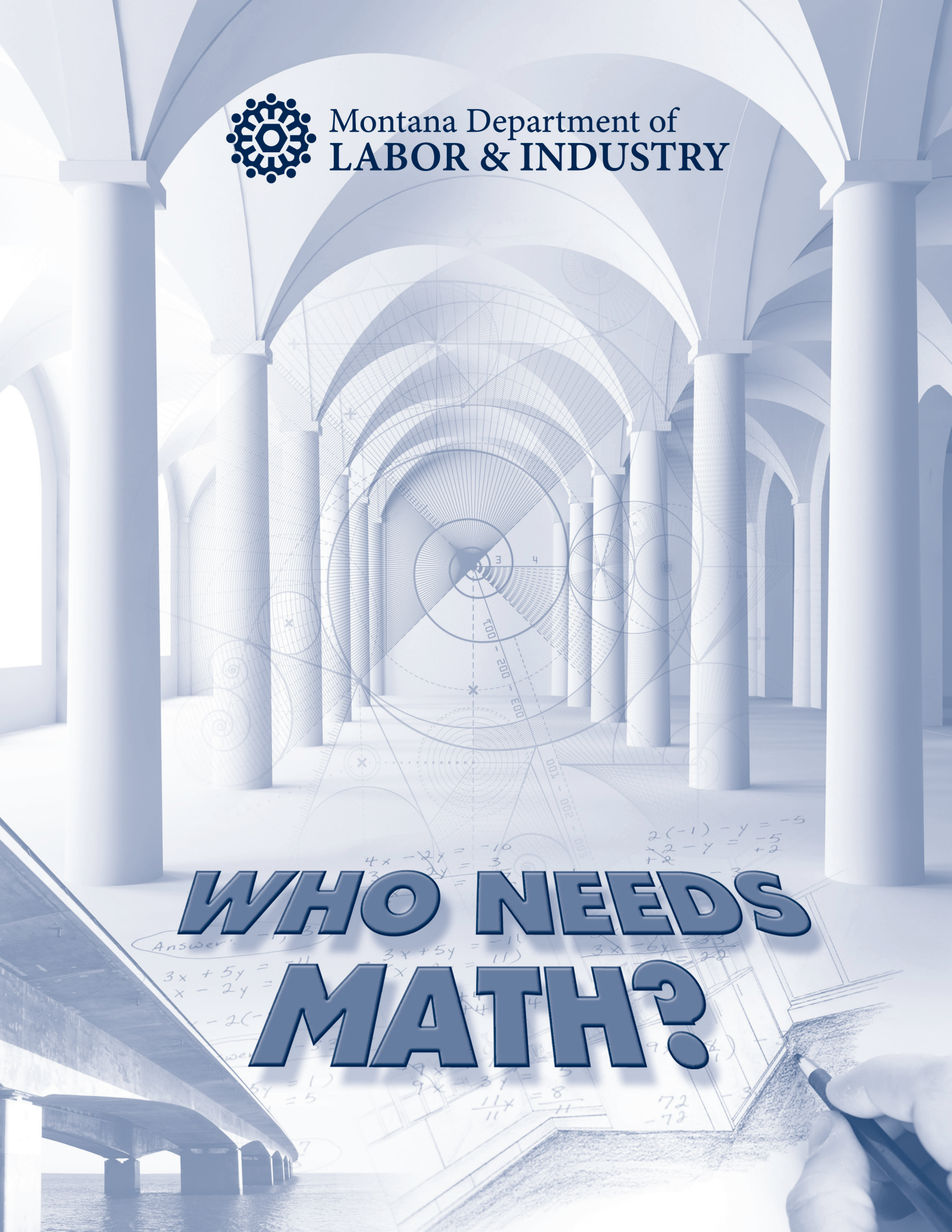
Montana Department of
LABOR & INDUSTRY
WHO NEEDS
MATH?

WHO NEEDS MATH?

State of Montana
Steve Bullock, Governor

Montana Department of Labor and Industry
Pam Bucy, Commissioner

Workforce Services Division
Mike Cooney, Administrator

Research and Analysis Bureau
Todd Younkin, Bureau Chief

May 2014

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Printed copies of this publication are available by request.

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Read This Publication If...

- **You hate math**
- **You are barely passing math**
- **You aren't going to college**
- **You are going to college but for a non-math related program**
- **Your parents were poor at math**
- **You think you will never need math in real life**
- **You want to learn about some exciting careers**

Who Needs Math?

There's hardly a student who has made it through a high school trigonometry class without asking,

"When am I ever going to use this stuff in real life?"

This publication is intended to answer precisely that question.

What you'll find within these pages is a collection of interviews with real professionals in a wide variety of occupations, all of whom use math regularly. As you read, you'll see that math turns up in some surprising places. Want to be a welder? Better not skimp on the geometry and trig. What about interior design? You'll need higher math skills to calculate the arc for that countertop. Simply put: math is everywhere!

Twenty-first century jobs rely heavily on math and science, yet U.S. companies have trouble finding enough workers with sufficient math and science skills to fill all their technology positions. As a result, they must seek highly skilled workers from other countries. Most experts predict that today's U.S. students will face stiff competition with foreign workers for American jobs.

Perhaps you've already chosen a career path and you know you'll never need math. Don't be so sure. Did you know that professional chefs are more than great cooks, but also business managers, accountants, and event planners whose success depends not only on the quality of their food, but their ability to plan menus that maximize their profits and minimize wasted resources? Did you know that lawyers must be able to make complex calcualtions to determine a fair settlement, especially those specializing in tax or corporate law? Patent lawyers even need degrees in engineering to understand the math formulas involved in the physics or chemistry used in certain products.[1]

[1] www.mathforum.org

Even if you're certain your chosen career does not use math, what happens if you change your mind? Taking advanced math classes in high school helps you keep your options open. If you haven't taken enough math in high school, you may not gain admittance to certain colleges or programs. Why limit yourself by taking only the minimal requirements?

There's also another reason to study math, perhaps the most important reason of all: math teaches problem-solving. Even if you never use a geometric proof after high school, the skills that it took to write those proofs will stick with you and can come in handy in ways you'd never expect. The bottom line is that math makes you smarter. It has often been compared to a mental workout. You exercise to keep your body strong. Even if you'll never have to run a mile or lift 200 pounds in your daily life, your body benefits from the exercise. Similarly, math exercises the mind, keeping your brain agile enough to work through complex concepts when it needs to.

In addition to the interviews found in this publication, we've also provided a number of activities to help you exercise your math skills, and to illustrate how math works in real world work situations.

Going to College? Be Prepared.

For admission in the Montana University System (MUS), minimum core requirements include three years of math (Algebra I, Geometry, and Algebra II, or the sequential equivalent). Students graduating in 2010 or later will need to complete the "Rigorous Core," to qualify for MUS Honors Scholarships. The rigorous core requires four years of math, including a course beyond Algebra II (such as Trigonometry, Pre-Calculus, Calculus, or Computer Math). Many out-of-state and private colleges require four years of math just for admission.

What math skills do Montana Universities expect entering freshman to possess?

Algebra:
- Solve algebraic equations and inequalities
- Simplify and rewrite expressions
- Factor polynomials
- Solve two equations with two unknowns

Geometry:
- Apply the Pythagorean theorem
- Construct and interpret 2-dimensional geometric figures
- Use congruence and similarity
- Prove properties from simpler properties

Functions:
- Describe functions symbolically, grapically, numerically, and verbally
- Analyze the graphs of many types of functions
- Analyze the effects of parameter changes
- Model real-world phenomena with a variety of functions

Trigonometry:
- Use trig functions and the laws of sines and cosines to solve triangles
- Apply basic trigometric identities

Remember, even non-math degrees in the Montana University System require 3-6 semester credits in math courses. If you make an effort to retain what you learn in high school, these courses will seem like review. If not, you'll have to relearn everything, but at a much faster pace.

Worried about those admissions exams? Take an academic practice test from MCIS! Practice tests include the SAT, ACT, PSAT, GED, ASVAB, & CLEP. Go to: www.mtcis.intocareers.org Username: visitor Password: visitor06

Accounting Technology Instructor

Barbara Yahvah

What exactly do you do?

I am a teacher at a technical college. I teach Business classes, such as accounting, economics, and introductory business. In addition to teaching in the classroom to a roomful of students, I will often arrange to meet with students one-on-one to talk with them about their career goals or help them with their assignments. College teachers are also expected to attend committees, stay up-to-date with the subjects they teach, and explore new ideas that will help students be successful.

What's the coolest part of your job?

The coolest part of my job is thinking up a fun way of teaching to the students.

What's your favorite part?

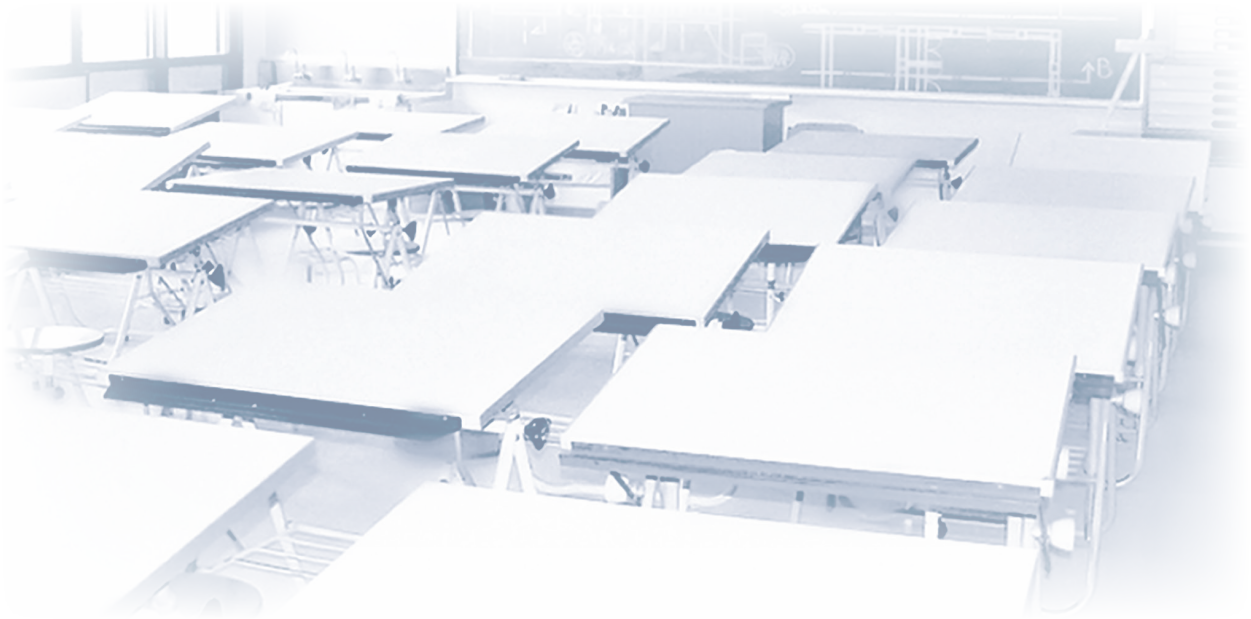
My favorite part is when a student says "ah, hah! I get it now!"

Tell a story about problem solving in your job.

I often relate math formulas with visual demonstrations, so students can understand better. In a basic math formula, such as a+b=c, I will replace each letter of the left side of the equation with a number. For example, a=4, b=0. The formula is now: 4+0=c. At this point, I physically lean over my left side so my weight is totally on my left foot. I then say, "I am listing (leaning) to the left, how do I get back in balance and upright?" The students respond, "by adding 4 to the right side of the equation." Throughout the discussions, I always visually lean to whichever side is "heaviest" until numbers are added to the other side to "balance" the equation. When the students are doing their homework, they always remember the demonstration.

Describe a funny story that happened on the job.

One day, I had written a lot of math formulas on the whiteboard and was adding the results. I was to the last total when I realized that the answer was wrong. I tried adding the numbers, again only to have the answer wrong, again. I turned to the students, and said, "Okay, I was just testing you, to see if you could come up with the correct answer!" The students laughed, especially, when I created a new "board" rule-if I didn't write



my initials on the whiteboard after I had shown some calculations, it wasn't considered finished-and I had the right to change it. After this, students would enjoy looking for"errors" on the whiteboard, once I initialed it-they actually were checking the mathematical additions and having fun!

