Phy-Sci Review

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Newsletter of the Physical Sciences at Solano Community College
• GEOLOGY • GEOGRAPHY/GIS • PHYSICS/ENGINEERING • ASTRONOMY •

Geography/GIS Highlights:

Physics & Engineering Highlights:

Special Edition: What is GPS & GIS?

Welcome to our second edition of Phy-Sci Review. In this issue we will highlight the growing fields of GPS/GIS. What are they? What is it used for? We will explain the uses by sharing with you some of the research projects of our Solano College students. We also highlight two articles from our Physics/Engineering Students. For additional information and photos, please visit our website:

http://mathsci.solano.edu/users/mfeighne/phy-sci.htm

Thank you and enjoy!
Mark Feighner, Editor
Geology/Physics/GIS

What is GPS? .....

The **Global Positioning System (GPS)** is a set of 24 satellites in orbit around the Earth and they are used to determine your exact location. A GPS receiver, like the one pictured below, uses the signals from the satellites to calculate the latitude, longitude, and elevation of a particular feature of interest. These units collect data in the field, and later, the data is mapped and analyzed using GIS software.

..... What is GIS?

Geographic Information Systems (GIS) is a system of computer software programs that visualizes, manipulates, and analyzes many types of data, including GPS data. There are many applications of GIS, including:

- **Emergency Services** (Fire, Police, Criminal Justice) – Location of fires and crime statistics.
- **Biology & Environmental** – Monitoring endangered species habitats & wetlands.
- **Business** - Site Location, Delivery Systems – UPS delivery, real estate locations.
- **Industry** - Transportation, Communication, Mining, Pipelines.
- **Healthcare** – Mapping and planning of infrastructure and client services.
- **Government** – Homeland Security, Local City Planning, State, Federal, and Military Uses.
- **Education** - Research, Teaching, Administration.

GIS has been identified as a high growth industry by the U.S. Department of Labor in a report published in 2002: the market for geospatial technologies in 2002 was estimated at $5 billion. This market is projected to have annual revenues of $30 billion by 2005, consisting of $20 billion in the remote sensing market and $10 billion in the Geographic Information Systems (GIS) market.

Using GPS/GIS to Make a Better Rockville Park Trail Map

*Geology Honors student **Michael Snyder** equipped for the field with our Trimble handheld GPS unit with attached backpack and 'Hurricane' antenna for better accuracy.*

-Article and Photos by
Mark Feighner
Geology/GIS Instructor

In Spring 2007, Geology Honors student **Michael Snyder** completed a mapping project that is an excellent example of the use of GPS/GIS technology and the collaboration of Solano College with the City of Fairfield.

At the start of this semester, I was looking for a project for Michael and **Brad Paschal** (Biology Faculty at Solano) suggested that I speak with the Ranger at Rockville Park, **Teri Luchini**. Brad has been using GPS/GIS for his Biology Labs at Rockville to map the distribution of gall wasps and Brad thought she might know of a possible project (see Brad's article next).

