the team (me included) will follow the same schedule, starting day-after-tomorrow. This first rotation into the Western Cwm is needed to acclimate to the ever-increasing elevations on Everest. It is a tradeoff between climbing high and then coming down several times to gradually acclimate, versus minimizing the number of times one must traverse through the dangerous Khumbu Icefall.

This boulder displays a boudinaged vein of quartz and feldspar. *Photo by Dave Lageson.*

I am slowly climbing out of the hole that the virus (essentially a generic "head cold") put me in. I was acclimating well to altitude until I caught this bug, which about half our team has kindly shared. This would have been a minor nuisance in Bozeman, but at 17,200 feet (5343 m) it is a semi-big problem to shake off. But, I'm doing much better and am looking forward to getting out of EBC and seeing the geology first-hand on the high mountain walls that surround the alpine amphitheater of the Western Cwm.

This morning we passed out gifts to our Sherpa and Nepali cook staff at EBC. It is fun to see everyone wearing Montana State University caps, in addition to the water bottles, stocking-caps, and other MSU gifts that we passed out.

I am attaching a photo of a boudinaged vein of quartz and feldspar in a boulder along the trail through the middle of EBC. This is typical of the rocks one sees across the top of the Khumbu Glacier – almost every rock is a textbook example of a structural or petrologic process! This particular rock displays evidence of stretching or extension in one direction, producing "boudins" or detached pods of quartz and feldspar – a process called boudinage. This stretching event (or events) occurring during intrusion of innumerable granitic sills in the country rock beneath the Lhotse detachment fault. My Swiss Army knife serves as a scale for the photo.

One word to describe the weather during the past few days – COLD! We may or may not have sun in the morning, but the afternoons and evenings are invariably windy, overcast and snowy. I'm trying to dry some clothes that were washed a couple of days ago, and that is proving to be a challenge. Sometimes during the day I just have to retreat to my North Face tent and sleeping bag to warm up for a while, where I have short dreams of hot summer days in Bozeman and evening walks with my wife. But right now, the Khumbu wind is buffeting the tent and low snow clouds are swirling around Nuptse and the Icefall. Now I hear the call for "dinner!" Hopefully some hot food will warm my feet.

MULTIMEDIA

Dave demonstrates the geology of rocks found in Base Camp at: http://youtu.be/QifNqFwWVyE

Chapter 2: Our new home

April 12, 2012
By Travis Corthouts
Everest Base Camp

Greetings! A small group of us head into the Khumbu Icefall tomorrow at 3am (Me, Andy, Sam, Kristoffer & Hillary). We intend to sleep at Camp 1 tomorrow night and then Camp 2 (21,500 ft or 6553 m) for the following two nights. While at Camp 2, I plan to climb out to the bottom of Everest's SW face where I will sample outcrops; the samples I collect will be the focus of my masters thesis. We will have no connection with the outside world there, but as soon as I get back I'll send an update.

April 17, 2012
Everest Base Camp
By Travis Corthouts

Today the entirety of our team returned from either Camp 1 or Camp 2 after initially departing from Base Camp on the 13th. We set out in two waves of team members separated by a day; the first wave consisted of Kris, Hilaree, Andy, Sam and I. We left camp into the Khumbu Icefall at 4:30 am intending to make it to Camp 1 by mid-morning. The climb through the Khumbu Icefall has taken the name "the slow dance with the fat lady (or man) in the ballroom of death," and the idea is to get through without the fat lady tripping and falling on you – meaning, without having a serac crush you or an avalanche from Everest's SW face bury you. While these scenarios are rare, they are very possible and have happened innumerably over the years that climbers have been traversing the Khumbu. Anyway, our dance went well with no close calls and an on-time arrival to Camp 1.

Heading through the Khumbu Icefall. *Photo by Travis Corthouts.*

In the realm of mountaineering, the Khumbu Icefall has somewhat fabled status as it's the most technical and objectively dangerous feature on the most popular avenue to the roof of the world. So for me, as a climber, it meant a lot to pass through a legendary gauntlet that so many giants of the sport have also crossed. On our climb, we were virtually the only people in the icefall, as most expeditions are still arriving to Base Camp and we've been here for two weeks. Every year at this time the icefall turns into a circus due to the hoards of summit-seekers that blitz Everest. So we were lucky to get the rare opportunity to have the icefall to ourselves.

The route through the icefall is set by the "icefall doctors," a group of six Sherpas who establish and maintain the route each season. One of the fees paid by all expeditions using the icefall, goes

MULTIMEDIA

Watch a video of Travis crossing a crevasse in the Khumbu Icefall at: http://youtu.be/Dg3HSclwUio

Travis, Kris, Hilaree, Sam and Andy arrive at Camp 1: http://youtu.be/t4li7DM8tm0

Chapter 2: Our new home

to paying the doctors and the funding the material (ropes, ladders, pickets & ice screws) used to sustain the route. So, the doctors string up fixed rope throughout the icefall to protect climbers from falling into crevasses or down faces of snow and ice. They also lay cheap, light, aluminum ladders across crevasses and up seracs; where the span is too great for one ladder they will overlap ladders and tie them together. As the season wears on, the ladders degrade and break, ice screws and pickets melt-out, ropes fray; leaving plenty of maintenance for the doctors.

As you make your way through the icefall it essentially resembles a giant obstacle course. You're constantly changing your direction, pitch and technique as you adapt to terrain that resembles giant kernels of popcorn frozen together; kernels ranging in size from house to refrigerator. Fixed to your harness is a two foot length of 6 mm cord with a carabiner at the end; this is your means of attaching to the fixed ropes. When you arrive at an ice screw or a picket anchoring the rope, you have to un-clip and then clip back in on the other side of the anchor. You also use the ropes to pull up steep sections of ice and to body repel down the steep sections. Ladders are ubiquitous throughout the fall and are a bit tricky to work with because of the crampons on your feet, but you get used to it. The whole time, speed is essential, as the less time spent in the ballroom the better your odds are.

The view into a crevasse. *Photo by Travis Corthouts.*

Camp 1 (19,300 ft or 5882 m) lies atop the icefall amongst large transverse crevasses created by the Khumbu Glacier bending over the crest of the bedrock precipice that creates the icefall. From camp you can see the summit of Everest, Nuptse and Lhotse, the land is so big you have absolutely no grasp of scale. The summit of Everest appears to be just above you, barely out of reach, but it's 10,000 vertical feet (3048 m) above you! The landscape is simply outrageous, it's more eye candy than your brain can handle. Normally at Camp 1 the circus of tents and summit suitors might diminish the majesty of the surroundings, but we were the first expedition to reach Camp 1, the first tents in the western Cwm! Anyway, we arrived at 10:30 to find some duffels filled with our tents, stoves and food. We established camp, boiled water, made food and tried to nap. Sleeping was a bit hard as Camp 1 and 2 lay in the western Cwm, aka the "solar oven." The sun passes straight over the Cwm and reflects off the steep walls of Nuptse, Lhotse and Everest, converging at the valley floor. Temperatures in the CWM can reach up to 100°F and with sunlight bouncing everywhere, you must be diligent about covering all skin. We all felt good considering the 2,000 ft (609 m) elevation gain, a few slight headaches were the only complaints. Although, while at Camp 1 I got the worst bloody nose of my life; bleeding for over a half hour. I divulge this info because it is significant as background to future events.

To be continued (see p. 14)

Ladder crossing on the way to Camp 1. *Photo by Travis Corthouts.*

*cwm is pronounced "coom"

Chapter 2: Our new home

April 20, 2012
Everest Base Camp, Nepal
By Dr. Dave Lageson

We left Base Camp on April 14 (Saturday) at 3:40am for Camp 1 at the top of the Khumbu Icefall; it was obviously dark and very cold with an icy wind blowing from the upper reaches of the glacier as we strapped on our crampons and began the process of negotiating the icefall, following the route that the "Icefall Doctors" have prepared.

I lost count of the number of aluminum ladders laid across crevasses and against steep, tilted blocks of blue glacial ice the size of railroad boxcars, but I think there were at least 40 or so; some of the ladders were well-used and rickety, while others were newer and inspired more confidence. Some of the crevasses were so wide that the Icefall Doctors had lashed two ladders together to make a longer bridge.

Crossing an aluminum ladder over a crevasse is somewhat stressful the first time or two, but the learning curve is fast and steep; here are the basic steps:

• Clip into one of the safety lines with a locking carabiner;

• Focus your eyes on the ladder rungs, not on the depths of the crevasse beneath you, placing the front-points of your crampons on the next rung and your heel on the rung behind (depending on your foot size and spacing of rungs on the ladder, you may have to make adjustments);

• As you move across the ladder, one holds the two safety lines with tension, either by leaning forward or backward slightly depending on the angle of the ladder, which greatly helps maintain balance;

• The Sherpas often just scoop up a safety line in their hands and then literally run across the ladders without blinking, in stark contrast to the slower, methodical, turtle-pace of my ladder crossings; oh well – the crevasse crossings became much easier and quicker with time, even for this old man.

Ladder crossing on the way to Camp 1. *Photo by Travis Corthouts.*

Khumbu Icefall. *Photo by Travis Corthouts.*

I arrived at Camp 1 at the top of the Khumbu Icefall around 10:00 in the morning, making my first-time-ever transit through the icefall around 6 hours and 20 minutes – slow, but not totally disgraceful; it was a very aerobic workout! The morning was bright and sunny, so I rested in my Camp 1 tent, hydrated and ate some candy; by afternoon, it was cloudy, very windy and snowy (typical afternoon on the Khumbu Glacier – mornings can be a solar furnace, whereas afternoons and evenings are often windy and cold).