What surprised you about your job when you first started?

The willingness of students to accept me as a new teacher. The enthusiasm and true desire to learn by all students.

How did you become an instructor?

After I graduated from high school, I attended college as an art major. After some time, I decided that I would look for a business career and do my art on the side. I studied accounting and graduated with a bachelor's degree. My first "real" job was at a department store. After a few years, I was promoted from a sales associate to department manager, where I used my accounting skills in planning. I would count merchandise, estimate sales, and order extra items during holiday season. It was at this job that I realized I loved to teach. I would teach the other employees how to help customers and keep track of merchandise. I decided I would find out what education and work experience would be good for a teaching career. Because I wanted to teach adults who graduated from high school, I called a person at a college to talk with about career options. This person met with me and told me that an advanced college degree in the area that I wanted to teach would be necessary. I attended college the next fall to earn a Master's degree. While there, the college asked me to teach a first semester accounting class-my first true teaching experience! After I earned my degree, I worked at a state agency recording accounting entries. When a teaching job was advertised for the technical college, I applied and was hired. Since becoming a college teacher, I have continued my education by taking classes-after all, education is lifelong learning!

How has your job changed over time?

I have learned along with the students-how to know my subject that I teach better each day and how it takes teamwork to accomplish many things.

Any advice for students entering high school?

Do the best you can in all that you do. Your best may be different than someone else's best, and that's okay.

The Job in Brief...

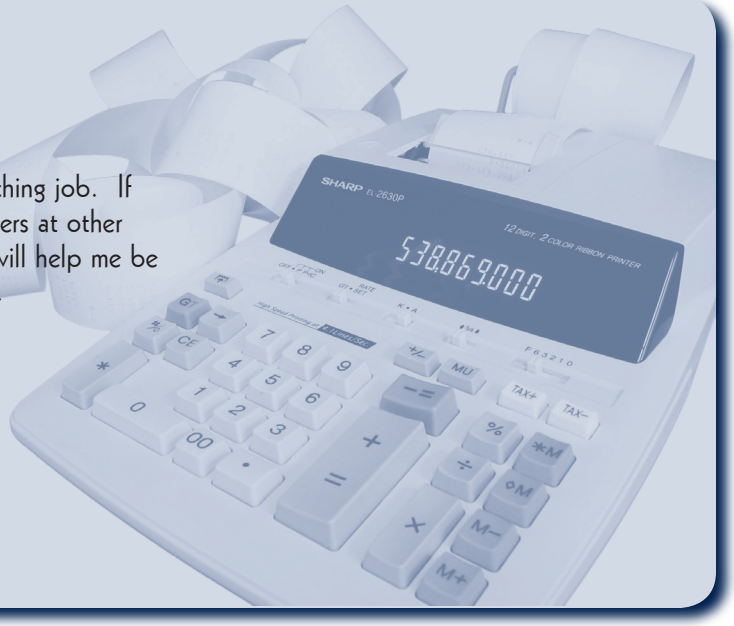
Title: Accounting Technology Instructor

Travel: There is not much travel with my teaching job. If I would like to meet with other teachers at other colleges, or attend a workshop that will help me be a better teacher, I may have to travel.

Education:

Bachelor of Arts in Accounting
Master's in Business Administration
EdD Educational Leadership (ABD)

Math: Every day.



Actuary

Brian Forman

There aren't many actuaries in the U.S. but Brian Forman is one. "Actuary" usually ranks at the top of the list of "most desirable jobs" and it's not because it starts with the letter "A." Being an actuary pays well, is low-stress and offers growth opportunities, job security, and positive work environment. It is challenging, however. Actuaries use math to predict how future events might affect the finances of their company—usually an insurance firm—so that the company can make financial decisions today.

To understand what actuaries do, you need to understand how insurance works. If you have life insurance, for example, every year you pay a certain amount of money (the "premium") to your insurance company. The company puts the money in a reserve. When you die, your family files a "claim" and the insurance company pays them money—often more than you paid in premiums (their "benefits").

What exactly do you do?

As an actuary, I make calculations about insurance policies—in my case, life insurance. I decide how much money company needs to keep in reserve in order to pay future benefits. I need to consider a wide range of factors and make some projections. We don't want to use the reserves to buy office supplies, for example. I also have to be certain to follow all the laws that apply when I make those calculations. In fact, I must sign and file statements with the state verifying that we have adequate reserves. As a manager, I oversee other employees and do product pricing. I help decide, for instance, how much to charge for a new type of insurance.

What's the coolest part of your job?

I get to see the impact of my decisions on the whole company.

What's your favorite part?

I like not having a day-to-day routine. I get to set my own schedule and priorities. I also like that I can provide information that people can't get any other way.

Tell a story about problem solving in your job.

Problem solving is really important. When I hire people, that's one of the major skills I look for. Problems arise all the time. For instance, we run computer-generated reports at the end of each month but we can't assume that they're right. We always review them. If one doesn't look right, then that's a problem and we have to figure out what happened. Maybe the numbers for a day were accidentally dropped, for instance, and not included in the month's total. We have to look at everything for quality.

How did you become an actuary?

My mom's friend's son was an actuary and it seemed like a good job. I was always good in math and science, so I decided in high school that I was going to be an actuary, too. I took as much math as I could and I went to one of the few colleges at that time that had an actuary program. I also took some of the necessary qualification exams while I was still in college, (e.g., calculus, probability, statistics) so that I could work as soon as I graduated.

Any advice for students entering high school?

Learn math and computers. They're important tools, necessary for any job-professional or not. I think that people should know what an error message on their computer screen means no matter what they do.

The Job in Brief...

Title:	Senior Vice President and Chief Actuary
Travel:	Very little.
Hours:	50 hours a week.
Education:	Bachelors of Arts, Masters in Actuarial Science (one extra year)
Math:	It's at the core of everything I do. I have to understand mathematical concepts, use algebra, formulate discounts and interest, and make projections.

For more information go to: www.BeAnActuary.org

Aviation Mechanic

Rena Smith

Aviation mechanics regularly service, repair aircraft, and perform routine maintenance and inspections. The Federal Aviation Administration (FAA) requires regular checks to be made to aircraft. Mechanics follow the FAA's maintenance plan. They may also inspect aircraft after they have flown a certain number of hours, days, or cycles of operation. Many aviation mechanics work only on preventive maintenance. They inspect the engines, landing gear, instruments, pressurized sections, and accessories. Mechanics who specialize in repair rely on pilots' descriptions to find and fix faulty equipment. Some listen to the engines to identify the problem. Others may use blueprints to learn where repairs need to be done. After completing the repairs, mechanics run tests to make sure the systems or parts are working properly. Mechanics may work on one or many types of aircraft. These may include jets, propeller-driven airplanes, and helicopters. Mechanics may also work for many different types of employers such as: general aviation, corporate aviation, a charter service, or large commercial airlines. Aviation mechanics are more likely to be specialized if they work for commercial airlines and more likely to generalize if they work for a general aviation company.

How did you become an aviation mechanic?

I started my on-the-job training as a helicopter mechanic when I enlisted in the U.S. Army. After two years in the Army, I enrolled in the Aviation program at the Helena College of Technology. After completing the two-year program, I tested for and successfully passed the Airframe & Power plant certification. This certification is issued by the FAA and is required for all civilian aviation mechanics.

What do you enjoy most about your job?

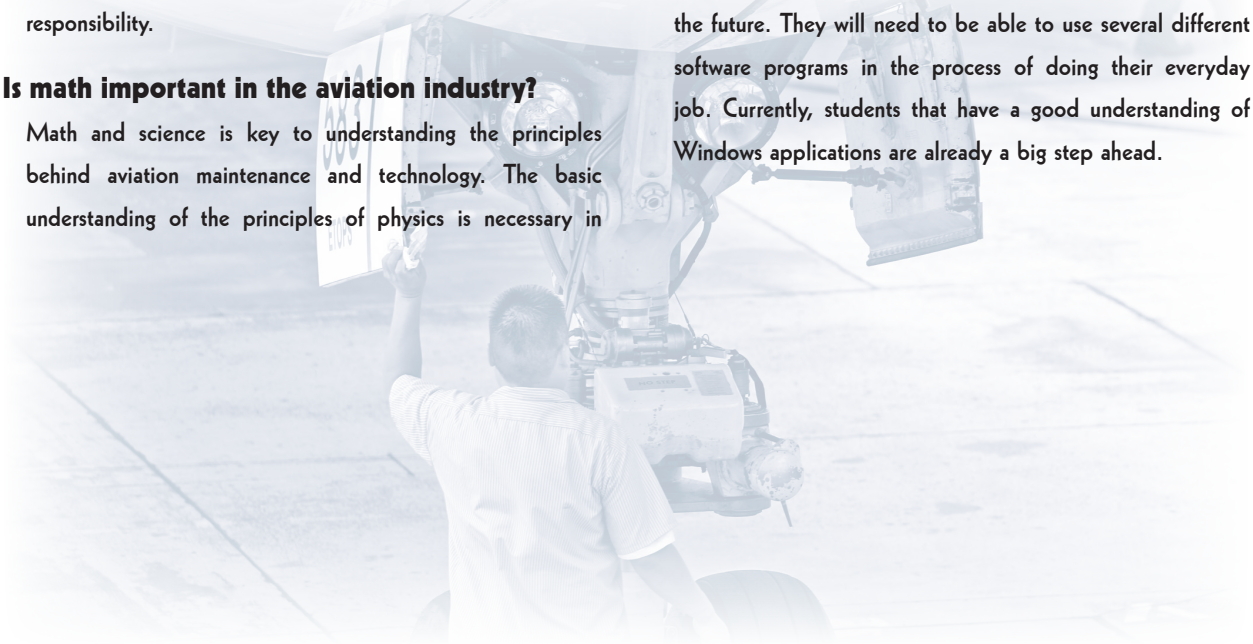
I love aviation, and take great pride in the fact that it is my responsibility to ensure that the planes that I work on remain safe while operating in the air. I fixed it, they are my responsibility.

Is math important in the aviation industry?

Math and science is key to understanding the principles behind aviation maintenance and technology. The basic understanding of the principles of physics is necessary in order to possess the knowledge necessary to work in aviation. Mechanics must have a basic understanding of aerodynamics, impacts of gravity, and basic equations that concern motion or velocity. Technical math or how to apply basic principles of math are vital competencies needed for problem solving in aviation maintenance. Measurements, calibrations, and math equations are used on a daily basis in an aviation shop.

How will aviation mechanics and their workplace be different 10 years from now?

Future aviation mechanics will need to have more training in the usage of computers to diagnose the more technical engines of the future. They will need to be able to use several different software programs in the process of doing their everyday job. Currently, students that have a good understanding of Windows applications are already a big step ahead.



Bridge Engineer

Stephanie Brandenberger, P.E.

I am a structural engineer and I design bridges for the Montana Department of Transportation. They may be big highway bridges or small bridges over a creek. They have to be safe for drivers and must withstand all kinds of forces, such as heavy trucks, high winds, floods, earthquakes and impacts from trains. They have to look nice and fit into the surroundings. They have to accommodate the needs of the public driving on it, as well as, the environment around it. No two bridges are exactly alike, so I have new challenges with every project I work on.

What exactly do you do?

First, I get an idea about how the bridge will be used, what it should look like, and how it will be constructed. I gather information on traffic, soils, and the environment around the bridge. I use math and physics to determine the forces on a bridge and how it will behave under these forces. Will it sway too much? Will it crack? This part is called "analysis" and is a big part of my job. Then I draw the bridge plans and all the pieces that make up the bridge, so someone can build it.

What's your favorite part?

Engineering is a lot like putting a puzzle together. I take pieces of information and fit them together and create something unique and helpful to a community. I like thinking of new ways to solve problems.

How has your job changed over time?

