Student-Led Outreach on Light and Atoms

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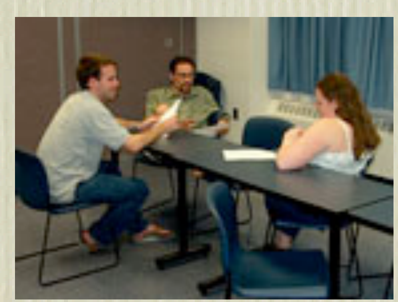
Lyman Briggs College

1967 2007

Lyman Briggs is an undergraduate, residential learning community at MSU, devoted to studying the natural sciences and their impact on society. Its building houses laboratories, classrooms, and student residential, dining, and recreational facilities. With 1800 students, LBC offers the "best of both worlds": the benefits of a liberal arts college and the resources of a great research university.




Flint schools & teachers participating in Spartan Science Day

Brownell Elementary School
Ms. Catanja Harrison

Williams Elementary School
Ms. Karen LaLonde

80 kilometers apart

5th grade students visiting from Flint, waiting for the program to begin.

MSU's student-run Science Theatre performs demonstrations:

... including a Dance of the Sound Vibrations...

... Flint students get in on the act!

Making slime with Dr. LaDuca

Microscopes & Cells with Drs Luckie, Smith & Urquhart

Perspective from Flint teachers

- **Many of my students come from homes where no one has ever gotten past high school.**

- **When I talk to my students about college and career plans they say "My mom says poor kids can't go to college...." This trip helps counter what they're hearing at home.**

- **Many students didn't know what a college was before this day and had never set foot in one before... they left the program saying "I want to go there!"**

- **The MSU students were awesome with the kids, even with those who usually present behavior problems. There was a spirit of camaraderie.**

- **One of the best field trips EVER!**

Perspective of MSU Student Organizers

- [T]he kids we were targeting are among the least privileged kids in the entire state - some coming from families that earn less than $8000 per year. Many of those kids have no idea what it means to go to college .... I am hopeful that as they grow up, they'll remember the fun they had at MSU and will see college as a realistic goal, not as an unrealistic dream.

- At the end of the day, just before the kids left, we asked how many of the kids would like to go to college someday. And when almost every single one of them raised their hand, that gave me all the satisfaction and reward that I needed for all the work that was put into it.

- Getting ten and eleven year old kids excited about science experiments, physics demonstrations and the use of technology could be paramount to their desire for education.

- I know I gained a greater sense of appreciation for my education, and those that have guided me along the way, i.e. parents and teachers.

End of the Program

(Can you spot the physics handout?)

Physics Activities on Light and Atoms

https://www.msu.edu/~sekhar/ewsb/outreach.html

MSU Honors College Students:

Garrett Warnell 2005-06

Edita Klimyte 2006-07

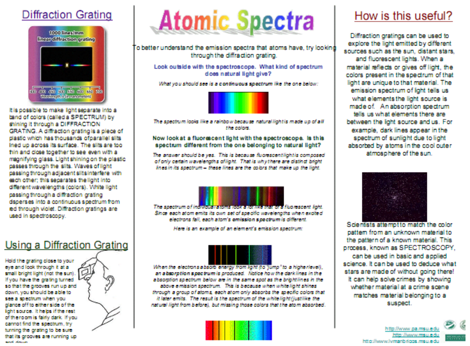
Tyler Augst 2007-08

Jamie Overbeek 2008-09

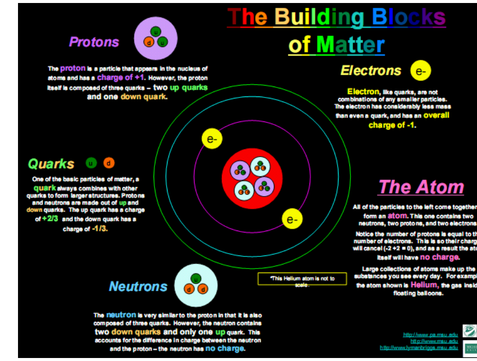
MSU Physics Professors

E.H. Simmons and R.S. Chivukula

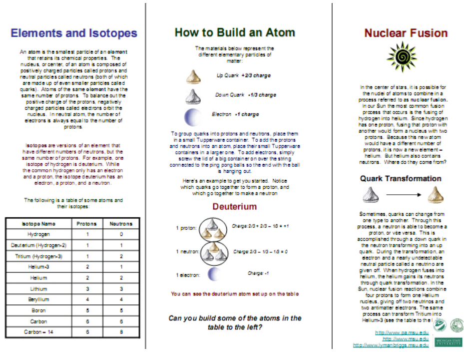
Available Handouts



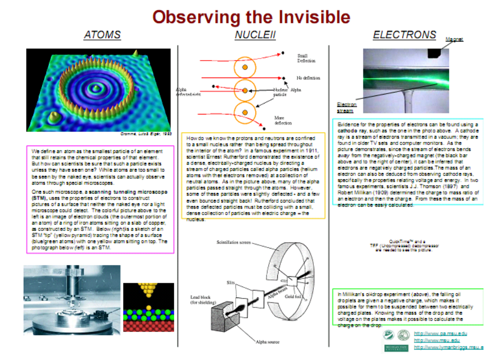
Atomic Spectra- information about emission spectra and how to use a diffraction grating