Although at the top of the Khumbu Icefall, Camp 1 is nevertheless surrounded by large and deep crevasses. One dare not wander around at night without a headlamp and a clear memory of the landscape, for fear of slipping into one of the crevasses. Interestingly, our outdoor latrine (carved out of snow) offers a spectacular view of gaping crevasses right below a steep slope on which the latrine is perched; this is no place to slip when dropping your pants in the middle of the night!

Chapter 2: Our new home

The next morning we started for Camp 2 (Advance Base Camp, or ABC), around 9:40am after eating, hydrating and packing gear; I seemed to have no energy and my pace up the glacier was very, very slow. As per the norm, it started off sunny, but then turned overcast and snowy with a fairly severe ground blizzard – I couldn't see my feet at times, which is not good on a glacier with crevasses! One of the Sherpa climbers stayed with me the whole distance to Camp 2, patiently waiting while I caught my breath every few steps and guiding me through the ground blizzard – he was my guardian angel for sure! I arrived at Camp 2 by mid-afternoon (at 21,200 feet or 6461 m), totally discouraged at my slow pace, completely exhausted and cold-to-the-core. Dinner and liquids that evening at Camp 2 helped to revive me a bit.

Camp 2 is located on the north flank of the Khumbu Glacier, where the glacier is covered with rocky debris from Mount Everest which towers above. My overriding impression of Camp 2 is the wind – the never-ending roar of the wind, thousands of feet overhead as the jet stream winds a circuitous path around the towering monoliths of the Greater Himalaya. Even when the wind is not blowing at Camp 2, one can hear the roar coming from above, accompanied by a white plume of cloud streaming from the summit of Everest. It is all very intimidating!

West Face of Nuptse. *Photo by Travis Corthouts.*

Climber in the Western CWM on the way to Camp 2. *Photo by Travis Corthouts.*

April 16th was a delightful day in the upper Western Cwm. It was sunny and clear throughout the day (what a delight compared to the previous day!) and I hiked to the base of the Lhotse face, looking for interesting rocks and marveling at the fantastic folds and faults in the lower Yellow Band marbles below the steep ridgeline between Lhotse and Nuptse. Of course, Everest towered above me all day long, with white granites at her base, overlain by dark metamorphosed pelites (Everest Series) and the distinct upper Yellow Band higher up (encircling Everest like a gold wedding ring) – all capped by gray, marine, fossil-bearing limestone beds on the summit pyramid 8,000 feet (2438 m) above me! The afternoon sky remained crystal clear and I had the privilege of watching the rocks on Everest turn to darker, richer colors as the sun slowly sank somewhere over the western Himalaya – standing at the base of Everest at over 21,200 feet (6461 m), I was alone and lost in tectonic thoughts as the tallest mountain on Earth showed me her evening colors. The only sound was the roar of wind a few thousand feet above.

The "roar" of Everest accompanied my dreams that night at Camp 2, and the next morning (April 17th) I returned to Everest Base Camp at 17,200 feet (5242 m). To put this into perspective, this is like going from Bozeman to sea level (almost) in terms of elevation loss; it is amazing how "low" 17,000 feet (5181 m) feels after spending a couple of days above 21,000 feet (6400 m)! I am pleased to report that I have yet to experience any of the usual side-effects of high altitude, such as headaches, etc. – at least side-effects that I am aware of. However, I am quite tired most of the time and easily exhausted when doing strenuous activity (…like walking!), so perhaps I have nothing to brag about.

I thank Mount Everest (Qomolangma) for the gift of a spectacular day and sunset at the head of the Western Cwm a couple of days ago, standing at the base of her southwest face. It was one of those deeply felt moments when a geologist becomes lost in the stories of the rocks and the incredible beauty of this planet. Geology offers a window of continuity from the distant geologic past to the present to the future, all captured by a sublime sunset reflecting off the varicolored rocks of Qomolangma.

Chapter 2: Our new home

April 19, 2012
By Travis Corthouts
Everest Base Camp

Continued from 04/18/2012

Temperatures hovered around 0°F for our night at Camp 1 and we woke to whipping winds. At 6am Conrad and Cory rolled into our camp after their dance with the fat lady. They had a close call toward the top of the icefall when a small avalanche swept down off of Everest's SW shoulder. Cory was closest to the path and was near enough to get dusted by the settling cloud of snow. A similar incident happened with one of our Sherpas a few nights ago in nearly the same location. In any case Cory was clearly rattled by the event. About two hours after arriving Conrad and Cory split for Camp 2 and we packed up and did the same about an hour later; some members in the second wave showed up as we were leaving.

The hike to Camp 2 isn't terribly hard as the gradient never gets too steep; however, you do gain 2,000 ft (609 m), bringing you to 21,500 ft (6553 m). It took about three hours of hiking with the first hour bringing us to several ladder crevasse crossings. You can see Camp 2 for most of the trek and it seems so close, but the epic scale of things is deceiving you, and Camp 2 continues to loom in the distance like an oasis. Sam, Kris and Hilaree left before Andy and me, so we were basically the only two people we could see as we hiked through the vast Cwm. After the ladder crossings early in the hike, I pulled ahead of Andy and we soon were black dots to each other. The air got noticeably thinner as I went and two breaths per step was my pace. It was a clear, blue, windy day and the summit of Everest was enveloped in lenticular clouds that churned like water boiling in slow motion.

Camp 2 at base of Everest southwest face. *Photo by Travis Corthouts.*

Our tents were the only tents set at Camp 2 and we arrived to find the others hard at work making tent platforms and our Sherpas, at making lunch. Camp 2 is a large camp for all expeditions and it usually offers the same amenities as Base Camp (BC), which is why it's also known as Advanced Base Camp (ABC). Camp 2 is set on the flank of the Khumbu Glacier, on a lateral moraine at the base of the SW face of Everest. It's here that Conrad and Cory will split from the standard SE Ridge route, onto the SW face and up to the West Ridge. The Sherpas in our expedition hadn't yet completed building camp, so after lunch we all worked on carving tent platforms out of the frozen ice/rock terrain; shoveling, chipping with a pickaxe, moving rocks, etc. Since none of us were acclimated yet it was funny to watch each other work for 30 seconds and then be totally winded. Our main goal was to finish the platform for our two-meter dome tent, which is a huge tent that multiple people needed to stay in for the night since not all other tent platforms would be done.

Cory, Andy and I stayed in the 2M dome tent ,and after it was set up we laid out our sleeping gear and went to dinner. At dinner Sam offered the group an Aspirin and a few of us, including me, indulged. At high altitude, your blood thickens and so a small dose of Aspirin, taken occasionally while acclimating, helps thin your blood. Anyway, after dinner Cory, Andy and I were back in the dome tent about to go to bed when I blew my nose and another bloody nose started. This episode was even worse as the Aspirin thinned my blood to that of water. After 20 minutes Andy went to Kris's tent to inform him since he was the leader for our team and it wasn't clear if the bleeding would stop. This was all compounded by my bleeding a day earlier since at such high altitude there is no way your body can replace the red blood cells in time. So I started to get slightly apprehensive as I sat there losing the precious vehicles that carry oxygen to my brain. Andy returned, and Kris felt if it didn't stop within an hour, I should go on oxygen for the night to minimize the risk of altitude sickness. Luckily it did stop. By taking the tissues away and just breathing as much air as possible through

Chapter 2: Our new home

Travis in the Western CWM on the way to Camp 2. *Photo by Travis Corthouts.*

my nose, the arid Himalayan air dried the blood fast enough to cause the bleeding to slow down considerably; then over an hour later, stop completely.

The next morning I woke feeling pretty good, although I did feel like I had a mild blood drive hangover. At breakfast Kris and I had a quick conversation, and we agreed that since I had lost so much blood I was at higher risk of getting altitude sickness, especially if I sprung another leak. So just to be safe, I decided I would pack up and leave for BC that morning ASAP. One of our Sherpas, Dangbu, was also leaving for BC that morning, so we paired up and departed Camp 2 at 10 am. I needed to leave urgently because the optimum hours to cross the Icefall are between 2 am and noon, so my window was closing. As the sun warms the icefall and things get soft and mushy, seracs aren't structurally stable enough to support their own weight and so are prone to collapse. On the same token, the chances for an avalanche increase as the snowpack loosens under the heat of the sun. Also, late in the day when things start to freeze again, melt water that has infested cracks and open spaces will expand as it freezes, cleaving off seracs in the process.

I was excited when I found out Dangbu would join me down to BC as he is a strong, experienced Sherpa, speaks pretty good English and is exactly my age. We cruised through the Western Cwm where we passed the rest of the team as they began their trek to Camp 2. At the top of the icefall we stopped for five minutes, drank water, split a Clif bar, I put away my camera and Dangbu adjusted his crampons. As he did before we left Camp 2, Dangbu insisted that he carry my pack, but I didn't let him. With Dangbu in front, we set out into the fall and quickly set a fast pace. A group of four Sherpas caught up to us and we let them pass; for the rest of the fall we kept pace with them. The Sherpas on Everest are extremely fast through the fall and I was completely winded just trying to match their speed. But it was windless and sunny, ice was beginning to melt, so I figured the faster I could get through the better. In the end, Dangbu and I made it from Camp 2 to the bottom of the fall in two and a half hours, and I was spent!

Chapter 3: Life in Base Camp

April 20, 2012
Everest Base Camp
By Dr. Dave Lageson

We are still in a holding pattern between rotations to Camp 2 in the Western Cwm. Aside from the seemingly endless process of acclimatization, we are waiting for Sherpas to "fix ropes" up the Lhotse face to Camps 3 and 4, with Camp 4 being on the South Col. We are told that ropes will be in-place by April 28. In the meantime, fighting boredom and trying to stay healthy are the two main tasks each day.