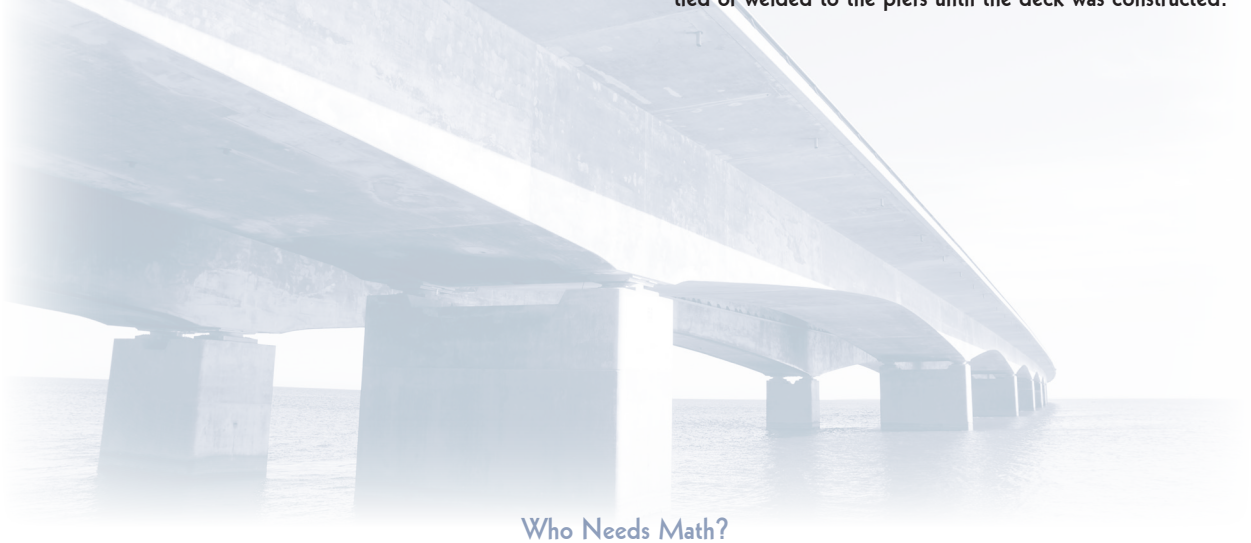
Computers have allowed engineers to analyze and design more complex systems, resulting in bigger, longer, taller, and more elegant structures than ever before.

How do people react when they learn what you do?

They want to know why things are built the way they are. I like answering their questions and helping them understand and appreciate all the great things they use every day that engineers had a part in creating.

Tell me a story about something odd that happened at work.

Sometimes, an engineer's job is about solving mysteries! Once on a construction site, a 6-foot tall, 145-foot beam that weighed 57 tons had just been set on piers. The workers went home for the night, and came back the next day to find the beam had fallen into the river! There was no wind and no earthquake to push it off. Why did it fall in the river? When concrete gets cold it shrinks a little, when it gets warm it expands a little. The morning after the beam was set, the sun came up and started heating up one side of the beam. That side started to expand. The other side was in the shade and was still cold. Since the two sides of the beam were not expanding at the same rate, the beam bowed out toward the warm side. It bowed out so far, that the beam lost its balance and tipped over. After we figured that out, the beams were tied or welded to the piers until the deck was constructed.



To see how a cosmetologist uses math, try the activity "Using Ratios in Mixing Hair Color Formulas" on page 34.

Cosmetologist

Linda Pouliot

What exactly do you do?

I cut, style, color highlight, and perm hair. I also arch eyebrows (we pluck chickens), apply artificial nails, perform manicures, pedicures, facials and massages. As far as personal customer service goes, I boost people's morale and self esteem, encourage changes to their self image, teach aftercare techniques, and shower them with T.L.C.

What's the coolest part of your job?

Boosting people's self image and one-on-one friendships. When your hair is "right" all is well in your world. I can make them feel so much better about themselves.

What's your favorite part?

I enjoy analyzing people's hairstyle to fit their features and to fit their life-style. Drastic changes are very fun!

Tell a story about problem solving in your job.

If a person hates to fix their hair, then for goodness sakes, give them a "carefree" cut. If they make a mistake at home on their own hair, we can correct it. If their problems are personal, really listen and brainstorm for solutions with them (if they ask for your input).

Describe a funny story that happened on the job.

At beauty college, after many practice hours, my first customer knew me AND my family. YIKES! Sooo, I intentionally took a very long time to cut, roller-set, and comb out her hair (3 hours), so it would be PERFECT. Well, a year later she was assigned to me at the salon where I was working. She took one look at me and said "Oh my Gosh, I DO hope you are FASTER than you used to be!"

How did you become a Cosmetologist?

I always loved "playing" with hair. I did my sisters', my friends', and "creative up hairdos" on myself from a very early age. Also, there was a funeral home close to my house when I was growing up. A friend and I used to sneak in there and see how awful the dead person's hair looked. We knew THEN that we can't be morticians. However, later we decided we wanted to work with "live" people. Now, I just want to make people beautiful "dead or alive."

What surprised you about your job when you first started?

I was surprised at how very challenging it is to work with the public, their moods and attitudes. You need to be patient with some who are very "picky" and hard to please. You need to be a good communicator and learn to know the difference between whether to talk or just listen to your customers. LEAVE YOUR OWN PROBLEMS AT HOME!

How has your job changed over time?

I have followed trend releases (new releases) twice a year for 30 years. Trends have gone from razor cuts to scissor cuts, and from "huge" hair, to no hair, to spiked hair. Coloring hair has changed from normal to "funky."

Any advice for students entering high school?

You must graduate from high school, or have your GED to be accepted to cosmetology school. I would advise you to work on your social skills and take sociology courses. You have to be able to get along with personalities that you don't like. You must accept people for WHO and HOW they are.

The Job in Brief...

Title: Cosmetologist

Travel: You travel to state and national conventions yearly or twice a year. If you have a customer who is sick or home bound, you need to go to their home.

Hours: I work Monday through Friday, 40 hours a week. In the beginning of your career, you need to work week days, evenings, and weekends to build up your clientele.

Education: High school diploma or GED and one year of cosmetology school. You will need to attend hair shows once or twice a year for your whole career.

Math: Math is used a lot in cosmetology, especially to run your own business. You'll need bookkeeping for monthly and year-end business, tax knowledge, and inventory skills for your products.

Designer

Julie Ludtke

What exactly do you do?

I am involved very early on in the decision making process. If the job is commercial, architects will specify what products are to be used. Codes will delineate the type and at times, the colors that must be chosen. In residential design, the designer is responsible for the choices and must work closely with the customer. Designers use math daily in figuring bids, percentages and measurements of rooms, square footage for walls and floors. This names just a few areas where math is an integral part of a designer's job.

What's the coolest part of your job?

Being able to be creative and help the customer achieve their dream. A lot of times the customer knows what they want for the final look, but they lack the ability to put it all together.

What's your favorite part?

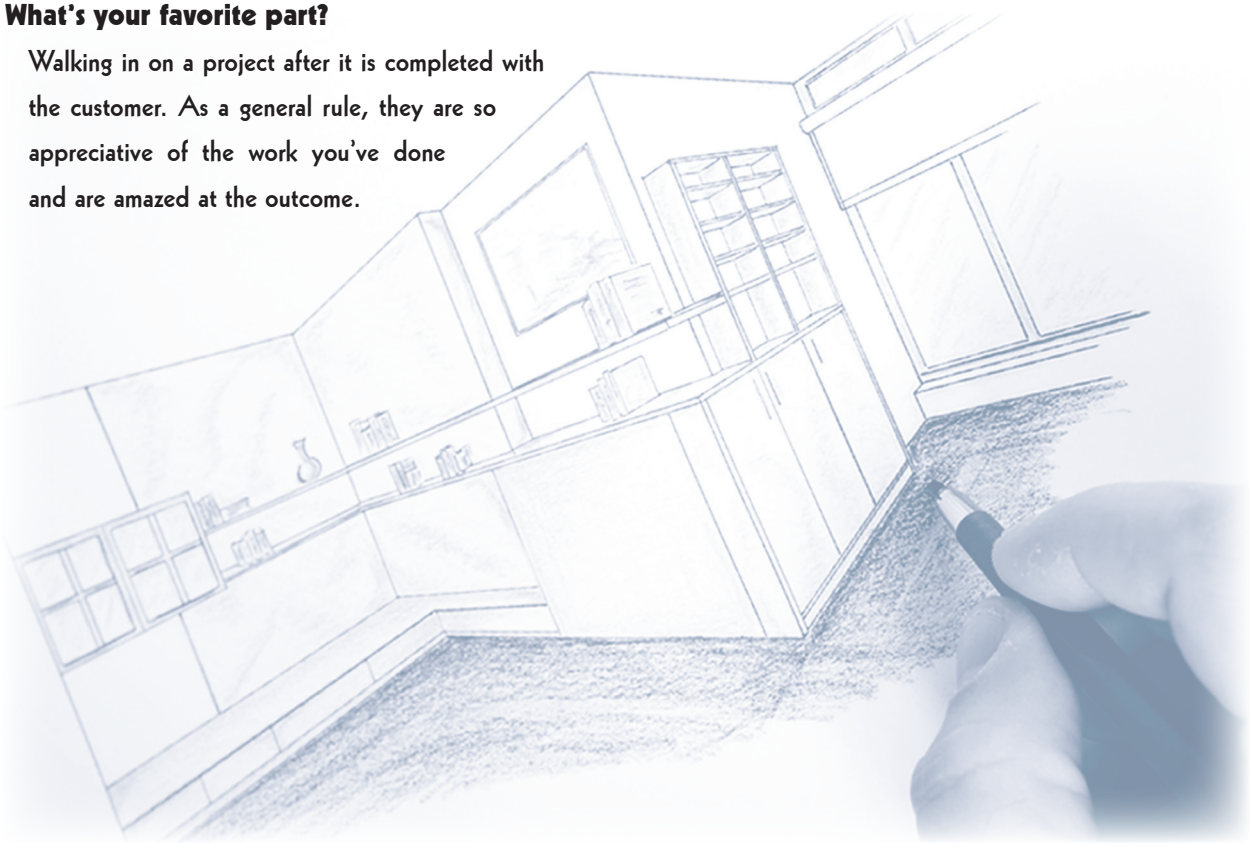
Walking in on a project after it is completed with the customer. As a general rule, they are so appreciative of the work you've done and are amazed at the outcome.

Tell a story about problem solving in your job.

When I do kitchen cabinet layout, it is similar to solving a puzzle. Cabinets come in 3 inch increment width wise and must be fit in exactly. We use a computer for the layout but it is figured manually before it is entered. Additions and subtraction of different sizes of cabinets and fillers make it work. When we are applying countertops, trigonometry is used for figuring angles and arcs.

Describe a funny story that happened on the job.

We had ordered carpet for a customer. The installers got to the job after the customers had gone to work. They laid the carpet pad and then left the job for lunch. At noon, the customers came home and saw the pad and thought it was the carpet. They proceeded to call



me and let me have it for ordering the wrong color of carpet. I apologized all over myself and looked into the matter. When I realized that it was just the pad and not the carpet that they had seen, I was so relieved, I almost cried. Mistakes of that nature could cost thousands of dollars to remedy.

How did you become a designer?

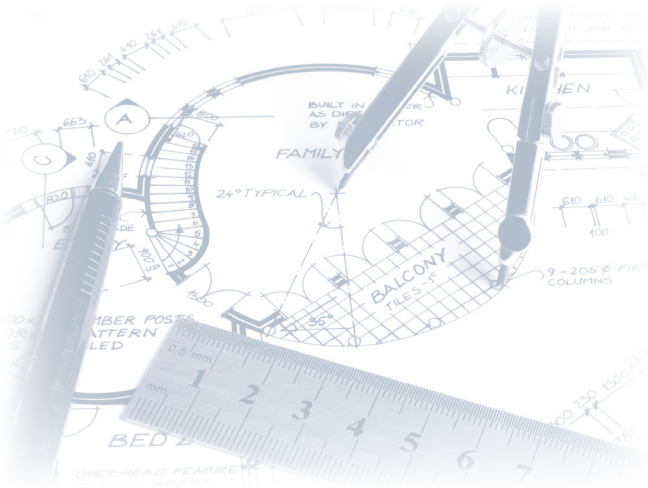
I attended Montana State University and majored in prelaw. It didn't take too long to realize that I was unhappy with my decision. I am very creatively driven so I embarked on honing my skills as a designer and buyer for a home design store.