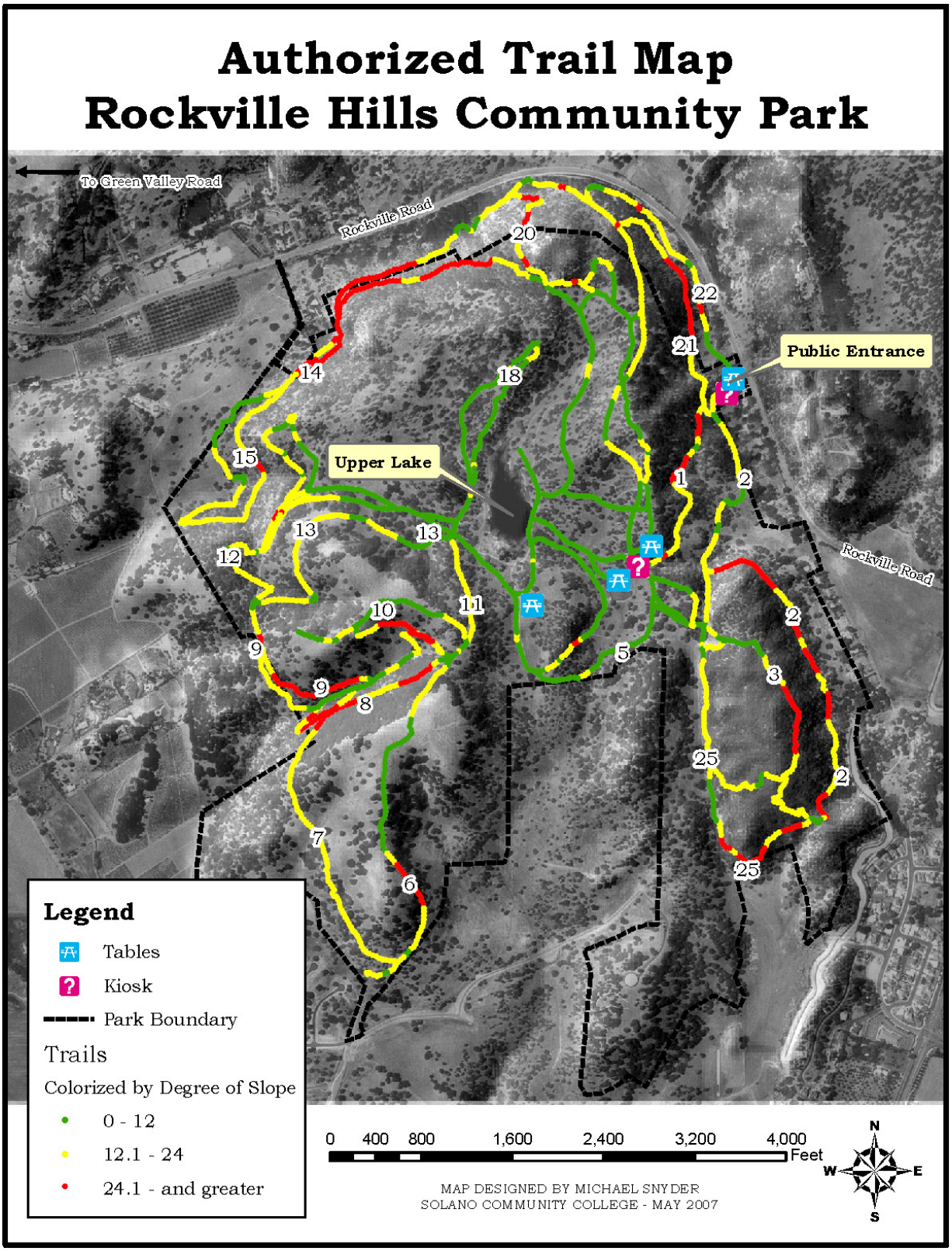
I contacted Teri and she told me that the City of Fairfield was just in the process of making new maps for Rockville Park and would be very interested in having a student map the trails. The trails have never had been mapped with GPS and they wanted a more accurate trail map. Also of concern was the steepness of some trails: she wanted some way to let hikers and bikers know what conditions to expect along each trail.
Using our newly purchased Trimble GPS unit, Michael started to map the trails. It soon became apparent that tree cover was degrading the GPS signal and producing inaccurate trail data. Luckily, we were able to purchase a much more sensitive 'Hurricane' antenna and backpack for our unit that worked very well in dense tree cover (see photo at right).

After hiking almost every trail in the park, Michael used our GIS software to combine the trail data with a variety of other data sources, including air photos and USGS digital elevation data. The figure on the next page shows the slope in degrees along each of the trails.