The Khumbu Icefall seems to be more dangerous this year than in past years, according to those with experience. The upper part of the route through the icefall passes right beneath a frequent avalanche slide path off a forked-glacier, the two forks projecting downward towards the Khumbu Icefall like menacing fangs. Avalanche debris in the run-out zone (through which the climbing route passes) consists of large chunks of blue glacier ice and rock, not soft snow. This is not friendly terrain and one must try to pass through quickly.

Everest Base Camp (EBC) has filled up like a small city experiencing urban sprawl. It is amazing how expansive and crowded EBC has become in just the last week or so! Still, the yak trains and porters continue to bring supplies and provisions as new teams arrive daily. One can hear the clang-clang of bells around the necks of yaks throughout the day, as they slowly negotiate the rocky, narrow trail on the glacier. One can envision EBC in a couple of ways, depending on your mood and outlook that day: 1) as a colorful, exotic, busy and exciting staging ground for climbers aspiring to gain the summit of Mount Everest, located in an incredibly beautiful alpine setting, or 2) as a severely over-crowded, rocky campsite, full of coughing/hacking sick people, where you have to watch every step for fear of slipping or rolling an ankle on the loose rock and ice.

Overall, conditions in the center of EBC are crowded, with latrines and tent-sites seemingly interspersed randomly. Thankfully, our expedition's campsite is quite a ways from "downtown." One good improvement in recent years is that the "poop barrels" beneath latrines are now packed out and the contents used for fertilizer in fields in the lower Khumbu Valley. However one chooses to view EBC today, it is certainly not the pristine setting that was encountered in 1963 by the first American Everest team. My personal feeling is that the area has exceeded its carrying capacity – there are simply too many people in too small a place, under harsh, high-altitude conditions. However, I am a first-timer here and I lack the perspective that veteran Everest expedition people have, so perhaps conditions are far better now than they used to be a few years ago? If so, please forgive my ignorance.

· Yesterday afternoon it became cloudy and cold (no surprise) and it started to snow. I retreated to my tent for a snooze. By dinner time, several inches of fresh powder snow had fallen at camp and the sky was gradually clearing to reveal a beautiful, pastel blue sky with remnant wisps of clouds swirling among the peaks. The last rays of sunshine were focused on Nuptse, illuminating the summit like a spotlight. There is something special about that last bit of sunshine for the day and the way that "evening-shine" bathes the mountains and glaciers in golden light. Yesterday evening, the summit of Nuptse was a golden torch with a banner of snow blowing off her summit like a yellow flame. The Himalaya are not timid mountains when it comes to showing off their grandeur!

Bathroom tents at Base Camp.
Photo by Travis Corthouts.

· What is it like back home now? I hear reports from my wife, but I feel so distant, almost like being on a different planet – a planet of rock, ice and a marginal atmosphere for life-support. I'm sure the grass must be starting to turn green at home – and flowers budding in the front yard? The seasons are changing and I'm a long, long ways from home. But here, in the heart of the Greater Himalaya, the Earth has a different agenda. This is a place of raw geologic forces and extremes, tectonic uplift battling with gravity and erosion. I've never witnessed such constant, primordial geologic activity – daily avalanches, rock slides, glacial ice popping beneath my tent in the middle of the night, and a landscape so fresh and jagged it looks as if it were pulled straight from the lower crust yesterday. In terms of geologic time, that's not far from the truth! It is entirely conceivable that the Appalachians could have looked something like this 250 million years ago, when the North American plate was part of the global supercontinent we call Pangaea – a giant collage of lithospheric plates, sutured together by great orogenic belts like the trans-Himalaya today.

Chapter 3: Life in Base Camp

April 22, 2012
Everest Base Camp
By Dr. Dave Lageson

It is a sad and sobering day on Everest, please keep the family of this young man, Tshering Sherpa, in your hearts.

In my last dispatch, I described some of the real dangers of the Khumbu Icefall and, in the one before that, I described the process of crossing crevasses on aluminum ladders. Well, today tragedy struck. A young Sherpa climber (Tshering Sherpa), who was working for one of the large expedition companies (Peak Freaks), was killed this morning when he was crossing a deep, crevasse at the top of the icefall close to Camp 1.

He was returning to Base Camp after having made an early morning haul to Camp 2, up the Western Cwm. Apparently, he did not clip a carabiner into one of the two safety lines that straddle either side of the ladder and fell 50 meters into the crevasse while crossing.

Sherpas do indeed cross these ladders with incredible speed and clipping-in with a safety carabiner is not always done. Some of our own Sherpas, who were also carrying loads to Camp 2 this morning, were at the scene to help recover the body. This particular crevasse was spanned by two ladders that were roped together – I remember it very well from my first rotation through the icefall. Tshering's body will be evacuated from the top of the icefall tomorrow morning by helicopter.

Sherpas have a tradition of lighting a juniper fire and saying prayers at the base of the Chorten in the pre-dawn hours before leaving for the icefall. This tragedy is a reminder that one can never take this climbing business for granted, that safety precautions must always be followed – even for a "routine" crevasse crossing. However, the Khumbu Icefall is far from routine by any standard – it is dangerous and unpredictable.

April 23, 2012
Everest Base Camp
By Dr. Dave Lageson

The climbing team is organizing equipment and provisions for the second rotation into the Western Cwm and Camp 2. This rotation will be a big one. The team will be at Camp 2 for several days this time (21,200 feet) and ascending the Lhotse headwall to Camp 3 at least once, perhaps twice depending on personal health, to acclimate to ever-higher elevations. Camp 3 lies at approximately 24, 278 ft (7400 m). The plan is to "tag" Camp 3 and then return to Camp 2 for the night, followed in a day or two by a second ascent to Camp 3 for the night. After this, the team will return to Everest Base Camp (EBC) for a few days of rest before the third and hopefully final climb back to Camp 2 for the final summit push.

In the meantime, Travis and I are training three of our strongest Sherpa climbers to help expedite the rock sampling and GPS measurement work on the summit pyramid of Mount Everest. The incredible strength, speed and stamina of the Sherpa climbers make them invaluable to the geology research program. Also, it is a source of national pride for them to be directly involved in the research, particularly the GPS measurement work on their mountain – Qomolangma. Because they know the mountain so well (all have

MULTIMEDIA

Watch a Video of Conrad explaining some of the gear they use high on Everest: http://youtu.be/3vImNA_4qLQ

Dave and Donuru during geology training. *Photo by Travis Corthouts.*

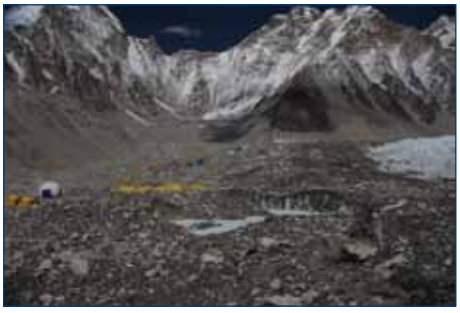
Chapter 3: Life in Base Camp

summited multiple times), their advice is invaluable about the location of good outcrops high on the mountain and the safest way to access them; some of the outcrops are not directly on the Southeast Ridge route. Sherpa climbers are truly super-humans at high, Himalayan elevations.

Some of the members of our team are moving their tents to new locations. Despite the fact that this part of the glacier is covered in rocks, one doesn't have to dig very deep to find glacial ice. Over the course of several days or a couple of weeks, the tent floor may become very uneven and uncomfortable as the tent differentially settles and/or the area around the tent melts. Everything here seems to be on the move – even your tent can't stay still!

The population of EBC is between 700-800 people right now. Here is the breakdown according to the latest informal census from expedition leaders:

- o 247 Everest climbers and guides
- o 76 Lhotse climbers and guides
- o 290 Sherpas
- o 200 Everest Base Camp staff (estimated)



Everest Base Camp. *Photo by Travis Corthouts.*

April 26, 2012
Everest Base Camp, Nepal
By Dr. Dave Lageson

WARNING: This dispatch is somewhat "heavy" on geology! For even more detailed information, refer to published papers by the authors mentioned at the end.

We sent out samples of Montana "granite" to selected schools across the State. I have seen a few photos of Montana students studying their samples with a hand-lens. That is really inspiring and fun to see. I do the same thing, every day, up here on the flanks of Mount Everest. A little piece of rock can tell an incredible story about the history and evolution of the Earth.

GRANITES OF EVEREST & NUPSTE

Montana has a lot of granitic rock! From Homestake Pass to the Bitterroot Range, western Montana is well-known for its massive bodies of intrusive "granite" and associated mineral deposits (copper-silver-gold-molybdenum). Although many of these felsic intrusive rocks are not true granites in a modal sense (many are granodiorite or quartz monzonite), we may casually refer to them as "granitic." Most of these granitic plutons were intruded around 75 million years ago during a time when the Rocky Mountains were just starting the rise (Late Cretaceous – the onset of the famous Laramide Orogeny). This is something that Montana and the Mount Everest region have in common – lots of granitic rock, although the Everest granites are much younger!

The Everest region is reported to have the greatest proportion of granitic rocks in the Greater Himalaya, inclusive of Nuptse and Makalu. When I look out over the frozen rock pile that constitutes the lower Khumbu Glacier below the Icefall, I see two distinct colors of rocks; the vast majority of rocks are very light-colored, often stark-white granite (leucogranite); on a bright, sun-drenched morning, one must wear very dark sunglasses to even glance at these rocks – they are so incredibly white!