What surprised you about your job when you first started?

I guess I was not completely taken by surprise by any aspect of my job. I knew ahead of time that there was a great amount of work involved in becoming a designer.

How has your job changed over time?

I believe that people's homes are very important to them. With the unrest in the world today, they need a haven to go home to. A place where they can unwind and feel safe and comfortable is a priority.



Any advice for students entering high school?

High school should be a time of discovery for you. Listen to your intuition and follow your instincts. Take all the math and science that is offered. I use math every day in so many different areas of my job, that a goodworking knowledge of algebra, trig., and geometry is essential for me. Science will equip you for existing in our great world. I believe that as time goes on designers and architects will be building and using 'green' products that are more environmentally compatible with nature.

The Job in Brief...

Title: Designer

Travel: On occasion I travel out of our area. I attend seminars and school. I am required to complete so many hours of continuing education. I also attend trade shows so I can see the new and innovative products available.

Hours: I usually put in about 45-50 hours a week. Being a job foreman requires me to be in the field continually working with subs. I work around a lot of other people's schedules and must be available when they are.

Skills and education:

Schooling gave me numerous skills that I use every day. A major in design, architecture, CAD (Computer Drawing or Drafting) would be most helpful, but there are several avenues that a person can pursue other than a 4-year degree. Working in the field for 5-7 years and then taking continuing education courses will allow you to apply for an ASID designation. Working towards this designation will show your customers that you are capable and able to take on their projects and to carry out and complete the work. Being designated shows committment to the profession.

Math: Every day.

For more information go to: www.asid.org/become

Diesel Mechanic

Ralph Rinehart

Diesel mechanics repair machines used in construction, logging, or any other heavy equipment that has a diesel engine. They maintain equipment so that it operates properly and safely. When equipment breaks down, they examine it for defects. Mechanics often use computerized diagnostic hand-held computers to diagnose components that need repair. They may take the equipment apart to inspect or repair various parts. Sometimes they use jacks or hoists to lift or move large parts. It is of utmost importance for most owners of diesel equipment to keep them running properly. For this reason, most diesel mechanics get the opportunity to work a great deal of overtime. Breakdowns of equipment are almost never expected, but always seem to happen when you are least expecting it. All diesel mechanics are expected to own their own hand tools when they start in the trade and continue to add to them as they gain experience. A mechanic beginning in the profession may own only $2,000 in hand tools, while a diesel mechanic with several more years of experience may own up to $20,000 in hand tools.

How did you become a diesel mechanic?

While growing up in Montana, I was always very active in working for the family logging business. We owned diesel trucks, crawlers, and other diesel equipment that I was held responsible for keeping in good working order. I learned a lot about mechanics from my dad and was able to complete my first diesel overhaul by the age of 14. After graduating from high school, the family business was sold due to a declining lumber industry. I went to Denver where I worked road construction for one year, then moved to Portland where I worked on the city's first pillared highway project. One year later, I came back to Butte and started my career in diesel mechanics working for Robert's Rocky Mountain Diesel. There, I enrolled in a 4-year apprenticeship program that only took a little over 2 years to complete, due to my prior work experience in diesel maintenance. I was then promoted to a Field Service Tech and made a journeyman level wage while traveling and dealing with large corporate diesel accounts.

What do you enjoy most about your job?

I most enjoy the interactions with my customers on the job. Most of my customers are repeat business and ask for me in person when they need their diesel worked on. I enjoy the recognition that I receive from them and the trust that they have in my work.

Is math and science important in the diesel industry?

Math and science are key competencies that a diesel mechanic must have in today's workplace. The basic understanding of the principles of physics is necessary in order to understand how to problem solve in the diesel trade. Basic math, technical math, and geometry are also subjects that must be mastered before one can fully understand the principles of diesel mechanics. Measurements, ratios, fractions, and metric to American standard conversions are common calculations that need to be made everyday in the workplace.

How will diesel mechanics and their workplace be different 10 years from now?

Future diesel mechanics will need to have more training in the usage of computers. They will need to be able to use several different software programs in the process of doing their everyday job. Currently, students that have a good understanding of Windows applications are a big step ahead of students with no computer understanding. The future diesel garage will be a much safer work environment due to the help of hydraulic machinery for heavy lifting and the increased attention put on the prevention of industrial accidents.

Director of Finance

Bill Woon

What exactly do you do?

I am responsible for all of the financial recording, reporting, audits, payroll, computer system maintenance, and support to the management team and C.E.O.

What's the coolest part of your job?

I get to be involved in almost every aspect of the organization.

What's your favorite part?

Interacting with employers and the public. Being a trouble shooter and problem solver.

Tell a story about problem solving in your job.

Last fall we had problems with the software that calculates the productivity on gross pay of the employees. The system was not calculating overtime properly for employees that received differential pay. We recreated the logic of the software and the order of calculation to determine the steps used to create gross pay. It turned out that the order of the calculation of differential pay and overtime pay had to be adjusted to calculate properly. The error was corrected and the system is working well.

Describe a funny story that happened on the job.

A U.S. Senator from Montana was touring our organization with a group of reporters. One of the employees with disabilities ran up to the Senator and said "I know you, you are Senator _____. You sure look better on TV than you do in person."

How did you become a Director of Finance?

I went to college and passed the CPA (Certified Public Accountant) exam.

What surprised you about your job when you first started?

The complexity of the payroll and accounting systems to comply with the reporting requirements of the State and Federal government.

How has your job changed over time?

We have become much larger in the past 15 years and have placed a lot more reliance on computers and information technology.

Any advice for students entering high school?

Be open-minded about the classes you take and the education process. Don't be afraid to try new courses to see if you like them.

The Job in Brief...

Title:	Director of Finance	Hours:	40
Travel:	None	Education:	Bachelor of Science, Bachelor of Arts, CPA

Drafter

Anthony Eaton

When it comes to building a building, a lot happens before construction workers arrive. First, a property owner hires an architect to create a design. Then someone translates the design into a practical plan that construction workers can use. That someone is a drafter, like Anthony Eaton. Drafters use CAD (computer-assisted drafting) software to create the work plan, called a blueprint. Printed on paper two feet tall and three feet wide, it shows exactly how long and high each wall is, where each pipe goes and so on. Like the architects and engineers they assist, drafters help design more than buildings. They might work on equipment or gadgets or help with bridges and other structures. In all cases, though, drafters help turn ideas into reality.

What exactly do you do?

My main responsibility is drawing building designs on the computer. The architect gets the clients and comes up with the main design of the building. I put those ideas on paper so that the builders know exactly what goes where when they're building. To do that, I need to work with different kinds of engineers to make sure everything works inside, like plumbing, electrical outlets, and so on. I'm in charge of managing my progress. My boss doesn't sit over my shoulder but I have to get the work done on time. I also have to meet all the building regulations, such as handicap accessibility, and they change all the time. Finally, I do some field work before I begin a project, especially if it's a renovation. That means I visit the building site and measure the actual space.

What's your favorite part of the job?

Seeing it all come together when the building is finished.

Tell a story about problem solving in your job.

Right now I'm working on remodeling an historic courthouse. The current building codes require accessibility for everyone, including people with disabilities. Buildings weren't made that way in 1860. So far, I've added an elevator, which requires precise measurements. That will help people in wheelchairs. I also have to add accessible bathrooms and figure out how to fit one in a tiny area behind the elevator. It's challenging, but I get to be creative.

How did you become a drafter?

By chance. I was going to be a forester but during my sophomore year, my high school added a drafting class, which I liked. Then I took more drafting in college. This is my first job; I started in January.

What do you wish you'd done in high school?

I wish I'd taken more science and math in high school. My junior year I just took Algebra and the science minimum and that was it. I wish I'd taken physics. Physics tells about the forces and it comes into play when you're building something. I'm currently looking for a physics class that I can take. With a computer you don't have to know higher math formulas but what if you're out of the office and don't have the computer? You need to know it then.

The Job in Brief...

Title:	Computer Assisted Drafting (CAD) Technician	Education:	Associates of Occupational Studies
Travel:	Sometimes I visit the building site because it helps in future designs.		Certified through the American Design and Drafting Association
Hours:	40-55	Math:	Yes. I wish I knew more.

For more information go to: www.cadalyst.com

Forensic Scientist

Gary Molina

"DNA Test Reveals Prisoner's Innocence." You've probably read headlines like this, but what does it mean? We asked Gary Molina, a forensic scientist who tests DNA for the Texas Department of Public Safety ("Forensic"means related to the legal system). Because of Gary and others like him, the justice system has convicted many guilty people to jail and freed some innocent ones. These days, scientists are more important in solving crimes than ever before.

DNA–Deoxyribonucleic Acid, the substance that makes up your genes–decides what you look like and more.This "blueprint for you" resides in the center, or nucleus, of almost every cell in your body. No two people (except identical twins) have exactly the same DNA.

Forensic scientists use DNA tests to identify a pattern or "profile" of DNA left at a crime scene. They can get it from blood, saliva, skin, hair--almost anything the criminal left behind. By comparing this "DNA fingerprint" with the DNA of a suspect, scientists can tell the likelihood of the suspect's being at the scene.

We interviewed Gary in his office and lab in downtown Austin. He shares the building with the famous Texas Rangers, and often assists on their cases. Posters line the hallway walls, describing how DNA helped solve some famous Texas crimes.

Despite the good DNA testing can do, it can be stressful. There's no room for mistakes. But when work seems hard, "I remind myself of the job's importance and how it helps victims," Gary says. If, like Gary, you enjoy science and want to fight crime, forensic science might be the job for you!

What exactly do you do?

My work falls into three categories. First, I test evidence DNA here in the lab. Then I write a report of the findings. Second, if the case goes to trial, I may testify about the results. Finally, sometimes, when a crime occurs in a small town that doesn't have its own lab, we go there in our mobile lab and take evidence at the actual crime scene. Usually, though, the investigators bring the evidence to us.

What's the coolest part of your job?

Helping to solve crime.

What's your favorite part?

I get to combine two of my interests: public service and science.

How has your job changed over time?

New techniques have changed it a lot. In 1992, when I started, all we could do was identify blood type and some proteins from blood samples. Now, with DNA testing, we can get a lot more information and not just from blood.

How do people react when they learn what you do?

They're very interested and want to hear stories.

Tell me a story about something odd that happened at work.

You can find unexpected items at crime scenes. In one case, the murder suspect was wearing jeans with a "Not Guilty" brand label on the back. But the jeans had the victim's blood on them, so it was pretty clear that the suspect was guilty. I keep a photo of that bloodstained brand because it's so bizarre.

Tell me a story about solving some problem at work.

I'm currently working on a case where the only evidence is a piece of chewed gum left at the crime scene. The problem is how to get the DNA out of it. I think I'll be able to do it by freezing the sample and swabbing it to get some residue of saliva left on the gum. Another time, we had to identify a skeleton. We did it by getting DNA from the center of one of the teeth.

How did you become a forensic scientist?

I was always interested in science. I liked my science classes in school, particularly the labs. I worked in a lab during college and then in a hospital lab afterwards. One day, I saw an ad for this position and got hired.

Where will the job of forensic scientist be ten years from now?

I think the public will know more about DNA testing. More people will enter the field and that will increase competition for jobs. There probably won't be as many advances in DNA testing as there have been in the last ten years, but we'll be able to collect DNA from even more places than we can today.

What's the next step in your career path?

I like what I do now. Eventually, I'd like to move into management, though the competition for manager jobs is fierce.

Any advice for students entering high school?

Enjoy your science classes but don't focus only on science. And keep an open mind about what you want to do. What you end up doing, and loving, might be different from what you originally had in mind.

The Job in Brief...

Title: Forensic Scientist

Travel: Some travel for court, investigations, and conferences.

Hours: 40 per week, but I'm always on call (usually called just 3 times a year)

Education: Bachelors of Arts in Biology

Math: I use it a lot of the time, like when I'm deciding probability and running statistics.I need math, such as algebra, to determine what quantities of DNA to use for testing.

