A New Kind of Science
A Book Review from UPNews

by Black Nash

This hefty 1200 page book is a bit daunting at first but once you get into the material it flows smoothly and isn’t quite as dense as originally assumed. Written by computer scientist Stephen Wolfram, it collects years of research and presents it in user-friendly format. The book has 400 pages of notes/references and includes hundreds of pictures to elaborate on the content. While the remaining parts of the text may be somewhat dense and dry, it is enjoyable to look at Wolfram’s “new kind of science.”

Wolfram believes the universal laws scientists use can be represented by simple programs known as cellular automata. After running thousands upon thousands of programs, he witnessed the same unexpected events. Randomness and complexity evolved from very simple instructions given to the programs. A single rule may go as follows: there are only two options, black or white, for a cell to choose from. The cell below the particular cell being observed is determined by the color of the top cell and its adjacent cells. If the top cell and the cells to its left and right are all black then the cell directly below the middle cell will be white (see diagram below). If Mr. Wolfram is correct in saying that very simple sets of rules run the universe and have created what we see here today, then every field of science would be altered: physics, chemistry, biology, etc. Despite criticism from fellow scientists, simple programs have been shown to model thermodynamic behavior, crystal growth, and sociological phenomena with relative ease.

Currently, Stephen Wolfram spends most of his time continuing to develop Mathematica, a computation software he created. He also delivers talks on his research, teaching people about his very complex set of instructions, which may go as follows: there is a basic set of rules given to the program. A single rule may go as follows: there are only two options, black or white, for a cell to choose from. The cell below the particular cell being observed is determined by the color of the top cell and its adjacent cells. If the top cell and the cells to its left and right are all black then the cell directly below the middle cell will be white (see diagram below). If Mr. Wolfram is correct in saying that very simple sets of rules run the universe and have created what we see here today, then every field of science would be altered: physics, chemistry, biology, etc. Despite criticism from fellow scientists, simple programs have been shown to model thermodynamic behavior, crystal growth, and sociological phenomena with relative ease.

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To the n00b5

There’s a lot to do as a physics major at the University of Florida. Aside of course from tons of homework.

Research

With the current job market being as bad as it is, you’ll definitely want to start bolstering your resume as soon as possible. One of the highlights on a job or graduate school application is being a published author. Despite the seemingly hefty prerequisites to research, it is possible to start doing research that might lead to your name on a published paper as an undergraduate.

Take a look at the Physics Department research page (http://www.phys.ufl.edu/research/), find a few professors whose work looks like it might be interesting to you, and send them e-mails asking if they need any help. Some professors may have hands on the lab and help out, but then there are some who might be able to offer you some, and still others may be willing to allow you to take ‘independent research’ credit with them (another gold star for a freshman’s or sophomore’s transcript).

Scholarships

It’s always good to win lots and lots of scholarships. Applying to graduate school is a bit pricey, so the money you win will come in handy, but the prestige of some of these awards are real ‘career makers,’ particularly for people pursuing careers in academia. The Goldwater Scholarship is one such prestigious scholarship based on the applicant’s research ability and potential. A physics major or student working with a physics professor at UF may be considered for this award going back at least four years. A well kept secret is that graduate programs, particularly in the liberal arts, pay students to attend their programs. It is possible to win scholarships and grants on top of whatever financial aid a graduate school might offer, and the more scholarships you win starting at a young age, the more practice you get and the more impressive you’ll look when you start applying for the truly baller status scholarships your senior year and beyond.

Ah, another year, another welcome...

The Society of Physics Students (SPS) is the microcosm of the many ongoing in the UF undergraduate physics program. SPS holds Research Opportunity For Undergraduate (ROFU) seminars several times a year, where professors who are looking for undergraduate research assistants will try to recruit students who are interested in working. The UF chapter of SPS will begin this year offering its most active members scholarships at the annual end-of-the-year picnic, and past members have even won scholarships at the national level. The approximately bi-monthly SPS meetings are also a great opportunity for physics majors old and young to intermingle, eat free pizza, drink free soda, and learn about what research other undergraduates are doing.

SPS Lounge

On the second floor of the physics building is the SPS Lounge – a place to relax, socialize, and generally feel like you’re part of the physics community at the University of Florida by providing a forum for undergraduates to share their views and experiences with each other and to act as a source of information for opportunities and events in physics.

UPNews is always looking for Undergraduates who want to contribute. If you’d like to get involved, e-mail us at upnews@phys.ufl.edu
Weak Forces: The Big W

What’s the Weak Force?

You may have heard of the four fundamental interactions of nature: Strong, Weak, Electromagnetic, and Gravitation. When you first start physics you start learning about gravitation and not soon after, electromagnetism. What about the weak and strong forces? Well they were going to ignore it. Here’s a bit about the weak force.

As you might learn in modern physics, just as EM is mediated by photons, and gravity is mediated by W and Z bosons. The W is named for the weak nuclear force. The Z was given its name for its lack of electric charge. The W+ has a charge of +1, and the W- has a charge of -1. The W boson mediates weak interactions of particle Physics.

The z are very heavy at 80.4 and 91.2 GeV/c² respectively (compared to ~0.5 MeV/c² for an electron or ~1 GeV/c for a proton) and all have a spin of 1. Because these mediating particles are so massive, they possess only limited range, meaning the weak force acts only over a limited range.

The W can play a role in certain nuclear decays. A neutron can decay into a proton, electron, and electron antineutrino. On a more fundamental level, the flavor change observed in neutrinos works in the neutron changes to an up resulting in the creation of an electron and a W- boson. By emitting a W- the down quark changes to an up, conserving spin and lepton number, and the neutron becomes a proton. This interaction is shown in this Feynman Diagram:

To be continued in next month’s issue...

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Cookie and Coffee Time!

One last exciting event worth mentioning is the bi-weekly cookie and coffee time hosted by SPS. On Tuesdays, there are fresh baked cookies, and freshly brewed coffee and tea available for $0.50 each in the main upstairs conference room, NPB2205 (just follow your nose). On Thursdays, these same things are available in the physics department afternoon coffee break. Of course, the cookies are so delicious, they disappear very quickly. The Thursday coffee time immediately precedes the weekly colloquium, where a distinguished visiting professor or a UF professor gives an hour-long talk about his research. The physics department, like any other department, has a lot of regular events planned: coffee time, seminars, and other conferences. These always take place in the non-classroom environment, and is another great opportunity to meet your fellow classmates, and get to know the professors and staff on a more personal level.