The other, less abundant rocks scattered across the glacier's surface are dark-colored, gray-green pelites, gneisses, amphibolites and calc-silicate rocks, often intruded by thin granitic sills parallel to layering or foliation. Both the light and dark rocks are derived from the incredibly steep mountain walls that encircle Everest Base Camp at the "elbow" of the Khumbu Glacier. This suite of rocks, leucogranite and the dark-colored rocks, constitute the "structural top" of the Greater Himalayan slab, being a giant thrust sheet bounded by the Main Central Thrust (MCT) to the south and the South Tibetan Detachment System (STDS) immediately to the north. One significant splay of the STDS, the Qomolangma detachment fault, crops out near the summit of Mount Everest!

Leucogranite. *Photo by Dave Lageson.*

Chapter 3: Life in Base Camp

Leucogranite. *Photo by Dave Lageson.*

The Everest-Nuptse leucogranites owe their white color to the main constituent minerals, namely quartz, microcline or orthoclase, and plagioclase. Muscovite is a major accessory mineral, often forming a primary foliation parallel to the length of sills. Often, there is so much muscovite that the rock sparkles with the silvery reflection off mica cleavage planes. I don't believe I've ever seen such beautiful, muscovite-rich, glittery granite.

Another type of leucogranite has much less muscovite and seems to be finer-grained and denser. The North Face climbers on the expedition rave about how wonderful this rock is for climbing; it is firm, has solid hand-holds, and is not abrasive. It seems to be the perfect texture for bouldering and technical climbing, similar to the granitic rock found on the glacially carved walls of Yosemite.

The Everest-Nuptse-Makalu leucogranites were intruded as thick sills, with magma moving up-dip towards the south (towards India) from a plumbing system or network of smaller sills and dikes at depth to the north beneath the Tibetan Plateau. The thickest sill is over 2,000 meters thick and 4 kilometers wide, cropping out across Nuptse.

Most researchers agree that sill intrusion was forceful, meaning that magmatic pressure (aided by volatiles) forced open preexisting foliation planes and hydraulically fractured the country rock, resulting in sill-dominated pluton geometry with subordinate cross-cutting dikes; magmatic intrusion was definitely not passive diapirism.

The rock walls above Everest Base Camp are literally saturated with leucogranite sills at all scales of observation, from thin sills a few centimeters thick to those hundreds of meters thick. Many of the sills are boudinaged, or stretched apart, due to subsequent strain as the Greater Himalayan slab was tectonically emplaced relatively southward. This whole tectono-magmatic process has been termed "mid-crustal channel flow" by Himalayan researchers.

When did all this magmatism or "channel flow" take place in the crustal slab of the Greater Himalaya? The best way to date igneous rocks is through the analysis of radiogenic isotopes, which are essentially "atomic clocks" that are set at the time of crystallization of a melt.

A recent paper by Jessup and others (2008) places the age of crystallization at around 24 million years ago, through the analysis of U-Th-Pb isotopes from several monazite grains. Other research papers report a similar age (24-22 Ma), with a younger melting event around 18-17 Ma. These incredibly young igneous rocks have been exhumed or brought to the surface through the combined effects of "tectonic unroofing" thanks to the South Tibetan Detachment System, isostatic rebound, and deep fluvial and glacial erosion. This is one of the most dynamic geologic stories to be told on the planet!

For more information on the topics presented in this short dispatch, refer to the original published journal articles by M.P. Searle (Oxford University) and M.J. Jessup (University of Tennessee) and their various co-authors. Many of these journal articles are available on-line through the library of Montana State University.

Students in Winifred, Montana examine rock samples. *Photo courtesy of Bill Lee.*

Chapter 3: Life in Base Camp

April 26, 2012
Bozeman, Montana, USA
By Jenni Lowe-Anker

Hello from Conrad's wife, Jenni. I returned a week ago from Nepal and a month long trek which included accompanying the team to Base Camp and staying there for three days. This is a photo of Donuru Sherpa with his family in Phortse from six years ago. Donuru is one of the strongest of the climbing Sherpas on the team and has been an instructor for the Khumbu Climbing Center for six years. His brother, Panuru is the team sirdar and his father is the Lama who came to Base Camp for the puja. Donuru is a kind, gentle and thoughtful man and a pleasure to be with. We were lucky to have him accompany us on our trek before he returned to Base Camp to work for the team.

Donuru Sherpa and his family. *Photo courtesy of Jenni Lowe-Anker.*

April 27, 2012
Everest Base Camp, Nepal
By Travis Corthouts

Usually I'm not in the right place at the right time to see something incredible happen, I always just miss it; that wasn't the case this morning.

After breakfast I took a walk up to the Everest ER medical clinic where I found myself sitting in the sun, chatting with some of the staff. The ER location is as far up valley as a base camp location can be, which offers a great look at the icefall and into the beginning of the Western Cwm. While chatting with ER staff and enjoying the morning rays, we heard the common rumble of an avalanche and looked up to the faces that flank the icefall, but saw no avalanche. We looked back at each other to continue talking but the rumble increased and we looked back, but again saw nothing. Seconds later people began screaming and shouting and this time we looked up to see a cloud of snow over 100 ft (30 m) high barreling out of the Western Cwm over the top of the icefall. The mass of snow was so tall it didn't even seem real and it filled the entire width between the walls of Everest and Nuptse. We were in disbelief - Camp 1 sits right at the top of the icefall. All you could hear was people saying "no, no, no" as the cloud pushed out over the icefall. Near the top of the fall I could see a single file line of small black dots disappear, people, making a routine descent were now enveloped by the expanding cloud. All we could think was, is Camp 1 completely buried? How many people are lost? The scale of what we saw didn't make sense at first, the top of the icefall is low angle, nearly flat, and yet a plume of snow ten stories tall went blasting over it like an explosion. The avalanche must have been massive!

Avalanche cloud. *Photo by Travis Corthouts.*

Guides, Sherpas and anyone nearby affiliated with an expedition, converged at the Everest ER tents. All with radios in hand on a different channel listening to someone screaming in Nepalese, Italian, English, whatever; it was chaos for several minutes following the avalanche. As the snow dust cleared I looked up to see the black dots, which were now huddled in a group – safe! Imagine their panic when they saw what was

Chapter 3: Life in Base Camp

coming for them, not knowing if a river of snow would entomb them or the tail-out would just dust them; luckily it was the latter.

News began piling in from the radios; one of the doctors who speaks Nepalese was frantically taking notes to keep track of which expeditions radioed in as "all accounted for." There were still so many questions. The radio talk was frantic, with people on scene and in Camp 2 rushing to get a tally on their clients/guides and to form a search and rescue plan ASAP. Some of the first details were - one Sherpa was definitely missing, an orange helmet was found along the debris periphery, some people were injured, a young man was blown into a crevasse, and members on multiple radio channels called for their Camp 2 first aid kits and skeds (body sleds) to be sent immediately to the site. I stayed at the ER for a half hour and then returned to Camp - right now it's just Dave and I at Base Camp, the rest of the team is on their second rotation up the mountain.

Avalanche cloud over Base Camp. *Photo by Travis Corthouts.*

From our camp, Dave didn't quite get a good view of the action and so I informed him on the severity of the situation. We scanned the radios, getting updates on the status of each expedition; things were scattered, but it seemed most people were accounted for. We had little concern about our team as we knew all members to be up at Camp 2 or higher. The main effort soon revolved around the man who had fallen into a crevasse; he had been rescued from the void but was in critical condition. People on the scene were rushing to set up a tent to treat him and mark out an area for a potential helicopter rescue. The medical reports over the radio were poor, but we picked up that he was in and out of consciousness, barely responding when conscious, tachycardic (going into shock). All the while there were constant questions on the radio about a potential helicopter evacuation – is there a landing zone marked, what's the wind, elevation of clouds, is there a helicopter available, is the patient stable enough? Soon Simone Moro's high pitched, fast talking, Italian voice became involved in the conversation of a helicopter rescue. Simone has graced our camp multiple times as he is friends with Conrad and Cory; he was also one of Cory's partners last year on the first winter ascent of Gasherbrum II. Simone is one of the more decorated mountaineers alive today and he's planning the Everest-Lhotse traverse this year without oxygen. He's also a helicopter pilot and owner, experienced in high altitude rescues. In fact he was the pilot who flew to Camp 1 to retrieve the body from last week's casualty.

Before long Simone was airborne and on his way to Base Camp from Lukla. We listened to his ETA (estimated time of arrival) updates over the radio and when he warned 1 minute, we could hear the dull roar of his blades and we stepped out of our mess tent to watch him blast over our camp. He landed and held idle, waiting for the go ahead from people coordinating the rescue above. I grabbed my camera and a radio and jogged to the helicopter, parking myself 50ft away with the helicopter pointed right at me. I could see Simone through the windshield and I listened to the communications between him and rescuers on site. A few minutes passed and then a voice on the radio said, "Simone, ready to take off?" Simone insta-replied, "OK OK, we take off!" He throttled up, lifted about 10 feet, dropped the nose of the chopper straight at me then floored it. The rescue took minutes only and Simone landed back at Base Camp briefly to drop off Rachael, the ER doctor, and then took off to Kathmandu hospital. That's all the detail I have now, but I will keep you posted as things develop.

Chapter 3: Life in Base Camp

April 29, 2012
Everest Base Camp
By Travis Corthouts

Yesterday was another action packed day. Just after lunch a Nepalese individual with radio in hand came running into our camp asking for Cory's insurance information. The info was needed so they could get approval for a helicopter evacuation of Cory as he was having serious health issues. After descending to Camp 2 from a recon mission to the West Ridge with Conrad, Cory could not catch his breath. After hyperventilating for over an hour at Camp 2, he was put on oxygen, but even at two liters/minute his respiration rate abated only slightly. He also was complaining of slight pain from his lower left lung. This coupled with his breathing lead doctors at Camp 2 to think he was suffering from a pulmonary embolism.