For more information go to:

www.forensic-science-society.org

www.forensicsciencesfoundation.org/career_paths/careers.htm

General Construction Worker

Harold Kelly

The tasks of general construction workers vary according to the type of construction they do. Most perform physically demanding tasks. Most perform their work outdoors unless weather is bad. Most are sometimes exposed to contaminants, hazardous equipment, distracting noise levels, and even very hot or very cold temperatures. Regardless of work environment, the construction worker must be sure that all details are done and their work is exact. Poor construction could result in serious safety hazards. They are also expected to be dependable, prompt, skilled, and productive with their time on the job. General construction workers are expected to have knowledge of various structural designs. They must have the knowledge necessary to construct buildings, read plans, blueprints, drawings, and models. They must also have a vast knowledge of power tools and their various applications.

Major employers for the general construction workers are heavy construction, office and industrial building construction, home building construction, concrete work, and highway and street construction companies. General construction workers usually work eight-hour shifts, though longer hours are also common. Some workers only work during seasons when weather permits.

How did you become a general construction worker?

After I graduated from high school, I became an apprentice with a construction company that I had some connections with through some relatives. I worked there until I became a journeyman construction worker.

What do enjoy most about your job?

I enjoy the physical work, working outdoors, and the feeling of ownership that I have after I have completed construction on a project. I enjoy the fact that I work 40 hours each week and never have to worry about taking my job home with me when I leave.

Is math and science important in the construction industry?

Yes, a strong background in basic math and linear measurements is very important as well as the ability to use geometry to solve problems is important in the building trades. Workers must be able to do simple math and measurement calculations in their head without the assistance of a calculator. Workers must also learn how to estimate on a regular basis.

How will welding and the workplace be different 10 years from now?

Future construction workers can look forward to a cleaner and safer work environment as more stringent safety standards are put into place by OSHA.

Hydraulic Engineer

Mark Goodman

A hydraulic engineer for the Montana Department of Transportation is involved with all aspects of surface runoff. Runoff can originate from small watersheds such as streets and highways or from large watersheds such as the Yellowstone or Missouri River. The hydraulic engineer's duties include determining how much water we need to pass through the highway, which is referred to as a "hydrologic analysis," and what frequency event we should be concerned with. For example, a 10-year flood, 50-year flood, or even a 100-year flood event will need to be analyzed in order to determine how large of pipe or bridge we need to put in the roadway without causing water to "back up" and cause damage to the roadway, upstream property or buildings, and without causing an inconvenience to the traveling public.

Many tools are available to the engineer to perform his job. A hydraulic engineer uses aerial photos, topographic maps, stream gauge data, surveyed cross-sections, and soils data, to name a few of the resources available to help them make good decisions. The computer is also used extensively to design the hydraulic openings required, this is referred to as a "hydraulic analysis." The many different options and alternatives in order to come up with the most cost effective design. This, of course, is the goal of the engineer, to come up with a solution to a problem, to minimize the cost to the public while still providing a safe transportation system and also being environmentally friendly.

What exactly do you do?

A hydraulic engineer's work includes making field reviews of proposed highway projects, collecting the data required to do a hydrologic analysis of drainage crossings, and preparing a report and recommendations for new structures in the proposed highway.

What's the coolest part of your job?

Solving problems related to water and its affect on the transportation system. Also, trying to reproduce flood events with our hydraulic models. My favorite part of the job is developing computer models that mathematically reproduce an event that has occurred in nature, such as a flood.

How do people react when they learn what you do?

They are surprised at the amount of detail involved in sizing something that seems so simple as a culvert.

How has your job changed over time?

Three of the biggest changes are the advent of the personal computer and the availability of computer software to analyze hydrologic and hydraulic events, the attention we pay to the effect of our designs on the environment, and the involvement of the public in the design process.

Tell me a story about something odd that happened at work.

We were trying to determine why the surveyed water surface elevation upstream of one of our bridges was so high during a flood event. We just couldn't get our models to predict such a high water surface elevation. After talking to maintenance folks they told us that a house had actually fallen into the river and became lodged on the bridge. This of course blocked the bridge opening and caused a much higher elevation than we could have ever predicted.

Medical Photographer

John Glowczwski

One second you're cruising along the highway. The next, your car smashes into a tree. When you awake,you're in a hospital bed, missing your left leg from the knee down. The doctor's say your leg was hanging by a thread and they had to amputate. But you can't believe it. Surely they could have tried harder! That's what you think—until you see the photos.

The photos? Someone took pictures of your injury? Yes, and these are no ordinary snapshots. They're professional prints that show, close-up, how your leg looked before the operation. Though they horrify you, they help you realize you're lucky just to be alive!

Medical photographer John "Glow" Glowszwski has taken such photos. He's also photographed countless surgeries so that medical students and surgeons-in-training can learn. He takes photos of injuries so that patients can file insurance claims to pay their bills, and his attractive publicity photos encourage people to attend the University of Texas Medical Branch (UTMB) at Galveston and use its hospital.

These days, Glow and his coworkers are transforming their photography lab on the UTMB campus. They're moving from traditional chemical photo processing (which requires a "dark room" and lots of smelly chemicals) to digital processing (which uses computers). With a digital camera, photos are ready instantly. Special software helps you make any changes and then you just print it out on film paper—no fuss, no muss, and no stinky hands!

What exactly do you do?

When it comes to my publicity work, I spend most of my time arranging photo sessions for my customers—people in different departments at UTMB. First, I learn exactly what they need. Then I find the locations and get the models, making sure we use people of all ages, colors, and races. I take the photographs and develop them, making adjustments when necessary.

When I take medical photographs, I spend most of my time with the surgeons, waiting until it's time to shoot, then snapping the picture and waiting some more. I've learned a lot about anatomy that way. I also sometimes train people in other departments so that they can take medical photographs themselves.

What's the secret of your success?

Being professional. I ask permission before taking people's pictures and I don't use the photos for any reason other than what I say. I never use photos to make anyone look bad. As far as locations go, such as hospital rooms, I ask before moving anything and I clean up afterwards. Most of all, I don't waste anybody's time. Because of that, people are happy to work with me when I need them.

What's the coolest part of your job?

Taking photos. It's fun! Of course, a lot of the people who think that have not seen what goes on behind the scenes.

What's your favorite part?

When people STOP and look at one of my photos. When they pause to see what's going on in it.

What surprised you about your job when you first started?

That I didn't mind not getting paid that much. Of course, my college professors had warned my classmates and me that we would have a hard time making a living in photography, period. But I proved them wrong.

Describe something that moved you on the job.

UTMB has a hospital with a children's cancer ward. Those kids are amazing. Their attitude reminds me that every day is a gift. Sometimes I take photos of kids who eventually die--but their photos remain. Lakisha, for instance, was a little girl who died of cancer but a poster of her hangs on a wall in one of the hospital wards and it's like she lives on. Along that same line, every year I take a group photo of the campers at Rainbow Camp, where kids with cancer go and bring their brothers and sisters and friends. Often there are some kids who didn't survive from the previous year. Sometimes their fellow campers make dream catchers for them and hold them up so they're still in the group photo. It's a very touching part of my job.

How did you become a photographer?

I got into photography in high school. It's a good way to meet a wide variety of people and you get free access to all the events.

How has your job changed over time?

For my first six years as a professional photographer, my work was strictly medical photography in the operating room or ER. Now it's more public relations-related. That's great because I was ready for the change. Medical photography is very standardized and fast-paced; there's little room for creativity. Publicity-oriented work allows me to be more creative. Another change is I now teach people how to do medical photography. That's because more departments take their own pictures nowadays because it's less expensive.

Any advice for students entering high school?

Learn computers! In college, I wish I'd stuck with my computer science minor because of how digitized the photo world is becoming; it would have been easier to keep up with developments if I had.

The Job in Brief...

Title: Photo Imaging Specialist

Travel: About 10 times a year to photo shoots and training sessions.

Hours: 50 hours a week.

Education: Bachelors Degree in Photojournalism

Math: I use it all the time for lens calibration and other things. For example, to know how much light to allow in the photo, I have to measure it using math values. I have to imagine the picture before hand and do calculation to achieve it.

Polar Meteorologist

Rick Toracinta, Ph.D.*

**Rick Toracinta passed away in November 2005. This interview is included to honor his memory, and to highlight his dedication to advancing scientific knowledge and passing on this knowledge to others.*

Many people worry about global warming, Earth's atmosphere is very slowly heating up. What will happen to plants, animals, and humans if it continues? No one knows for sure but Rick Toracinta is trying to find out. Rick is a meteorologist, someone who studies weather. He tries to understand the weather of the past and the present and predict what might happen in the future. You see, global warming is not new. The Earth's atmosphere has actually been heating up for the past 20,000 years. Before then, giant glaciers covered large areas of the globe. As the planet warmed, the glaciers retreated to the North and South Poles, leaving the land and seas as we know them today.

Rick predicts future weather in two ways. First, he uses computer models to simulate (to calculate and display) what the earth used to be like 20,000 years ago and what happened as global warming began. In addition, he works with other meteorologists to better understand how the weather at the earth's Poles affects the weather elsewhere on the planet today. If glaciers at the Poles melt, for instance, how serious would the flooding be and how would it affect the weather? The answers he finds may help us prepare for future changes.

What exactly do you do?

First, I help develop and improve a computer model of the earth's atmosphere. Since the atmosphere is like a fluid, you can describe it mathematically and turn that into computer programming. I'm constantly perfecting the model, which means doing actual programming. Developing the model requires me to work with others, such as geologists, glaciologists (people who study glaciers), and meteorologists who specialize in paleoclimatology (the study of the climate in remote geologic eras). They help me make sure that my study is reasonable.

In addition, I actually work with the model, setting up simulations, running them, and analyzing the results. I verify the results by getting actual weather reports from the North and South Poles. Then I try to figure out why the model/simulation did or didn't work.

Finally, I write papers about the results. A study is not very good if others can't benefit from the information gained. Also, publishing allows other people to give you feedback and new ideas.

What's the coolest part of your job?

To get a glimpse of "way back when" even if it's only with a computer model.

What's your favorite part?

Seventy percent of my job is setting up simulations. The neat part is getting the results and then asking new questions: What if we do this? It's like being in a lab, running experiments.

Tell a story about problem solving in your job.

I find problems to solve every day; that's what I do. For example, I'm currently trying to figure out how the climate was 20,000 years ago. A huge ice sheet covered North America instead of the grassland and mountains of today. Ohio, where

I live, was under maybe a half a mile of ice. I have to add that ice sheet to the model. But exactly how tall or deep was it? That's my problem. I'm working with experts in other areas of science to solve it. One colleague can describe how the landscape used to be by observing how the earth is today. He's like a hunter looking for footprints in a forest. He sees deep scour lines on the ocean floor, for example, and knows that a glacier moved across it. I'm also working with a guy who is an expert on glaciers and has an icesheet simulation program. By sharing our expertise, the three of us are coming up with a clearer picture of how the earth used to be. We're helping ourselves as we help each other. That's how we're solving the problem.

How did you become a meteorologist?

I've always been fascinated by weather and storms, even as a kid. My earliest memory is of watching a thunderstorm with my dad. As I got older, I loved watching the Weather Channel. I knew early on that I wanted to be a meteorologist, though I had other interests over the years. Throughout, though, weather was always the continuous thread.

What will polar meteorologists be doing ten years from now?

We will have a much better understanding of climate change and how the Poles relate to that. Today there's so much still unknown. In the future, I think we'll still be using computer simulations but they will improve a great deal.

Any advice for students entering high school?

Learn mathematics and physics; they're the foundation of everything you learn from then on. If the foundation is not solid, what you build on it won't last. If you're interested in something, watch, observe, and learn. Don't just rely on what you get out of a textbook. Find out what you need to study. I regret that I didn't talk to people in the field to find out exactly what classes I needed. My first couple of years in college were extremely difficult because calculus and physics were new to me. They were just review for my classmates who had taken those subjects in high school. My grades were good but I had to work a lot harder than the others.

The Job in Brief...

Title: Polar Meteorologist

Travel: 3-4 times a year I attend conferences in places such as Colorado, Sweden, and Antarctica.

Hours: 50 hours a week.