At our final meeting (photo at bottom), we learned from **Esther Blanco** (Park Planner) that the City of Fairfield - like so many cities - is moving to GIS to integrate not only parks and recreation information, but many other types of data. These include: property taxes, emergency response, fire assessment, police and crime statistics, electrical and water utilities, and transportation. With all services in one central database, city employees from any department will be able to access the most up-to-date information available. In addition, a more limited database is planned for public access online.

Michael is completing his first year at Sacramento State as a Geography Major with a concentration in GIS. He is already working as a GIS Intern at the California Energy Commission in Sacramento.

***Michael Snyder** (left) presenting his final data and maps to **Esther Blanco** (center), Park Planner, City of Fairfield, and **Teri Luchini**, Park Ranger at Rockville.*



Rockville Park Trail Map with degrees of slope along each trail segment with air photo [Michael Snyder].
[Best seen in full-color at: http://mathsci.solano.edu/users/mfeighne/phy-sci.htm].

Biology Students Use GPS/GIS to Study Oak Parasites in Rockville Park

-Article and Photos by
Brad Paschal
Biology Instructor

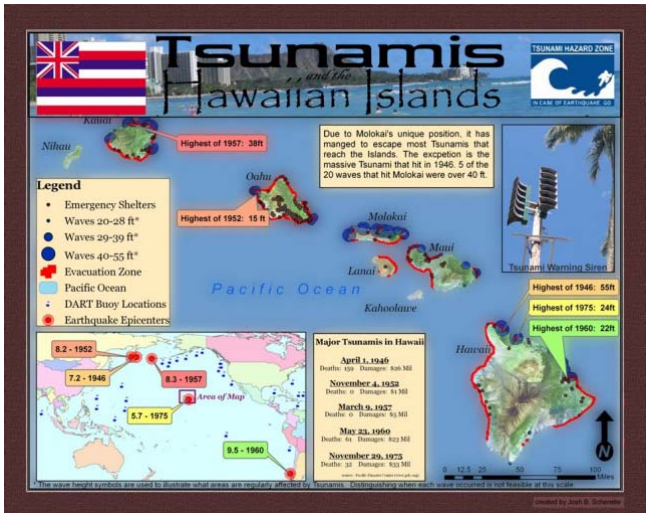
Students from my Biological Sciences 1 course are using GIS technology to study a parasite on the oak trees in Rockville Park. The parasites are commonly called gall wasps, and they are unlike other types of wasps. These wasps are only several millimeters long and, strangely, don't have stingers. They are parasites on the many oak trees in Rockville Park, particularly the blue oaks. The wasps require the trees for reproduction.

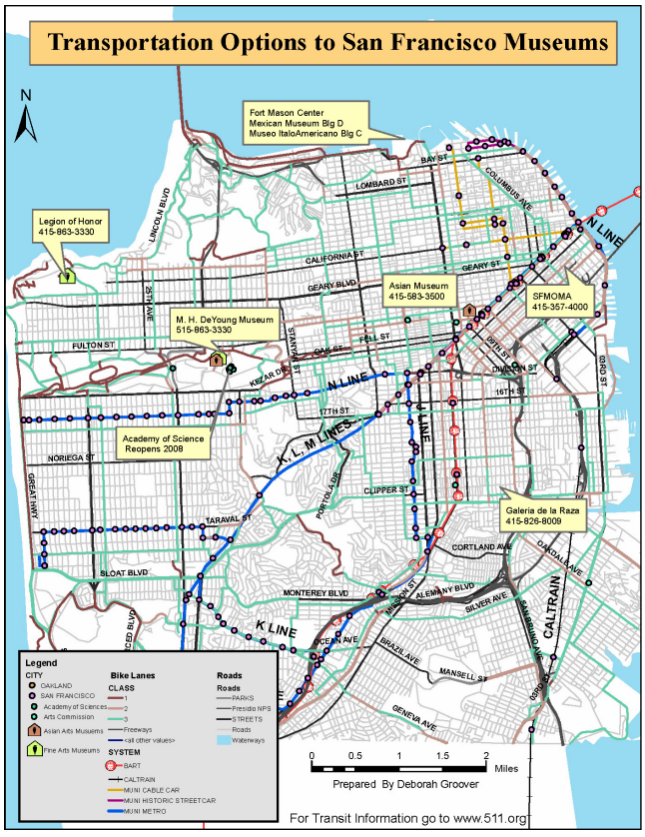
TOP RIGHT: *Students at Rockville Park counting number and type of galls on oak leaves and recording their location with GPS receivers.*