Cory's assistant Andy, Mark Jenkins and a team of our strongest Sherpas escorted Cory to Camp 1 where a helicopter could pick him up; conditions at Camp 2 were too risky for a helicopter landing. The contingent moved fast through the Western Cwm, running while pulling Cory behind in a sled. At crevasses, Cory had to get out and cross the ladders on his own steam. As they approached Camp 1, the pain increased in Cory's lung and Rachael at Everest ER radioed for his oxygen rate to be turned up to three liters/minute.

Helicopter takes Cory to Kathmandu. *Photo by Travis Corthouts.*

As all this went on I monitored the radio intently, occasionally chiming in when our Base Camp had information or resources to offer. Around the time they arrived at Camp 1, I loaded up my camera gear, water and an extra layer and left toward the helipad area intent on helping and recording as much of the action as possible. As I was leaving, I heard over the radio that the helicopter was cancelled since clouds had invaded Camp 1, making landing impossible. Several hours had passed since the news first made it to our camp. It was 5pm now and a decision needed to be made – have Cory risk a night at Camp 1, or guide him through the icefall to the Everest ER where he could receive initial treatment.

An evening dance with the fat lady was the decision. With this news, two Sherpas from our expedition suited up and left camp running for the icefall to help in the descent; I radioed they were on their way with an extra bottle of oxygen too. An hour after Cory's entourage started into the icefall I headed into the Khumbu Glacier to meet them at the bottom of the fall. When I met the group Cory was in front walking on his own, as he had for the entire icefall because the terrain is far too rough to descend in a sled. I joined Andy in filming everything we could. As we approached the ER tents a helicopter swooped a few stories over our heads, landing quickly and then holding idle. Rachael escorted Cory into a tent while we waited outside. Rachael gave Cory a shot in his stomach to thin his blood and then we escorted him on the short walk to the helicopter.

Today Cory is stable in Kathmandu hospital, receiving the necessary tests to see exactly what was affecting him. Right now things are hanging in the balance for Conrad and Cory's West Ridge attempt, but either way it looks like Cory will be OK.

Helipad at Base Camp. *Photo by Travis Corthouts.*

Chapter 4: Science and research

April 30, 2012
Everest Base Camp
By Dr. Dave Lageson

The Mayo Clinic team is here from Minnesota for ten days of research and medical testing. I am a participant in their study and thus far have had a heart ultrasound test, blood analyses, lung volume measurements, cognitive tests, and a variety of other medical assessments. Although I appear to be in good health and have acclimated very well to these high elevations, I continue to lose weight at a steady rate; thus far, I have lost 20 pounds and now weigh 145 pounds (my weight as a teenager). The side-effects of this weight loss include fatigue and general lack of energy. We are above the elevation at which the human body can maintain itself for long periods of time, and weight loss is an unavoidable consequence of the body's effort to cope.

Everest Base Camp is on the move! According to informal GPS measurements by Travis, we have moved about 15 feet (4 m) since arriving at EBC on April 1st. Of course, this is attributed to the fact that we are camped on the Khumbu Glacier. Even though many glaciers in the Himalaya are in recession and shrinking due to climate change, just as in Montana's Glacier National Park, the ice within still flows downhill. Evidence of this slow downhill creep includes the creaking and groaning of ice that one hears at night beneath the tent – the voice of the glacier calling out to other glaciers, like the echo-sounds of whales in the ocean. We are in a different type of ocean here, an ocean of huge rocky waves whipped up by the tectonic storm occurring between India and Eurasia.

The Mayo Clinic team. *Photo by Travis Corthouts.*

MULTIMEDIA

You can watch a video of the Mayo team explaining their research on Mt. Everest at http://youtu.be/bIGIsN5BYqw

MULTIMEDIA

Check out a video of Travis and Conrad measuring the flow of the Khumbu Glacier at: http://youtu.be/aJQz5B8t_bQi

Chapter 4: Science and research

May 3, 2013
Everest Base Camp
By Travis Corthouts

The rest of the team returned safely from Camp 2 the day after Cory's evacuation, May 28th. The tests Cory had in Kathmandu didn't find a cause for his health issues; although that isn't unusual as the exact cause of severe effects from altitude can be invisible. On the day of his evacuation, the Mayo clinic team arrived at our Base Camp and the head doc said even if it was a pulmonary embolism it's likely to go unseen. We all wish the best for Cory and hope to see him back out in the mountains soon. For now, he will be heading back to Colorado. As for Conrad, he is still trying to find a way to climb the West Ridge and looking for a new partner. He is currently talking to Simone Moro, as Simone is also a North Face athlete and was planning a solo ascent of Everest and Lhotse this year. Right now Simone is excited but needs to first adjust his contracts and permits, so nothing is in stone yet.

A quick update about the Camp 1 avalanche last week - it could have easily been the worst disaster in Mt. Everest history. According to those who witnessed it from Camp 2, the avalanche was absolutely massive and was caused by a huge serac collapse near the summit of Nuptse. The debris swept down Nuptse, all the way across the Western Cwm and then like a snowboarder in a half-pipe, went part of the way up Everest's SW face; the debris field was a few football fields wide. A half hour prior, witnesses at Camp 2 had noticed a large train of people trekking through the Cwm to Camp 2. So when they saw the avalanche barrel across the valley near Camp 1, they assumed because of the high traffic, that casualties could be near 30 people. And if it had let go at almost any other time that morning, there would have been. I know on our first rotation up the mountain, Sam, Andy and I left Camp 1 for Camp 2 at about 9:30, putting us right in the path. In any case, the timing of that avalanche was a miracle.

Despite that good fortune, this year on Everest is horrible in terms of conditions. The mountain is naked, it hasn't snowed on the upper mountain since we have been here, and with no moisture, the mountain has no glue to hold it together; rockfall is becoming a major problem. Yesterday, May 2nd, a Sherpa for the guiding service Peak Promotion was working within a group of Sherpas to fix lines on the Lhotse face when a rock struck him in the face. The projectile broke his jaw and left him unconscious for 45 mins; he was taken from Camp 2 by a helicopter. Another Sherpa was struck today, breaking his arm badly.

So far this year, there have been more than twice the evacuations of last year and the climbing has hardly started. Most expeditions are just finished with their first rotation up, we are finished with our second. Also, the lack of snow has left the Lhotse Face as a sheet of blue ice, as opposed to a face of styrofoam-esque snow, easily penetrated by a boot. If these conditions go unchanged, then it will make the Lhotse Face extremely difficult for the less experienced climber. The Lhotse Face is 45 degrees, and blue ice at that angle is very awkward no matter who you are. The 1.5 inches of metal spikes jutting from your toes is all that can penetrate the ice, leaving your calf muscles to balance and support you, as the face isn't steep enough for your arms to reach out and touch. At first this might seem fine, but the Lhotse Face is 3000 vertical feet (914 m), and unless you have experience front-pointing in crampons, you'll burn out fast.

Travis adjusts the Trimble basestation antenna on top of the teahouse roof.
Photo by Travis Corthouts.

Yesterday we had a round table meeting discussing how the scientific work of rock sampling between the South Col and summit as well as the GPS elevation survey will be carried out. The outcome was good with several members of the SE Ridge team wanting to be involved in any way possible. Basically, between now and the summit attempt, Dave and I will train multiple Sherpas and team members on how to do the science. Depend-

MULTIMEDIA

Travis explains the expedition's power supply at:

http://youtu.be/PxETZPXFeNg

Chapter 4: Science and research

ing on how well people get trained will determine whether I'm needed at Camp 2 during the summit push to support climbers/Sherpas doing sampling and GPS work.

However, it's become clear there's a power supply issue with the GPS equipment in Gorak Shep and over the last two weeks I have been there several times to check on our equipment. I'm fairly sure I figured out the problem last time I was there and I've been negotiating with the teahouse owner over how to fix it. Either way, I know a lot more about solar power than I did before I began this journey. Troubleshooting the problem might normally be easy, but I'm in a remote place with almost no resources and there's a huge communication barrier between me and the locals. But it's all part of the fun and the owners of the teahouse are very nice and make me great food every time I visit. Anyway, if things continue to be questionable with that equipment, during the summit push it will be more important for me to be in Gorak Shep monitoring the GPS equipment rather than at Camp 2.

Conrad Anker's lung capacity is measured by Mayo Clinic researchers. *Photo by Travis Corthouts.*

I can't finish this dispatch without saying something about Mayo medical clinic. The group of nine doctors and researchers joined us at Base Camp on the 28th of April and with them brought nearly a metric ton of medical equipment. Their study on the effects of altitude and its correlations with heart disease and congestive heart failure is truly groundbreaking. One of the doctors, Dr. Bruce, has been with Mayo for decades and has done research all over the world on things that are just mind blowing.

One of the pieces of data they're collecting, that I think is pretty cool, involves calorie consumption. The doctors had the team drink a solution of stable isotopes which allow the docs to pinpoint the exact amount of calories burned between urinating. So on the summit day each climber will take a urine sample at the outset and then another on their return. By doing this, for the first time ever Mayo doctors will be able to calculate exactly how much energy a climber uses to summit Everest. They will also have climbers do the same for camp-to-camp travel, resulting in a caloric value for going from Base Camp to the summit of Everest. This is just one of many "firsts" that Mayo will be making while doing their research up here.