Education: Bachelors of Science in Meteorology, Masters of Science in Atmospheric Studies, Ph.D. in Atmospheric Studies

Math: It's the foundation of what I do. I wouldn't understand how the computer generates pressure and wind without it. For specific problems, I need to know calculus because it's closely related to physics.

For more information go to: www.weather.gov/om/edures.shtml (National Weather Service)

Real Estate Appraiser

Joe Moore, IFAS

What exactly do you do?

My job is to make an unbiased opinion of value on a piece of property. I do this for banks so they know how much money they can loan on a property. I also do this for insurance companies, estates, and many other reasons.

What's the coolest part of your job?

Trying to figure out what different components of a property are worth. We use a lot of math formulas to figure out what other people are willing to pay for different parts of a property. Some things are worth more than their cost and some are less. It's kind of like detective work. My favorite part of the job is appraising a building from plans and specifications. I have to figure out what it is going to look like and what it will be worth when it is built.

Tell a story about problem solving in your job.

When interest rates were real high a few years back, people would get real creative in selling property. My job is to determine only the value of the real estate so if a seller included something extra with the house, I would have to find out what that added to the value. Often time sellers would finance the property for a lower interest rate than the banks could. Then I would have to find the value of that financing.

How did you become a real estate appraiser?

I was asked to join with my father when I had to quit working the trades due to health problems.

What surprised you about your job when you first started?

The amount of math needed.

How has your job changed over time?

We use computers a lot more now. There is some use of statistical analysis by lenders rather than old fashioned human appraisers.

Any advice for students entering high school?

Study hard. You will probably learn more in the next four years than you did in grade school or will in any comparable time in the future. Most jobs now require continuing education and this will be your base.

The Job in Brief...

Title: Real Estate Appraiser

Travel: I'm out of the office looking at the subject and comparable sales every day, but I don't have to go far.

Hours: 40-60, I'm self-employed and set my own hours.

Education:

One year of college. Earned a designation as Senior Appraiser from NAIFA.

Earned a State Certification as a General Appraiser (Commercial).

Research & Development Director

Mark Moore, Ph.D.

Dr. Mark Moore saves lives. No, he's not a firefighter or medical doctor. He's a scientist. He works for a "bio-tech" company that makes heart valves—the structures that control the flow of blood through your heart. If one of your valves stops working properly, you may die.

Luckily, surgeons can replace damaged valves. For years, they've used mechanical valves, which last a long time but make a clicking sound and requires patients to take lots of medicine. Today they also use heart valves taken from pigs, called "tissue valves." Mark and his team research ways to make the valves last longer in the human body. He and his company have received many patents (the right to receive profits from a product or process) for his work—a sure sign that he's pushing technology forward.

As Director of Advanced Technology (often called research and development or R&D), Mark gets to see how his work affects others. He regularly meets with surgeons who use the heart valves his company produces and sometimes he even encounters the people whose lives he helped save.

What exactly do you do?

On the research side, I help plan experiments, assess new technology and write reports. On the managerial side, I direct and supervise people. On the communication side, I meet with surgeons who use our implants. I also teach people, both inside and outside the company, about the technology we're designing and improving. I also attend national and international meetings to present our newest advances to the scientific and surgical communities.

What's the coolest part of your job?

I get to work on devices that save people's lives.

What's your favorite part?

I get to span science, from theory to application, from idea to finished product. I also influence decisions that make a difference to the company, its products and its customers.

Tell a story about problem solving in your job.

Anything that surgeons implant in a person has to be germ-free-sterilized. One time, we were trying a new sterilization process. We got the test results back and it didn't work, so we got together to figure out what to do next and ended up putting the solution into an incubator that shook it to make it more active. Then we added more sterilizing solution. Not only did we get it to work, we also ended up receiving a patent on that process.

Describe a funny incident that happened at work.

In this field, some companies try to spy on others and steal their product ideas. This leads to an atmosphere of distrust that can backfire. I was at an international surgical meeting where companies like ours have booths to display their medical devices to surgeons, their customers. Everyone wore name badges; the surgeons wore one color, the people from the medical device companies wore another. One surgeon accidentally got the wrong color badge. When he visited the various booths, everyone ignored him, thinking he was a competitor. It happened in almost every booth. He was not happy. Surgeons aren't used to being ignored.

Any advice for students entering high school?

I wish I'd known how important it was to know other subjects besides science. The more I learn, the more I realize that things I didn't think were important really do matter.

The Job in Brief...

Title:	Director, Advanced Technology
Travel:	Once a month all over the U.S., Europe, and Mexico.
Hours:	50 hours a week.
Education:	Bachelors of Science in Chemistry, Bachelors of Science in Math. Ph.D. in Chemistry
Math:	All the time, you need it to understand the results of experiments.

Storm Chaser

David Gold

"Most people have never seen a tornado," says David Gold. "They're much rarer than the news or the movies make them seem." But David is not "most people." When a tornado touches down in Texas or a nearby state, David and his crew are probably there.

David is a storm chaser. His company takes people on ten-day "tours" of storms and tornados. Why do people want to see wild, even violent weather? Probably the same reason David does. "The goal isn't to watch things get destroyed. I think storms are pretty," he explains. "I enjoy it. If I didn't, I wouldn't do it."

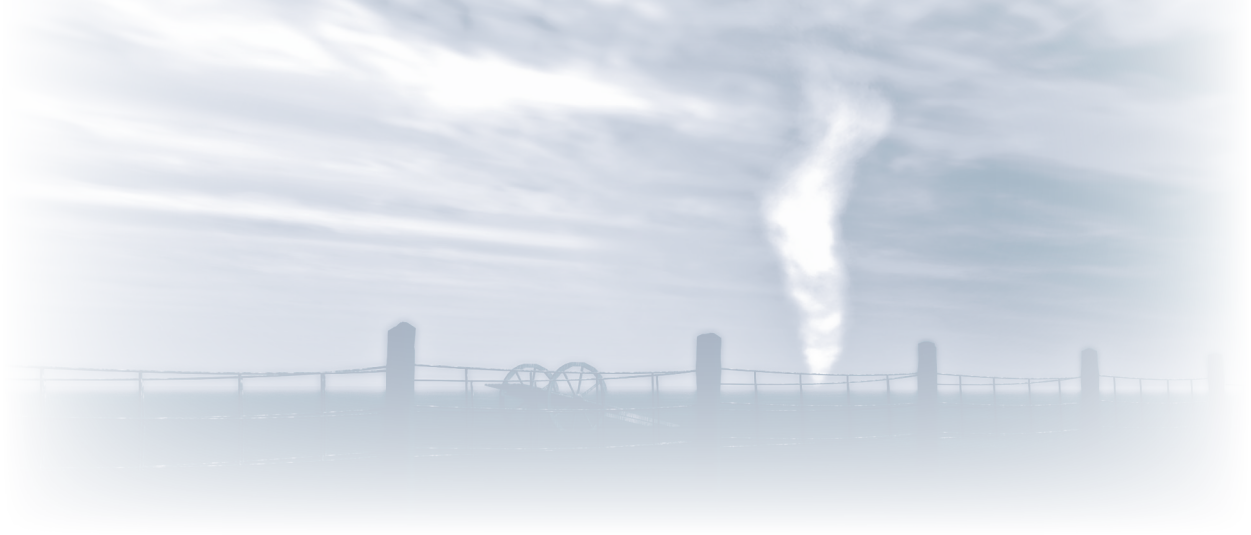
Like most storm chasers, David is a meteorologist—someone who studies and predicts weather. Driving to storms takes time so storm chasers need to know in advance where the best storms will be. David makes accurate predictions. News crews and filmmakers regularly travel with him because they know that he'll guide them to the storms they want to capture on film.

When we spoke, storm-chasing season, which runs from the end of April until the end of June, was about to begin. In fact, just a few weeks later, his tour group got to see two tornados in southern Oklahoma. Storm lovers get their money's worth with David.

What exactly do you do?

Each tour lasts 10 days and I do them almost back-to-back during the two-month storm season. During the tour, I have three main responsibilities. First, I make a forecast about where a storm is most likely to hit. Second, I get my customers there. I'm responsible for booking hotels, meals, making travel arrangements, driving, and so on. Third, I provide customer service. I watch over the group, making sure we don't lose anyone. I also educate my clients. To me, education is as important as seeing storms. Most of the tourists are ordinary people, from different walks of life who are interested in severe weather. They want to learn so I try to make meteorology understandable to them. I give them useful information they can apply in their own lives. Most of this teaching is verbal because when you're storm chasing, handouts tend to get destroyed!

During the off-season, I make plans and arrangements for the storm season; hiring assistants, booking customers months in advance, updating the website, and handling the finances. I also make deals with media organizations to give them some footage. Last year, for example, an international National Geographic group made a documentary of us, which appeared on British TV.



Describe a typical day of storm chasing.

Looking for tornados is the ultimate goal. We start each day with a forecast made the night before. In the morning, we analyze data and see where our best chance is. I give the group a briefing, explaining our plans. We drive to the region and I refine that forecast throughout the day. We get there early and get the latest data to narrow the area where we think the storm will be. Then we wait. If we're lucky, we get a good show.

What's the coolest part of your job?

Being free on the road and seeing storms.

What's your favorite part?

Helping people realize their dreams. Some people have always wanted to see tornados and other big storms in person and I help them do that.

Describe a funny incident at work.

There are a lot of them. One time, we got stuck in the mud in the middle of nowhere. We had two vans, plus a rental car with reporters in it. We had to wait until some farmers noticed us and pulled us out. It was so bad that the rental car was useless afterwards. Meanwhile, we're in the middle of a storm with tennis ball sized hail falling on us. It was pretty funny.

And a couple of times, in both 1998 and 1999, we had customers who made noises that attracted a huge herd of cattle in a nearby field. Both times the cattle tried to jump the fence to get to the noisemakers. It was hilarious.

Tell a story about problem solving in your job.

Problems happen all the time. Last year we hit a deer with a severe storm bearing down on us. The bumper on the van smashed into the left front tire and we didn't have a crowbar to pull it off. Instead, we had to use what we had—a tire jack, brute strength and our brains—to figure out how to get it back into usable condition.

How did you become a storm chaser?

I've always been interested in weather. The first thing I did when I got to college was to go to the Meteorology department and ask the grad students to take me storm chasing. I also went to the National Severe Storms Lab weather service and begged for an internship (an unpaid job), which I got.

What do you wish you knew in high school?

I wish I'd understood the importance of building a sound foundation in the basics in all subjects. In college, no one is going to walk you through the basic Trigonometry you should've learned in high school. I took a lot of math and science classes in high school but I didn't work up to my potential. I had to make up a lot of it later. That's why it's important to really understand your homework.

It isn't easy. You have to work very hard. You get out of it what you put into it. But the harder you work, the more you change yourself. If you want to be good at what you do, you have to put time into it, no matter how naturally gifted you are. And if you mess around in high school and college, you can't advance further.

The Job in Brief...

Title: Storm Chaser

Travel: I average about 600 miles a day during the storm season.

Hours: 50-60 (year-round)

Education: Bachelors & Masters in Meteorology Science & Math

Math: Math and science are crucial. Math is a system of rules that lets you manipulate the basic physical laws of science. It's like building a house. Science is the boards and the bricks. Math is the saw and nails that shape and hold the basic materials together.

For more information go to: www.weather.gov/om/edures.shtml (National Weather Service)

Welder

Tim Harris

Welding is a universally accepted practice to permanently join metal building materials in today's construction.Welders plan work from drawings or a set of detailed blue prints. Welders perform manual welding in which they entirely control the work or they can do semiautomatic welding, in which they use machinery to help perform some tasks. There are several types of welding for several different purposes and different types of building materials. Oxyacetylene welding uses a mixture of gasses, arc-welding uses sticks of welding material with electricity, and wire welding uses spools of wire with electricity. Welders also repair broken or cracked metal parts. They sometimes fill holes and seams in metal products. When a job is done, they chip or grind off excess weld or solder, using hand or power tools. Welders also examine their work to be sure it meets requirements. Sometimes this even requires the use of small x-ray machines so that the internal strength of the weld can be inspected. Welders primarily work indoors but outdoor work is becoming more common with the larger and taller buildings of today. Their work requires much attention to detail and must allow the pace of their work to be determined by the speed of their equipment.