ABOVE: *Close-up of galls on the underside of oak leaves.*

Gall wasp reproduction is dependent on the formation of a strange growth called a gall. A female wasp lays an egg on a portion of the tree that has unspecialized cells. The egg hatches into a larval wasp, and no one is quite sure what, but something in the larval saliva causes the formation of a growth called a gall. The oak tree cells around the wasp egg are meristematic cells and consequently are not very specialized. Since they have not committed to a "fate" they have a great potential to form different tissues or structures. No one is quite sure how, but the wasp re-programs these cells to grow and morph into the gall, which serves as a brood chamber to protect and incubate the offspring of the wasp. When fully developed, the wasp bores through the gall and flies away (look for a small circular hole). There are several species of gall wasps in Rockville Park, and each species produces a noticeably different gall. Many of these galls are very colorful and elaborate during the fall.

Although individual galls may be easy to see, the wasp population uses a very broad geographical area and the students need to use GIS technology in order to see this landscape. The students investigate physical and chemical factors that might influence the distribution of the galls. Female wasps seem to be picky about where they deposit their eggs, and consequently, the distribution of galls is not uniform or random. Students in the past have investigated the effect of hillside slope and the effect of soil chemistry on the abundance and distribution of the galls. The students count the frequency of the galls on a random sample of trees and then enter this data into handheld GPS receivers, which they also use to map the location of individual trees. Later in the lab, the students use GIS software to create maps of Rockville Park with the data they collected layered on top of an aerial photograph of the study site. So far, students have discovered interesting patterns regarding the roles that hillside slope and soil chemistry seem to have on where the female wasps decide to deposit their eggs.





Sample Student GIS Projects from GEOG 10 (Intro to GIS): Top: ***"Tsunamis and the Hawaiian Islands"*** *by* ***Joshua B. Scherette****. Bottom: "****Transportation Options to San Francisco Museums"*** *by* ***Deborah Groover****.*

See other student projects online at:

http://mathsci.solano.edu/users/mfeighne/GIS/GIS.SP07.pdf

http://mathsci.solano.edu/users/mfeighne/GIS/GIS.FL07.pdf

New Option for Science Credit: GEOG 001 Lecture + GEOG 0001L Lab

The newly added Physical Geography Lab (GEOG 0001L) has just received transfer agreements (IGETC and CSU GE).

GEOG 001 - Physical Geography: An introductory study of the Earth's natural environment. The course includes a detailed analysis of weather, geologic landforms, climate, natural vegetation, the oceans and other natural environmental elements. Special emphasis is given to the human impact on the environment. (3 Units Lecture)

GEOG 0001L – Physical Geology Laboratory: A lab course to supplement GEOG 001. Emphasis will be placed on using the skills and tools of modern physical geography and analyzing and interpreting geographic data and GIS. Maps, aerial photographs, satellite images, weather instruments and computer analysis are stressed. (1 Unit Lab)

GIS Classes at Solano: GEOG 010/GEOL 010 Intro to GIS

Solano currently has two classes in GIS in both Geography (GEOG 010) and Geology (GEOL 010), but more are planned in the future! Stay tuned! In this class, you will learn the basics of GIS and learn the software to complete a final mapping project. Samples of students' projects are at left.