Mayo researchers pack up blood and urine samples before heading home. *Photo by Travis Corthouts.*

Chapter 4: Science and research

May 4, 2012
Everest Base Camp
By Dr. Dave Lageson

The Lhotse Face or "headwall" is sheer ice this year – blue, glacial ice. Normally during the spring climbing season, it is covered with some depth of snow that allows climbers to kick steps into the steep, 45- to 50-degree headwall of the Khumbu Glacier. But this year, with the lack of snow and high winds, it is bare ice with embedded rocks of all sizes. As such, it is extremely dangerous and requires more skill with crampons than normal. The lack of snow and high winds are making Everest extremely dangerous this year, much more so than normal according to experienced guides.

The Khumbu Glacier now has a "river" on it. What started off as a small trickle a month ago has grown into a fairly large creek. This is a sure sign that spring is coming – even at 17,000 feet (5181 m)! The "Khumbu River" flows between the two longitudinal segments of the glacier, namely the "ice segment" near the base of Nuptse and the "rock-covered segment" near the base of Pumori. As one walks the trail to the center of Everest Base Camp, there is now a rumble from the ever-growing river on the surface of the Khumbu Glacier.

The weather continues to be very windy up high with consistent afternoon clouds. However, the forecast for the next week or so suggests that the winds may slacken above 7500 meters (24,606 ft), thus enabling Sherpa climbers to fix ropes to the South Col and then the summit. The mid-May summit window may be starting to crack open! It all depends on the wind and snow.

MULTIMEDIA

Dr. Lageson explains the rapid melting of the Khumbu Glacier:

http://youtu.be/HNi6_IV9mbQ

Helicopters are busy early morning and late afternoon; we occasionally receive a duffel bag of supplies via helicopter, as a favor I suspect, because helicopter time is extraordinarily expensive. The approach path to the landing zone seems to be right over our camp, as we are often "buzzed" by very low-flying choppers early in the morning.

Sometimes it seems like a military operation here, with helicopters coming and going, communication tents, mess halltents, etc. However, I don't think the U.S. military has Tibetan prayer flags flying over their outposts, which makes Everest Base Camp very colorful!

Everest and the Khumbu Glacier. Base Camp is to the left of the glacier. *Photo by Travis Corthouts.*

Chapter 4: Science and research (and poetry)

May 4, 2012
By Dr. Dave Lageson
Everest Base Camp, Nepal

Note from MSU Extended University
Dave was hesitant to share the following poem with everyone, but we think it's important to show the connections between science and the arts. Dave said this poem came to him in the middle of the night while the glacier creaked and groaned around him. He thought this might inspire your students to write their own poems about mountains and glaciers and the Himalayas.

Yeti's Cry

I thought I heard a Yeti last night, screeching and howling over the rock and ice.

Was it the groan and creak of the glacier beneath, or the call of a wild man beast?

I thought I heard a Yeti last night, as the moon shone bright over the Khumbu ice.

Was it the tumble of rock on the moraine nearby, or the wind hissing through the seracs on high?

Was it a Yeti I heard last night, as I lay awake with longing thoughts of home?

Could it be the call of the fabled Bigfoot man, or Mallory's ghost crying for his wife's hand?

Could it be the sound of water seeping through the icy cracks below, or the mournful cry of rocks as their tectonic strain grows?

I thought I heard a Yeti last night, howling like a wolf from peak to peak.

Was it the roar of the wind on Nuptse's crest, or just the night time sounds of the Himalaya at rest?

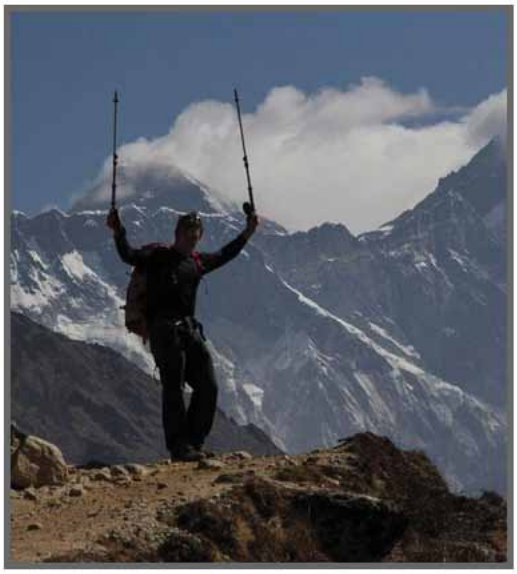
I thought I heard a Yeti last night, piercing the thin air as the stars shone bright – it's lonely sleeping on a bed of ice!

~By Dave Lageson
Everest Base Camp, May 2012

We Go

By Lindsey W., Anderson School

Distance - its not that far
Time - its a day's climb
But the weather
May get worse
To the top we go
Almost there
We walk very slowly
So close now
Only steps left
To the top we go
We have made it to the top
So down we go
But the view
Is breath taking
Just a moment longer
So down we go



MULTIMEDIA

You can read all the poems created by students participating in the Everest Education Expedition
http://midd.me/Do2V

The Perfect Snow

By Sky G., Anderson School

A mountain of friends
Snow
Trees
And rocks
The cold shadows
Hold the hard snow
But the gleaming slopes
Are as slow as mud

Where is the perfect snow?
In the trees down below,
Under a cliff,
Or in a bowl
But a good day
Is determined
by the skiers
That run like
The mountains
And ride like the snow

Chapter 5: We've got rocks!

May 5-May 8, 2012
Everest Base Camp, Nepal
By Travis Corthouts

May 5, 2012: Today I worked on training several of our Sherpas — Danuru, Jungbu and Sonum — in rock sampling. Danuru heads up mountain tomorrow to help Sherpas from other guiding services fix ropes up to the summit. While doing so, Danuru will try to sample rock from multiple places on the Lhotse Face as well as the South Col. Jungbu and Sonum will leave the following day to work on ferrying loads of gear and oxygen up from Camp 2 to Camp 4 at the South Col. But before they leave I'll meet with them to go over how to use the GPS equipment they will be carrying to the summit.

May 6, 2012: Dave as well as the Mayo Clinic doctors left this morning to head back to the States. After lunch I trained Jungbu and Sonum on the GPS equipment that we will use to measure the elevation of Mt. Everest. On summit day for the SE Ridge climbers, Danuru, Jungbu and Sonum will leave Camp 4 very early so they can complete the GPS work on the summit before other climbers reach the top. On their way down from the summit they will each work to sample rocks from several locations between the south summit and the South Col. Sam, Hilaree, Emily and Phil will also each work to sample rock on their descent from the summit.

May 7, 2012: Last night I came down with a bad stomach flu and I wasn't able to hold down any food or water all night. This morning I was able to start drinking and eating again, but only a little as my stomach was still very sensitive. I feel absolutely drained and I think it will take a few days before I feel normal again; getting sick like this at 17,000 ft (5181 m) is difficult to recover from. At one point in the night I had become so dehydrated my entire body felt like a giant cramp, even my organs felt weird. It was kind of scary being in that condition, all I wanted was to drink a gallon of water but even a small sip would make me throw up.

May 8, 2012: Today I received our first rock samples from up mountain. The samples were taken by Danuru, one of our strongest Sherpa who was a part of the contingent of Sherpa fixing ropes to the summit. While fixing ropes, Danuru took samples from the Lower Yellow Band, Geneva Spur and the South Col. He then sent them down mountain with his brother Mingma, who works for the guiding service International Mountain Guides. I've taken a close look at the samples with my Baladeo loupe to get an idea of their composition. It appears the Geneva Spur and South Col rock samples are schist and the Lower Yellow Band rocks are psammites. Dave and I will be able to determine this for sure when we get the samples back to MSU and we can look at them using a microscope. Tonight the SE Ridge climbing team leaves for their third rotation up mountain. Normally the third rotation would be the summit push, but poor conditions on the mountain have delayed rope fixing and therefore no ropes have been fixed to the summit. So in the interest of maintaining their state of acclimation the team has chosen to do a third rotation, they will go as high as the South Col (nearly 8000m or 26,246 ft), returning to Base Camp by the 15th.

Travis with the first rock samples from the Yellow Band, Geneva Spur and South Col. *Photo by Travis Corthouts.*

Chapter 5: We've got rocks!

May 11, 2012
Everest Base Camp,
By Travis Corthouts

Today the Southeast Ridge climbers safely made it up to Camp 3 and all members are feeling good. Tomorrow they plan to climb up to the Geneva Spur or possibly higher before they descend down to Camp 2 to spend the night. Then, on the 13th they intend to return to Base Camp where the team will wait for a calm weather window to make their summit push. Conditions on the mountain have improved dramatically as fresh snow has been falling on and off for several days now. The snow has helped reduce rockfall by acting like glue, holding loose rock in place or absorbing falling rock before it goes cascading down the mountain. Conrad left last night for a brief acclimating rotation to Camp 2 and potentially higher. His potential new partner, Simone Moro who recently came down with a cold, is still feeling too sick to join him; though the pair intends to begin climbing as soon as Simone feels better.

When the SE Ridge climbers return in a few days, they will hopefully have more rock samples taken from the outcrops on the Lhotse Face. The day before the climbers left on the 9th, I refined the rock sampling method in order to make it easier for them, and I'm curious to see how well it worked. Here is the outline of how the rock sampling will be done - When the climbers or Sherpas bang a rock sample off of an outcrop, it's critical for them to record where the sample was taken. Recording that info is tough when you're bundled up like an astronaut; writing in a journal or using a GPS unit becomes cumbersome and time consuming. So the method the climbers will use involves putting the sample into a Ziplock bag, then recording the elevation

Travis on Pumori looking out over the lower Khumbu Glacier. *Photo by Travis Corthouts.*

the sample was taken at onto the bag with a Sharpie. Climbers may also write the initials of what feature they are closest to, such as L.Y.B for "Lower Yellow Band". I made lanyards for the Sharpies so climbers can wear them around their neck, keeping the Sharpie from freezing. When they need the Sharpie they just pull and the cap stays on the lanyard around their neck. Also, I pre-opened all of the Ziplocks, hand rolled each of them individually and then stuck a piece of tape to the end of each bag to provide a tab big enough for someone to grasp with large mittens. Hopefully these little preparations will go a long way toward making the rock collecting easy and efficient. Once Dave and I receive the samples we will use that elevation data coupled with the known location of the route to determine where exactly the sample was gathered.