How did you become welder?

After I graduated from high school, I enlisted in the U.S. Navy for four years of service. After the Navy, I attended a welding school, then was hired as an apprentice welder for the Arsarco Smelter. I was put into fabrication and repair, which meant that I was responsible for fixing and repairing all of the heavy equipment around the plant.

What do you enjoy most about your job?

I enjoy the fact that I work 40 hours each week and never have to worry about my job on my time off. I also enjoy the fact that most welders belong to unions that pay for the employee's development and certification programs.

Is math important in the welding industry?

Math key to understanding the basics of welding. Basic math and trigonometry are important when it comes to making correct design and dimension measurements. Geometry is also a very important subject when it comes to being a good welder. Understanding how to measure closed and open angles and calculate distances without the use of a calculator is key to success in this career.

How will welding and the workplace be different 10 years from now?

Future welders will have a safer work environment in the next ten years. There have been many advances in safety equipment that they use in the workplace. New equipment has been manufactured to protect welders from noxious gases, better eye equipment to protect from damaging rays that are given off from welding, more emphasis has been placed on proper lifting techniques.

Tips for Success in Math

Math Study Skills:

- Take responsibility for studying.
- Attend class every day and take complete notes.
- Ask questions in class. You're not the only one who wants to know the answers.
- Ask the teacher questions after class.
- Maintain good study habits throughout the entire semester.
- Math is learned by doing problems. Do the homework--practice makes perfect.
- Do not fall behind in your work, each class builds upon the previous one.
- Form a study group to go over problems you have trouble with.

Studying for a Math Test:

- Do the homework when it is assigned. Cramming weeks of work into a few days is not a good idea.
- Make a list of formulas and techniques when doing homework to use for studying before the test.
- Ask questions when they come up, not the day before the test.
- Review each section of the chapter and rework some of the problems.
- Often math books will have chapter reviews at the end of the chapter. Use the chapter reviews to prepare yourself for the test.
- Start studying for the test early, do not wait until the night before the test.
- Don't pull an "all-nighter" before a test. You'll need plenty of sleep to do your best thinking.

Taking a Math Test:

- Look over the test first to get a sense of length and identify problems that you know you can do right.
- Start by doing the easiest problems first. Get all the points you can early in the test, just in case you run out of time at the end.
- Figure out how much time you can spend on each question. If a question takes too long, skip ahead and go back later, if you have time.
- Show ALL your work. Even if you can't finish a problem or get an incorrect answer, you can sometimes get partial credit.
- Save time by not erasing. Just draw a line through work you want to ignore.
- Read the questions carefully and do all the parts of each problem.
- Verify your answers. Do they make sense in the context of the problem?
- Check every problem if you have time. This one step can save you from simple mistakes.

Biologists, Frogs, and Probability

Some biologists are responsible for finding the cause of declining populations of animal species. When researching infectious diseases the biologists become the equivalent of crime scene investigators. An example of this happened in the high altitude lakes in California's Sierra Nevada. The yellow-legged frog population had declined rapidly to the point that it was put on the endangered species list. Biologists from the university of California at Berkeley were tasked with unravelling the mystery.

Several possible causes were examined such as disease, increased UV radiation, and predation by introduced species. They removed introduced trout from five of the lakes and found that after three years, the population of frogs went back to normal levels. As a result of these findings, the National Park Service and the California Department of Fish and Game removed trout from high altitude lakes. In Montana, the introduction of non-native fish into lakes has had an adverse effect on native fish populations as well. It is the job of wildlife biologists to monitor populations of native and non-native fish.

The following activity shows how the spread of an infectious disease can be calculated.

A family on vacation in Montana found a frog on the banks of the Yellowstone River. The parents were unaware that their youngest son had picked up the frog and put it in an empty cooler. When unpacking the car at Glacier National Park, the parents found the frog in the cooler. They had their son release the frog by Lake McDonald. The frog has an infectious disease. The lake has five other frogs living in it that are all vulnerable to the disease. The infectious disease has a one-day infectious period, and after that, the frog is immune. The new frog randomly visits one of the local frogs during his infectious period. The visited frog has not had the disease before. He gets it and is infectious the following day. He then randomly visits another frog during his infectious period. The disease is transmitted until an infectious frog visits an immune frog, and the disease dies out. There is one frog visit per day. Assuming this pattern, what is the probability that:

2 frogs get the disease _____

3 frogs get the disease _____

4 frogs get the disease _____

5 frogs get the disease _____

6 frogs get the disease _____

(Answers on Page 35)

Using Ratios in Mixing Hair Color Formulas

Hair color manufacturers give instructions on the bottles of their hair color products of how much of each part you use (developer and color). The term they usually use is ratio. A ratio of 1:1 means that the amount of developer is the same as the amount of color. (Developer first, then color)

1. How much color should be mixed with 60 ml of developer when the ratio called for is 1:1?

2. How much color and developer should be mixed when the manufacturer calls for a 1:1 ratio and you want 8 oz. of mixture?

3. What is the amount of color used when you decide to use 100 ml of developer using a 2:1 ratio?

Fill in the blanks:

Total Mixture	Developer	Color	Ratio
150 ml			1:1
2 oz.			1:1
30 ml			2:1
6 oz.			2:1
	10 ml		1:1
		4 oz.	2:1
100 ml			1:1

(Answers on Page 36)

Understanding the True Cost of Credit

Understanding credit card offers and reading the fine print can help a consumer pick the best card for their needs. However, once you read the fine print you may decide that none of them look attractive. This exercise is to show what types of important information are buried in the fine print. It also shows that as a consumer, regardless of the occupation, understanding how loans and credit cards work is very important. It is not intended to address the pros and cons of using credit cards.

Look at the two credit card offers and fill in the following table.
Once you have the table filled in, answer the questions that follow.

Name of Lender		
Annual Fee		
Interest Rates:		
On transferred balances		
On purchases		
On cash advances		
Computation of Variable Rate		
Grace Period		
Late Fee		
Balance Transfer Fee		
Cash Advance Fee		
Default APR		

1. Which card offers the best deal for the first 12 months on a balance transfer of $500?
2. Which card offers the best deal after 12 months?
3. If you pay the $500 balance off in two months what is the total cost of using each credit card?
4. If you make a late payment with a $500 balance what is the late fee and the new APR rate?
5. Which card has the best balance transfer offer if transferring $500 during the first 12 months and paying off the balance before the end of that 12 month period?

The following fine print came from credit card offers found on the internet on Dec. 28, 2006.

First USA – The Fine Print

(Note: for this exercise use the Elite Pricing)

Annual Percentage Rate (APR) for purchases: Elite and Premium Pricing: A 0% fixed APR for the first 12 billing cycles following the opening of your account. After that 14.24% variable for Elite Pricing, or 18.24% variable for Premium Pricing. Standard Pricing: From account opening, 23.24% variable.

Other APRs: Balance Transfer APR: Elite and Premium Pricing: A 0% fixed APR for the first 12 billing cycles following the opening of your account. After that, 14.24% variable for Elite Pricing, or 18.24% variable for Premium Pricing. Standard Pricing: A 0% fixed APR for the first 3 billing cycles following the opening of your account. After that, 23.24% variable. Cash Advance APR: Elite and Premium Pricing: 24.24% variable. Standard Pricing: 28.24% variable. Default APR: 32.24% variable. See explanation below. Overdraft Advance APR: 13.99% fixed (not available in some states)

Variable rate information: The following APRs may vary monthly based on the Prime Rate: Purchase APR: Elite and Premium Pricing: The Prime Rate plus 5.99% for Elite Pricing, or plus 9.99% for Premium Pricing for outstanding and new balances after the introductory period. Standard Pricing: The Prime Rate plus 14.99%. Balance Transfer APR: Elite and Premium Pricing: The Prime Rate plus 5.99% for Elite Pricing, or plus 9.99% for Premium Pricing for outstanding and new balances after the introductory period. Standard Pricing: The Prime Rate plus 14.99% for outstanding and new balances after the introductory period. Cash Advance APR: Elite and Premium Pricing: The Prime Rate plus 15.99%. Standard Pricing: The Prime Rate plus 19.99% Default APR: The Prime Rate plus up to 23.99%.

Grace Period for repayment of purchase balances: At least 20 days.

Method of computing the balance for purchases: Two-cycle average daily balance method (including new purchases).

Annual Fee: None.

Minimum Finance Charge: $1.00.

Transaction fee for balance transfers: 3% of the amount of each transaction, but not less than $5.00 nor more than $75.00.

Transaction fees for cash advances: 3% of the amount of the transaction, but not less than $10.00.

Other fees: Late Payment fee: $15,00 on balances up to, but not including, $100.00; $29.00 on balances of $100.00 up to, but not including, $250.00; and $39.00 on balances of $250.00 or over. Over-the-credit-limit fee: $39.00. International Transactions: 3% of the US dollar amount of the transaction, whether originally made in US dollars or converted from a foreign currency.

Rates, fees, and terms may change: We reserve the right to change the account terms (including the APRs) at any time for any reason, in addition to APR increases that may occur for failure to comply with the terms of your account. For example, we may change the terms based on information in your credit report, such as the number of other credit card accounts you have and their balances. The APRs for this offer are not guaranteed; APRs may change to higher APRs, fixed APRs may change to variable APRs, or variable APRs may change to fixed APRs. Any changes will be made in accordance with your account agreement. Your APRs may increase if you default under any Cardmember Agreement you have with us for any of the following reasons: We do not receive, for any payment that is owed on this Account or any other account or loan with us, at least the minimum payment due by the date and time due; you exceed your credit line on this Account, if applicable; you make a payment to us that is not honored by your bank; or, if at any time after your Account is closed, we demand immediate payment of your outstanding balance and we do not receive payment within the time we specify. The "Prime Rate" is the highest prime rate published in the Money Rates column of The Wall Street Journal two business days before the Closing Date on the statement for each billing period. Variable APRs are based on the 8.25% prime rate on 07/05/2006.

Citibank – The Fine Print

Annual percentage rate (APR) for purchases: 18.24% variable.

Other APRs: Balance transfer APR: As long as first balance transfer is completed within 6 months from date of account opening, 18.24% variable for 6 months from date of first balance transfer. After that, 18.24% variable. Cash advance APR: 23.24% variable. Default APR: 32.24% variable.

Variable rate information: Your APRs may vary each billing period. The CitiBusiness/AAdvantage Visa purchase and balance transfer rate equals the US Prime Rate plus 9.99%. The cash advance rate equals the US Prime Rate plus 14.99%, with a minimum cash advance rate of 19.99%. The default rate equals the US Prime Rate plus up to 23.99%.

Grace Period for repayment of balances for purchases: Not less than 20 days if you pay your total new balance in full each billing period by the due date.

Method of computing the balance for purchases: Average daily balance (including new purchases).

Annual fees: Annual membership fee: $0.00 for 12 months, thereafter $75.00.

Minimum finance charge: $0.50.

Transaction fee for purchases made in a foreign currency: 3% of the amount of each foreign currency purchase after its conversion into US dollars.

Transaction fee for cash advances: 3% of the amount of each cash advance, $5 minimum.

Transaction fee for balance transfers: 3% of the amount of each balance transfer, $5 minimum, $250 maximum.

Late fee: $15 on balances up to $100; $29 on balances of $100 up to $250; and $39 on balances of $250 and over.

All your APRs may automatically increase up to the Default APR if you default under any cardmember agreement that you have with us because you fail to make a payment to us when due, you exceed your credit line, or you make a payment to us that is not honored. We apply your payments to low APR balances before higher APR balances. That means your savings will be reduced if you make transactions that are subject to higher APRs.

Why Show Your Work?

If "When will I ever use this stuff in real life?" is the question most commonly posed to math teachers, then the runner-up has got to be: "Why do I have to show my work?"

The higher the level of math you take the more steps it takes to get to the answer. Many mistakes made on math tests are not due to a lack of understanding the concept being tested but instead due to simple mistakes.

There are two reasons to show your work. The first reason is that even if you don't get the right answer, you may sometimes get partial credit if you can show you learned the concept.