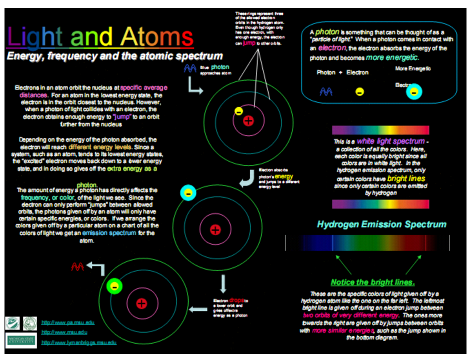
Atomic Model- instructions for building an atomic model using plastic containers and candies



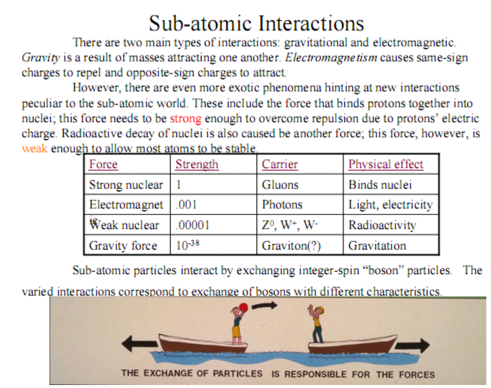
Photon Emission- information about photons, photon emission, energy, frequency, and the atomic spectrum



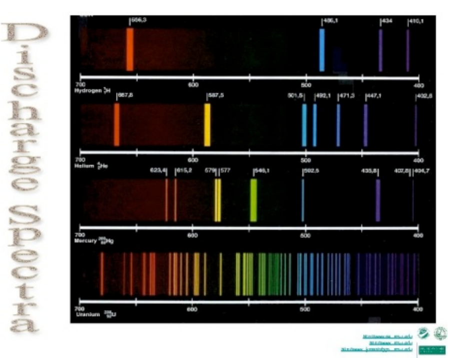
Discharge Spectra- sample discharge spectra for Hydrogen, Helium, Mercury, and Uranium



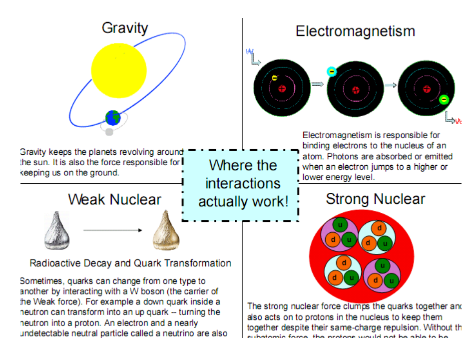
Fundamental Particles- outline of particles that make up the atom



How We Know- information about technology that allows us to identify atoms, nuclei, and electrons



Subatomic Interactions (2)- a front and back handout about the four main forces: gravity, electromagnetism, strong nuclear, and weak nuclear

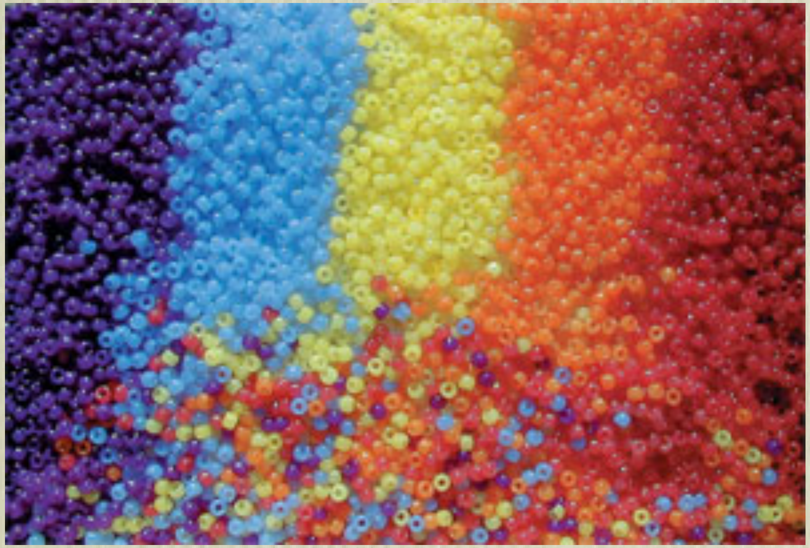


History of the Atomic Model (15) - from Democritus to Quantum Mechanics via experiments