As for me – Tomorrow I plan to hike up to Pumori Camp 1 or higher where I will sample outcrops and hopefully get a nice clear view of Everest. From Pumori I'll trek to Gorak Shep to check on the GPS receiver there, as well as download the data it has logged; hopefully I will find everything in order. After that I'll head back to Base Camp, hopefully arriving well before dinner. But, right now it's about 8:30 pm and the stars are gleaming, so I'm going to take advantage of the clear night and go take some photos. Adios from Everest Base Camp!

MULTIMEDIA

Check out the video of Travis sampling rocks high on Pumori at:

http://youtu.be/y5pN89I84p4

Chapter 5: We've got rocks!

May 16, 2012
Everest Base Camp, Nepal
By Travis Corthouts

Well, things have been pretty quiet here at Base Camp the last few days. Climbers returned safely from Camp 3 on the 13th and have since been hanging out, eating and relaxing. One bit of news is that SE Ridge climber Phil Henderson won't be joining the team on their summit push as he has come down with a cold and isn't feeling strong enough to make the push.

But, while our team is resting, almost all of the other expeditions have left to make their summit push. About 200 climbers went up, and are hoping to summit on the 18th or 19th and right now they are currently spread out between Camps 2 & 3. But with this large mass of people all going up at once, there is one potential problem that could develop – because the ropes to the summit have not yet been fixed, and the Sherpas responsible won't be fixing them until the 17th or 18th. So, what could happen is, the throng of people making their bid for the summit might catch up to the team of Sherpas still fixing. This could create a bottleneck, where climbers get stuck on the summit ridge waiting in the wind and cold as a team of Sherpas rush to finish fixing the ropes. Those waiting will risk frostbite and running out of oxygen, which can then escalate into a whole other realm of problems. But, obviously this is all speculation and we all wish that everything goes smoothly.

Also, we're not the only people to see this potential and we think those guides and Sherpas now up on the mountain will do everything they can to prevent this by making sure the ropes get fixed in time. The fact that nearly all other expeditions are going up right now is actually kind of a good thing for our team as it guarantees very little traffic on the mountain when we make our push later this month.

A line of climbers ascends between Camp 3 and Camp 4. *Photo by Ang Kaji Sherpa.*

One of our team's strongest Sherpas, Kaji from Makalu, will be a part of the team fixing ropes to the summit. He has made the summit of Everest 4 of 5 attempts and has six kids he puts through school by guiding climbers up the giants of the Himalaya. Kaji is absolutely great; he would literally do anything to help one of us and we all dearly wish him the best. Also, we're all very happy for him as fixing ropes to the summit is an honor that only the strongest Sherpas get and they receive good pay for it to; this is Kaji's first opportunity.

Now that everyone is back it's just a matter of waiting for a weather window for the climbers to be able to make their summit push. Right now the 25th is a tentative date, but we will see. Overall everyone here is pretty anxious to get this thing done and go home. It's amazing to be here, but we have been at Base Camp for six weeks now and sleeping in a bag on a pile of rock and ice wears on you. Not to mention just being this high up wears on you; you can barely metabolize protein so your body eats your muscle. Everyone has lost weight, some people up to 20 lbs; despite the fact that we eat a ton and have endless munchies at our disposal. Either way, I'm just staying busy and trying not to think too much about putting my bare feet on fresh green grass. "We must be patient if we are to reach the goal" –Heinrich Harrer, Seven Years in Tibet.

MULTIMEDIA

Watch a video of Travis giving a tour of his tent at Everest Base Camp:

http://youtu.be/d0l3cd76ZOQ

Chapter 6: First summit!

May 20, 2012
Everest Base Camp
By Travis Corthouts

I have good and bad news, I'll start with the good. As I mentioned in the last update, Ang Kaji Sherpa from our expedition was part of the contingent fixing ropes to the summit. Well, he reached the summit at about 1:30pm on the 18th, and he was the first person to set foot on the summit of Everest in 2012, reaching the top about 100 feet ahead of the group. When he returned yesterday, he gave me all the footage and photos from his point and shoot camera. I was amazed at what he recorded. While being the rope-gun for fixing, he managed to capture almost a hundred images and then a video of him doing a mad dash to the summit where, at the top, he ripped off his oxygen mask and said, "I'm on top Everest! First time in 2012, first person! Omg, I love my parents, I love my family, omg!" and then did a 360° pan of the view. So cool! What else for good news… oh, some yaks arrived in camp yesterday with some treats including a case of Coca Cola, a major morale booster. Conrad has officially joined the SE Ridge team and they leave for their summit push soon.

The bad – As I write this as many as four people are dead or dying on the South Summit (28,700 ft or 8747 m). Right now it appears the circus of over 200 people all pushing for the summit in a 48-hour period won't pass without cost. This scenario is still developing and those of us at Base Camp only know so much about exactly how it has come about. But we do know for sure that it started yesterday with two Koreans going snow-blind not far from the summit. I went snow-blind once when I was 17 and it's terribly painful and is the equivalent of a second degree burn on your cornea, you can't open your eyes for at least two days.

Ang Kaji Sherpa on the summit of Everest holding the Nepalese flag. *Photo by Ang Kaji Sherpa.*

I figure it happened to the Koreans because they got to the South Col, donned their gas masks, and then realized the mask caused their glacier glasses to fog; so they went without glasses. At that elevation without glacier glasses — forget about it — your eyes will get scalded. After the blindness set in their Sherpas were known to be helping them down. But, to compound the problem, one of the Koreans came down with High Alti-

The rope-fixing team moves through the Yellow Band. *Photo by Ang Kaji Sherpa.*

Chapter 6: First summit!

tude Cerebral Edema (HACE), one of the most deadly forms of altitude sickness. The afflicted individual became combative and punched one of the Sherpas in the face as he was trying to help him. HACE causes your brain to swell and so one side effect can be unwarranted aggression. In this situation, at this elevation, a Sherpa, who normally would do anything to save a life, has to leave their client or they would die trying to save them. (In fact, last year a Japanese climber with HACE punched his Sherpa, who was trying to help him descend, breaking the Sherpas glacier glasses and knocking them off. The Sherpa descended, going snow-blind in the process and narrowly surviving. The delirious Japanese man continued to ascend and died hours later; one of three people to die on Everest's south side last year).

Anyway, this morning we found out a third Korean went up to bring oxygen to his teammates; two of the Koreans returned. Three other unknown individuals were recently seen on the South Summit and those who passed them checked their vitals and found they were nearly gone. It's just so hard to save somebody at that elevation.

It's mid morning here and I'm listening to the radio as I write this, and right now it seems there is a fifth person, just below the Balcony, who is stumbling around, and apparently has resisted somebody's attempt to help him. The radio chatter consists of people trying to find someone at the South Col who is available and strong enough to bring the individual oxygen and Dex, (dex is a drug for extreme altitude sickness). They're also trying to figure out who he is based on what he is wearing. According to the voices on the radio, the weather up high is deteriorating and the tents at the South Col are literally being held in place by the weight of the people in them. Also, an Indian man has collapsed at the base of the Lhotse Face with snow-blindness and HACE. Some Sherpas are on their way to help him.

Rope-fixing team members just above The Balcony. *Photo by Ang Kaji Sherpa.*

I can't end this without giving Sherpas credit for owning this mountain. Not only do the Sherpas fix all the ropes and ladders up to summit, carry all the gear and oxygen up to higher camps, but they also save the lives of those in danger on summit day! Certainly by the end of the day there will be several people who owe their life to a Sherpa. The industry that exists on this mountain couldn't endure without the strength and altruistic nature of the Sherpa people.

May 23, 2012
Everest Base Camp, Nepal
By Travis Corthouts

Picking up where I left off from the last dispatch – four people have been confirmed dead and two missing as a result of the massive summit bid that took place on the 18th and 19th. So far these deaths "seem" to be caused by poor judgment rather than bad weather or objective hazards. Some of those who perished were known to have summited around 4pm, which is terribly late, especially after starting at 9pm the day before.

One of the most fundamental mountaineering rules is to establish and follow a turn around time, which is no later than 2 pm on Mt. Everest. If you don't, your chances of survival plummet as you run out of supplemental oxygen, energy and expose yourself to the elevated winds and decreasing temps. According to an experienced Everest guide I spoke to days ago, when someone runs out of oxygen high on Everest, they risk getting cerebral edema almost instantly. Not to mention, without supplemental oxygen your chances of frostbite skyrocket as

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your body fails to sufficiently warm the extremities.

So, neglecting your turnaround time causes the odds to stack against you rapidly, and history shows it's one of the biggest killers in high altitude mountaineering. These tragedies make the 2012 season one of the worst in several years, and it isn't over; days from now, about 100 more people are looking to begin their summit campaign on the window of the 25th and 26th.

Currently the whole team is up at Camp 3, ready to take advantage of that window. Tomorrow they move up to Camp 4 – the South Col – where they will rest into the evening and then leave early at night for the summit.

At Base Camp right now are Max Lowe, Phil Henderson and me, and from what we have heard, the team is feeling good as they continue to move up the mountain. The weather is looking good as well: winds will average 20 km/hr (12 miles/hour) on the summit day, and I will continue to get daily updates from our weatherman Mario, who is based in Switzerland.