Let's look at an example:

$$3(x - 5) - 4(x - 6) = -x - 39$$

This answer is incorrect.
So where did this student go wrong?

Let's work it out step-by-step:

$$3(x - 5) - 4(x - 6) =$$
$$(3 * x - 3*5) - (4*x - 4*6) =$$
$$(3x - 15) - (4x - 24) =$$
$$(3x - 15) -1(4x - 24) =$$
$$3x - 15 -4x + 24 =$$
$$-x + 9$$

If this were a 5 point question, the student would have gotten zero points. If they had shown their work, the teacher would have seen that at step 3 they did not multiply the -1 with the -24. This student may have been given 3 or 4 of the 5 points.

The second reason you want to show your work is that A and B students usually go back and check their answers before turning in their work. (Yes, we are revealing their secret).

It is much easier to look at the steps than to totally rework the problem to see if you get the same answer. Since positive and negative signs are one of the most common mistakes, remember to always recheck them. It's a time saver as well as a grade saver. There is nothing more frustrating than blowing a test by making simple mistakes you could have caught by reviewing your work.

Other common mistakes come from not reading the entire problem carefully. Let's look at a typical word problem to illustrate how showing your work can guard against common mistakes and save your grade.

Here is our problem:

"The sum of half of a number and 8 less than the number is 25."

Our student wrote the equation like this:

$$(1/2)N - 8 = 25$$
$$(1/2)N = 33$$
$$N = 66$$

This answer is wrong. You can replace the N with 66 and find out that your equation works; however, the equation itself is an incorrect interpretation of the word problem.

Why Show Your Work? (continued)

Let's diagnose this problem.

The sum of half of a number and 8 less than the number is 25.
N N

The sum of half of N and 8 less than N is 25.
1/2N N – 8

The sum of 1/2N and N – 8 is 25.
1/2N + (N – 8) =25

1/2N + N – 8 = 25
1/2N + N = 33
1/2N + 2/2N = 33
3/2N = 33
N = 33 (2/3)
N = 22

Now check this by replacing the number 22 back into the original sentence wherever the word number appears.

The sum of half of 22 and 8 less than 22 is 25

(1/2)22 + (22 – 8) = 25
11 + 14 = 25
25 = 25

Sure it takes more steps to write the problem this way, however, getting the problem correct is the objective. Diagramming any word problem is the best way to approach solving this type of problem. The end result is showing your work will improve your grade!

Here's a word problem for you to practice showing your work:

One half of Heather's age two years from now plus one-third of her age three years ago is twenty years. How old is Heather now?*

*Practice word problem and its solution from Purplemath.com

(Answer on Page 36)

Answer to:

Biologists, Frogs, and Probability

To solve the problem, we will create a probability tree, labelling the frogs A, B, C, D, E, and F. Frog A is the infected, non-native frog.

Day One:

During its one-day infectious period, Frog A will visit one other frog. Since none of the native frogs are immune, the probability that Frog A will infect a second frog is 1. Let's assume that this second frog is Frog B.

Day Two:

There is a 1 in 5 chance that Frog B will visit any given frog. If Frog B visits the original frog (A), which is now immune, the cycle of infection will end and a total of two frogs will get the disease. Therefore, the probability that two frogs will be infected is 1/5. However, the chances that Frog B will visit a vulnerable frog and continue the cycle of infection is 4/5.

Day Three:

Let's assume that the cycle continues and that Frog C has been infected. Frogs A & B are now immune, while Frogs D, E, & F are vulnerable. This means that the probability of Frog C visiting a vulnerable frog is 3/5, while the probability that it will visit an immune frog (and end the cycle of infection) is 2/5. To figure the probability that three frogs will be affected by the disease, take the 4/5 chance of the disease spreading beyond day two, and multiply it by the 2/5 chance that the cycle will end on day three.

4/5 x 2/5 = 8/25

Day Four:

If the cycle of infection continues, Frog D is now contagious, Frogs A, B, & C are immune, and Frogs E & F are vulnerable. The probability of Frog D visiting a vulnerable frog is now 2/5, while the chance it will visit an immune frog is 3/5. The probability that four frogs will be affected is calculated as follows:

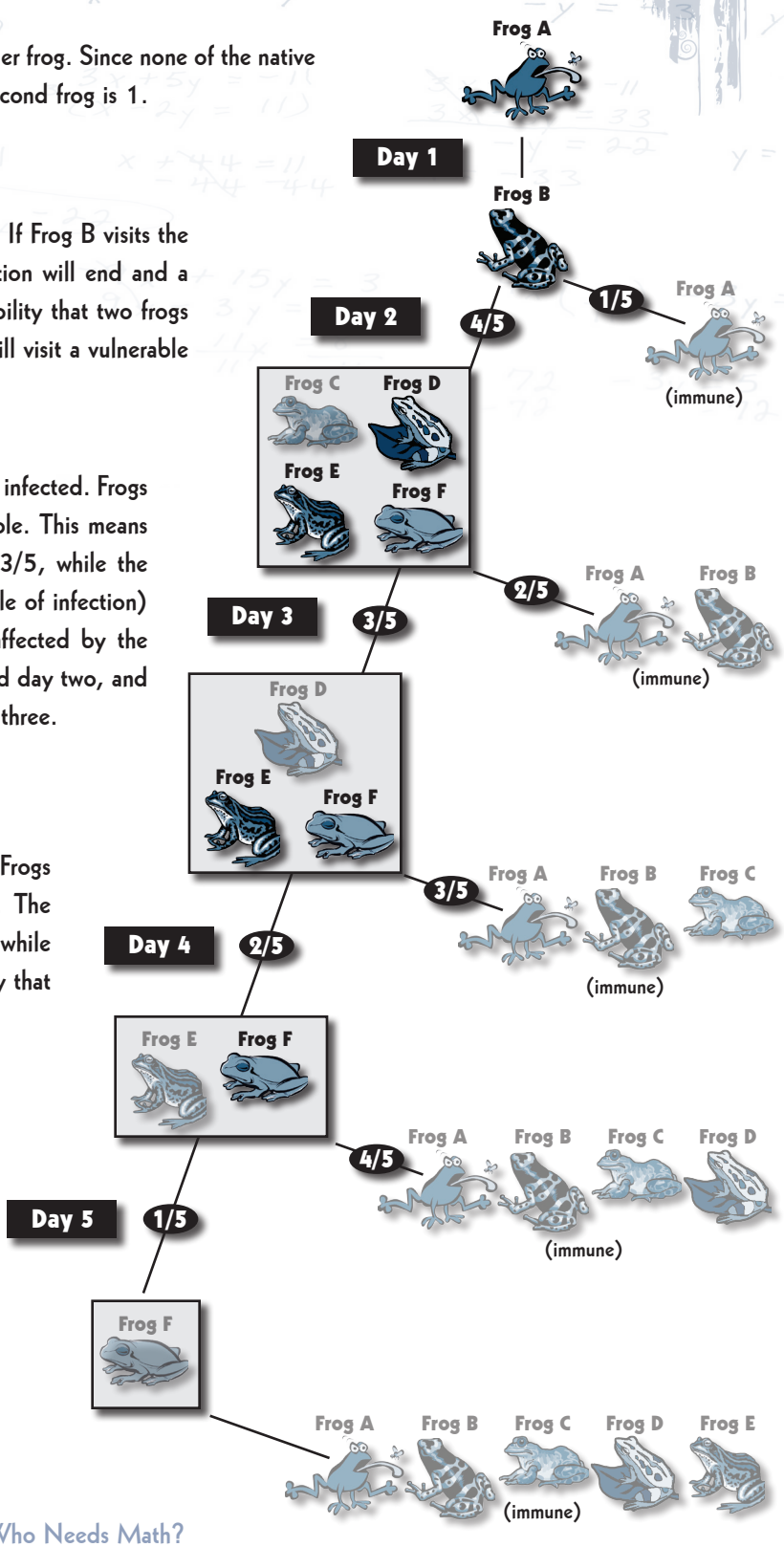
4/5 x 3/5 x 3/5 = 36/125

Day Five:

Following the same pattern, Frog E is now contagious, Frogs A, B, C, & D are immune, and only Frog F is vulnerable. This gives Frog E only a 1/5 chance of infecting the last vulnerable frog, and a 4/5 chance of visiting an immune frog. We can now calculate the probability for the final two scenarios:

Five frogs infected: 4/5 x 3/5 x 2/5 x 4/5 = 96/625

Six frogs infected: 4/5 x 3/5 x 2/5 x 1/5 = 24/625



Answers to:
Using Ratios in Mixing Hair Color Formulas

1 **60 ml.** **2** **4 oz. of each** **3** **50 ml.**

Fill in the blanks:

Total Mixture	Developer	Color	Ratio
150 ml	75 ml	75 ml	1:1
2 oz.	1 oz.	1 oz.	1:1
30 ml	20 ml	10 ml	2:1
6 oz.	4 oz.	2 oz.	2:1
20 ml	10 ml	10 ml	1:1
12 oz.	8 oz.	4 oz.	2:1
100 ml	50 ml	50 ml	1:1

Answer to:
Why Show Your Work?

Start by assigning a letter to represent Heather's age now: H = Heather's age now

One half of Heather's age two years from now plus one-third of her age three years ago is twenty years.

H+2 H−3

So, One half of (H+2) plus one third of (H−3) is twenty years.

1/2(H+2) or $^{H}/_{2}+1$ 1/3(H−3) or $^{H}/_{3}-1$

The equation, then, should look like this:

$^{H}/_{2}+1 + {}^{H}/_{3}-1 = 20$

Now solve the equation:

$^{H}/_{2}+1 + {}^{H}/_{3}-1 = 20$
$^{H}/_{2}+ {}^{H}/_{3} = 20$
$3H+2H = 120$
$5H = 120$
$H = 24$

Check your answer by replacing H with 24 in the original sentence.

One half of 24+2 plus one-third of 24−3 is twenty years.
(1/2)26 + (1/3)21 = 20
13 + 7 = 20
20 = 20

Heather is 24 years old.

MONTANA CAREER RESOURCE NETWORK

What is the Montana Career Resource Network (MCRN)?

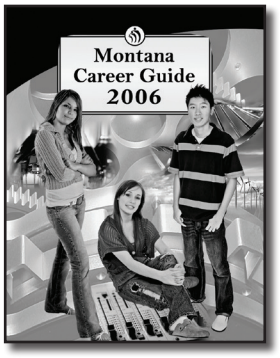
MCRN provides Montanans with career information to help them make smart career decisions. We help students become aware of the world of work, and to understand the connection between education and their future careers.

What kind of information and products does MCRN provide?

- **Career Development Publications**
- Links to **current job openings** in Montana and the U.S.
- Information on all **2 and 4-year colleges** and universities in the nation, with additional detail on Montana schools
- Detailed **Scholarship & Financial Aid information**, including over $155 million worth of Montana and national scholarships and grants—all researched and verified annually.
- Information on **training options** for any career field.
- 4-8 year **online planners** that are flexible, interactive, and adaptable as students progress or state requirements change.
- **MCIS - Montana's Career Information System**: the internet-based career exploration tool that lets user research hundreds of occupations, take interest and skills assessments, and take practice tests such as the ACT, SAT, GED, Civil Service tests (Police Officer, Firefighter, etc.), and more.

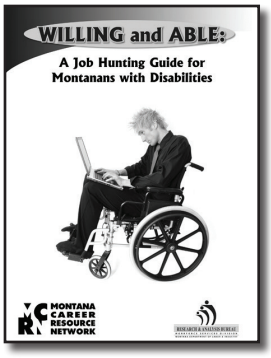
Use MCIS at: www.mtcis.intocareers.org Username: visitor Password: visitor06

Also from MCRN:



Montana Career Guide

Our annual guide to over 200 of Montana's top occupations. Includes info on wages, projected openings, and more. Also includes articles on choosing a training program, gaining work experience, marketing your skills in a resume, interviewing for jobs, and more



Willing & Able:
A Job Hunting Guide for Montanans with Disabilities

This guide informs readers of their rights under the Americans with Disabilities Act, lists helpful resources and agencies, and provides tips on searching for jobs, writing resumes, job interviews, and disclosing disability information.

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