GEOG 010/GEOL 010 - Introduction to Geographic Information Systems: Provides an in depth introduction to the fundamentals of Geographic Information Systems (GIS). The course will include an introduction to basic cartographic principles including maps scales, coordinate systems and map projections. Various applications of GIS technology used in science, business and government will also be presented. Specific topics covered in lectures will include an understanding of GIS terminology, raster and vector data structures, data sources and accuracy, methods of data acquisition, conversion and input, requirements for metadata, working with spatial data databases, and spatial analysis. The above topics will be reinforced in the laboratory with hands-on experience.

What is GIS? Find out here:
http://www.gis.com/whatisgis/index.html

The Studies of Standing Waves Using Fire and Loud Music

*-Article by **James Morad and Daniel Fletcher**, Physics and Engineering Students at Solano College February 2008*

Last year we brought to Solano College's Science Day two of the most important features of any astounding demonstration: columns of fire and loud music!

Motivated by Promethean instincts to produce fire, we scoured the internet in search of a demonstration that we hoped would illustrate a key theoretical concept in physics, as well as be accessible to a diverse group of people with a variety of educational backgrounds. Enter the "Rubens' Tube".

In 1904, Heinrich Rubens, for whom this experiment is named, took a long cylindrical tube with holes drilled in it, and filled it with a flammable gas. After lighting the gas he observed that certain generated tones produced at one end of the tube would cause the heights of the flames to create a sinusoidal wave!

The Rubens' Tube is a length of pipe that has been perforated (holes have been drilled) along the top and sealed at both ends. One seal is covered with a small membrane and attached to a small speaker or frequency generator, and the other is connected to a supply of flammable gas. The pipe is then filled with the gas, and the gas escaping from the holes is lit aflame. If the proper frequency is sent through the membrane, a standing longitudinal wave will form in air within the tube. The standing wave in the tube will create areas of low and high pressure. In the regions of high pressure, gas will be "pushed up" and the flame above the pipe will rise higher. The height of these flames therefore indicates the pressure in the tube.

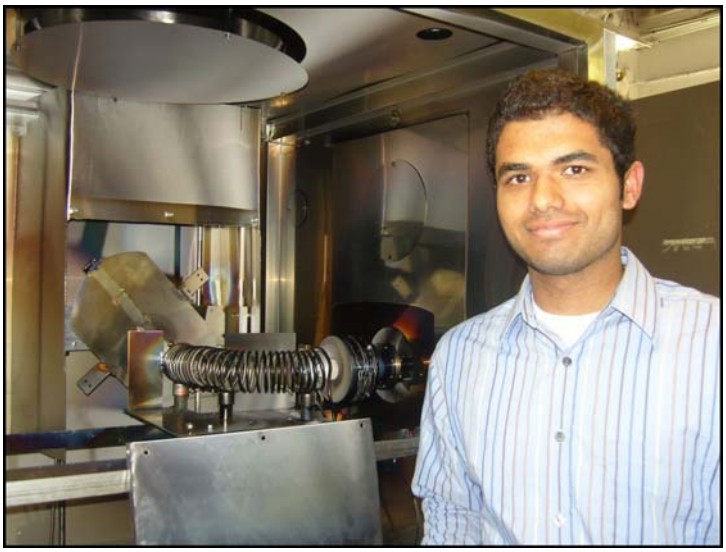
The construction and troubleshooting procedures lasted nearly six hours, and we both still remember the recurring thoughts that ran through our minds during the process: "there is no way this thing is gonna work!" But Science Day finally arrived, and much to our surprise and delight, the tube worked perfectly. The only minor problem we experienced was the freezing of the propane tank and gas line caused by the rapidly escaping gas. This freezing effectively caused a crack in the gas line, which we had to patch up with some duct tape.

Overall, this experience was an unforgettable one for the both of us. We are currently constructing something that is as intricate as it is exciting, and we can only hope that our contribution to this years' Science Day will help attract many more students to the excellent science department at Solano College.