I must say, with a good weather window, our team stands to do really well, as they are some of the most mountain-savvy and strongest individuals on Everest this season. I can't say enough about how much faster they are on the mountain than the average summit suitor this year, and speed is the key to safety and success on this mountain. Anyway, like I said, with a good weather window they stand to do great!

Tomorrow I trek down to Gorak Shep so I can monitor the GPS equipment there, during the period that the GPS receivers are recording data on the summit. It is critical that the GPS base station in Gorak Shep is running while the receivers are logging data on the summit. So what I will be doing is basically making sure the equipment in Gorak Shep doesn't go without power, which is possible, as the solar power system it runs on hasn't been perfect.

Otherwise, things have been relatively quiet in Base Camp, other than the constant helicopter traffic. It seems many of the people who summited on the 18th/19th are taking advantage of the helicopter service, which by paying $600, gets you a 15-minute ride straight to Lukla instead of doing the 35-mile (56 km) trek. I suppose that if I had spent $40,000-$80,000 to climb Everest, $600 would be nothing, especially if I was terribly homesick, which so many people are after being on a 10-week expedition.

So, every day Base Camp gets a little bit emptier, and it seems our expedition will be one of the last to leave. This is slightly ironic as we were the first to arrive here and were ahead of everyone in terms of acclimating. In fact we were ready to summit in early May and were certainly planning on it. Instead, the mountain had other plans and we had to be patient, but now, our time is near!

Base Camp. *Photo by Travis Corthouts.*

May 24, 2012
Everest Base Camp, Nepal
By Travis Corthouts

Well, just as I was about to leave the communication tent for the day and hit the trail for Gorak Shep, a guide from another expedition stopped by and informed me of some news. He said, according to Dawa Stephens from Asian Trekking, about 200 people are going to be pushing for the summit on this next window; rather than the 100 we originally expected. I'm sure our team will be able to overcome this with their speed and talent as climbers, however I am worried the crowds will interfere with their work of collecting rock samples. But we will soon see. That's all for now and the next 24 hrs should be intense, so stay tuned!

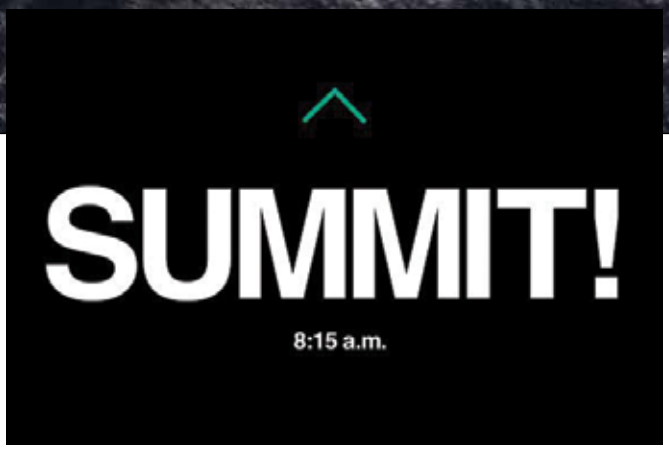
Chapter 7: The journey ends

Photo by Travis Corthouts.

May 26, 2012
Everest Base Camp Nepal
By Travis Corthouts

Success! Five members of our team summited yesterday morning and currently they are spread out between Camp 4 and Base Camp - Emily and Mark are heading down to Base Camp right now and the rest of the team is up, working on breaking camps down. Hilaree and Kris summited Lhotse in good style this morning at 5:30am and have made it back down to Camp 3 and possibly 2 by now.

Also, as I write this Conrad is on his way up Everest without the use of oxygen; as of an hour ago he was at the Hillary Step and the weather is awesome. He possibly has already summited, but we are still waiting to hear for sure. Basically the weather is perfect today and the crowds are slim, so I'm guessing Conrad chose to capitalize on this after resting at the South Col for 24 hrs. Right now I'm about to leave camp to go to Gorak Shep to take down the GPS equipment there and then continue to pack up camp when I return here. So that's all the news from Everest Base Camp for right now.



Chapter 7: The journey ends

May 27, 2012
Everest Base Camp, Nepal
By Travis Corthouts

So Conrad successfully summited yesterday morning at about 10:00am and has returned to Base Camp today along with the rest of the team. Conditions for Conrad were great as there were few crowds and the wind wasn't bad. All of the climbers were incredibly tired as they made it into Base Camp, running on fumes! Everyone is overjoyed with the success and tomorrow we begin the massive breakdown of Base Camp and we will potentially begin our trek out tomorrow.

The conditions when our first five climbers summited turned out to be pretty rough as it was very cold, windy and crowded. Sam and two of our Sherpas got frostbite on their cheek, which right now looks like a brown scab. I've been told this kind of frostbite will heal over time so no permanent damage will be done. The poor conditions made it very hard for the climbers and Sherpas to do the science work, but it still got done thanks to Dangbu and Danuru. Dangbu stayed on the summit of Everest for an hour in the wind and cold to run the GPS receiver. Danuru was able to gather several samples from multiple locations along the SE Ridge, he collected from the Summit, the South Summit, above and below the Hillary Step, the Yellow Band and Busher Rock. He was the only member capable of doing so as the conditions were too harsh, so thank you Danuru Sherpa of Phortse. Well, I have to get back to packing now as it's finally time to go home, so long from Everest Base Camp!

Jangbu and Danuru with rock samples from the southeast ridge. *Photo by Travis Corthouts.*

Conrad returns to Base Camp. *Photo by Travis Corthouts.*

Afterword: Home again

July 19, 2012
Connecticut, USA
By Travis Corthouts

Following up on the rock sampling: So I'm happy to say that all the rock samples have made it back to Montana State University after I mailed them from Kathmandu on May 31st. Dave and I will begin to analyze them this fall. My personal focus will be on the rocks from the Upper and Lower Yellow Band, while Dave is planning on doing an in depth study on the summit limestone. Our study will take a couple of years and may lead us back to the Everest region to conduct more field work, but we will see.

Thanks for being part of our journey!

For a full list of videos uploaded by the MSU team, visit: **http://www.youtube.com/user/MSUOutreach** To see more dispatches, photos and multimedia files, visit **www.montana.edu/Everest**

Questions from students

Throughout the course of the Everest Education Expedition, students from Montana and beyond emailed questions to the climbers, which were forwarded to them at Base Camp. The following are a sampling of questions that were answered by Travis Corthouts.

Are there llamas near base camp?

Thanks for your question! Yes there are some llamas down valley, like in Pangboche where we had one of our Pujas.

How do the sherpas know something is going to happen on the mountain? Are they just so used to it, that they recognize the signs for different events? Also, I wanted to know: What is it like crossing a ladder, and who on the team is most comfortable doing so? Thanks for your time.

Yes, the Sherpas' vast experience on Mt. Everest is why they know so much about the mountain, their experience is the basis for their knowledge and intuition. In our expedition the people most comfortable on the ladders are the Sherpas. But as far as the climbers, I would say Cory or Kris as they are the only climbers on our team who have crossed the ladders on past expeditions to Lhotse.

How long does it take to get to the top of Everest from Base Camp? How much food is needed to summit the mountain?

It takes about 5 weeks to acclimate, but once acclimated most people on their summit bid require 3 nights 4 days but the record is 18 hours from Base Camp to summit. The quantity of food is hard to calculate, but it would equal 3 large meals a day plus a lot of snacks each day for one month.

How is the weather? Is it really cold in the nights?

Yes, the weather is cold at night especially from camp 1 – 4 because it is very windy at night too. Above the South Col it's even very cold during the day. Between camps 1 and 2, when there is no wind, it can get up to 100° F (37° C) during the day because the sun reflects off of the valley walls, creating what we call the "solar oven." At base camp it's about 0° F (-17° C) at night and up to 55° F (12° C) during the day when there is sun and no wind.

Yak train. *Photo by Travis Corthouts.*

But today it's cloudy and windy out, so it's about 30° F (-1°C).

Yak questions:

1. What is the average load a yak carries?

2. How do they train them?

3. What are in the orange barrels?

4. What do they eat when packing?

5. How fast do they walk?

6. How much does a yak weigh?

7. How high (elevation) can they go?

8. How far do they usually go in a day?

9. How many yaks did it take to carry in this expedition's supplies?

Answers:

1. The average yak load is about 150-200 lbs (68-90 kg)

2. They train them by making them carry loads at a young age.

3. The barrels on the yaks might be gas for generators used to make electricity at camp. However, the blue barrels are used to carry all sorts of stuff like food and equipment. The blue barrels are cheap and very durable, so a good way to transport things to Base Camp.

4. The yaks graze on grasses, shrubs, herbs, lichens, leaves and twigs along the trail. Dried grasses (hay) and grains are brought along for them at the higher elevations without vegetation - such as Base Camp.

5. Yaks walk about 1.5-2 miles (2.4-3.2 km) per hour.

6. A yak weighs about the same as a Montana cow, 1,000 - 1,200 lbs (453 -544 kg)

7. The yaks only go as high as Base Camp (17,250 ft or 6492 m)

8. They travel up to 12 miles (19 km) in a day.

9. The Everest Education Expedition used 70 yaks!

How far is it from Base Camp to Camp 1 and from Camp 1 to Camp II?

As the crow flies, it's not far at all; just under 2 miles (3 km) from Everest Base Camp to Camp 1 and the same for Camp 1 to Camp 2. But the elevation gain is significant: Camp I is at 19,300 ft (5882 m) and Camp II is at 21,300 ft (6492 m).

Access all Everest Education Expedition curriculum materials at

http://www.montana.edu/Everest

The Everest Education Expedition
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