We would like to thank the many people who helped create and participate in Science Day - in particular, Dr. Melanie Lutz and Lab Technician Richard Crapuchettes, who helped inspire and motivate us to participate in this wonderful event. We hope to come to this years' Science Day and leave with many more good memories.

*Solano student **Caroline Parworth** demonstrates the Rubens' Tube.*

My Internship at Acree Technologies



*-Article by **Vaneet Loomba**, Physics and Engineering Student at Solano College February 2008*

Anyone that has taken a course with Dr. Lutz can testify to the fact that she is a demanding professor. From rigorous lab reports to nearly impossible exams, her courses encompass every aspect of a true university-level course. I am a product of her string of courses, and I am very fortunate to have such a professor provide me with such a solid foundation at the community college level. My hard work in her courses paid off very quickly when I interviewed for an internship position at Acree Technologies, a company that commercializes plasma technology in the fields of material science, innovative coating applications and specialized plasma sources.

My interviews consisted of many course-related questions, but because of my valued education here at Solano, I was thoroughly able to explain the respective underlying principles and earn myself the position. Once I was hired, I found out that I had competed with students attending UC Berkeley, and suddenly this feat tasted even sweeter.

At Acree Tech, I learn more than I could ever imagine, and my learning curve resembles an exponential graph. I work hand-in hand with extremely educated professionals who explain theory and ideas as if reading from a literature book. The extensive application of the material covered in my courses is visible in almost every project in our lab, and I know the fundamental principles that make it work. For example, we use instruments such as loop ammeters that apply Faraday's Law (instead of manual wiring) and we use a current carrying coil (that induces a magnetic field) to guide the electrons to a particular source. My workdays include micro-projects dealing with a certain design element of a major project. The constant demand for critical thinking and its coordination with my education makes this intern position a feasible career field.

Through this internship, I have the opportunity to learn and observe direct application of the material. My current courses such as circuits will only strengthen my intern position at Acree Technologies, and I truly appreciate the resources at SCC for making me an exemplary candidate for this position.

Faraday's Law in Action!

Mark A. Feighner, Ph.D.
Editor
Phy-Sci Review

Solano Community College
Math/Science Department
4000 Suisun Valley Rd
Fairfield, CA 94534

PHONE:
(707) 864-7000, Ext. 4665

FAX:
(707) 864-0361

E-MAIL:
Mark.Feighner@solano.edu

See more photos and information on the web!

Visit the Phy-Sci Homepage at:

http://mathsci.solano.edu/users/mfeighne/phy-sci.htm

Contacts for Physical Science at Solano ...

FULL TIME	MAJOR	@solano.edu email	Phone	Office
George Daugavietis	Math/Geography	george.daugavietis	4342	940
Mark Feighner	Geology/Physics/GIS	mark.feighner	4665	345
Melanie Lutz	Physics/Engineering	melanie.lutz	4324	342
Philip Petersen	Physics/Astronomy	philip.petersen	4613	928
Danielle Widemann	Geography/Geology	danille.widemann	4526	941
ADJUNCT	**MAJOR**	**@solano.edu email**	**Phone**	**Office**
Darwin Ho	Physics	darwin.ho	5302	---
Mackenzie Johnson	Geography/Geology	Mackenzie.johnson	5093	---
Russ Johnston	Physics	russ.johnston	5252	---
Don Kiernan	Geography	dkiernan	5110	---
Tim Leininger	Geography	tim.leininger	5254	---
Tom MacMullen	Physics/Astronomy	tom.macmullen	5279	---
Jeffrey Schaffer	Geology	jeffrey.schaffer	5287	---
Randy Smith	Astronomy	randy.smith	5244	---
LAB TECH	**MAJOR**	**@solano.edu email**	**Phone**	**Office**
Richard Crapuchettes	Physical Science / Engineering	richard.crapuchettes	7188	331

PHY-SCI REVIEW
Mark Feighner
Math/Science Department
Solano Community College
4000 Suisun Valley Rd
Fairfield, CA 94534-3197