Ultraviolet (UV) Light

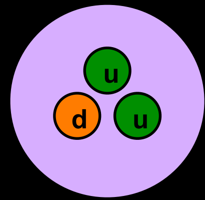
Electromagnetic spectrum
Detecting the invisible
Light and color
UV rays and sunburn
Devising experiments
Take-home detector

Educational Innovations INC
www.teachersource.com



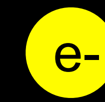
The Building Blocks of Matter

Protons

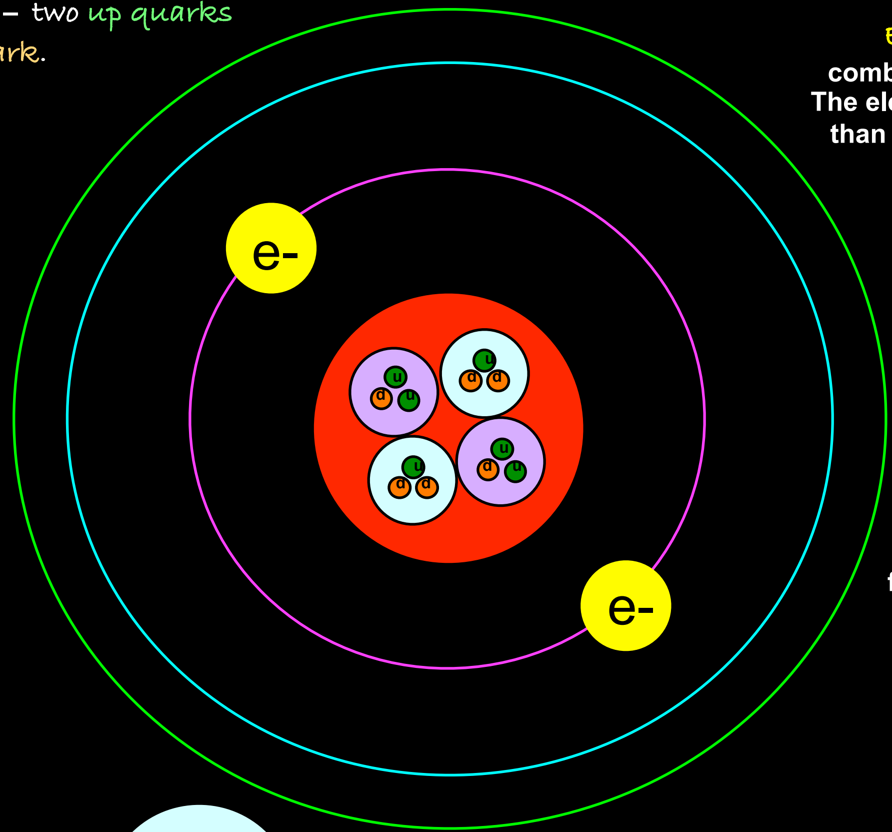


The proton is a particle that appears in the nucleus of atoms and has a charge of +1. However, the proton itself is composed of three quarks – two up quarks and one down quark.

Electrons



Electron, like quarks, are not combinations of any smaller particles. The electron has considerably less mass than even a quark, and has an overall charge of -1.



Quarks

One of the basic particles of matter, a quark always combines with other quarks to form larger structures. Protons and neutrons are made out of up and down quarks. The up quark has a charge of +2/3 and the down quark has a charge of -1/3.

The Atom

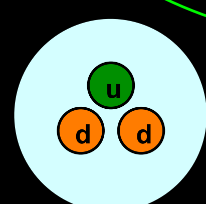
All of the particles to the left come together to form an atom. This one contains two neutrons, two protons, and two electrons.

Notice the number of protons is equal to the number of electrons. This is so their charges will cancel (-2 +2 = 0), and as a result the atom itself will have no charge.

Large collections of atoms make up the substances you see every day. For example, the atom shown is Helium, the gas inside floating balloons.

*This Helium atom is not to scale.

Neutrons



The neutron is very similar to the proton in that it is also composed of three quarks. However, the neutron contains two down quarks and only one up quark. This accounts for the difference in charge between the neutron and the proton – the neutron has no charge.

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Elements and Isotopes

An **atom** is the smallest particle of an **element** that retains its chemical properties. The nucleus, or center, of an atom is composed of positively charged particles called protons and neutral particles called neutrons (both of which are made up of even smaller particles called quarks). Atoms of the same **element** have the same number of protons. To balance out the positive charge of the protons, negatively charged particles called electrons orbit the nucleus. In neutral atom, the number of electrons is always equal to the number of protons.

Isotopes are versions of an element that have different numbers of neutrons, but the same number of protons. For example, one isotope of hydrogen is deuterium. While the common hydrogen only has an electron and a proton, the isotope deuterium has an electron, a proton, and a neutron.

The following is a table of some atoms and their isotopes:

Isotope Name	Protons	Neutrons
Hydrogen	1	0
Deuterium (Hydrogen-2)	1	1
Tritium (Hydrogen-3)	1	2
Helium-3	2	1
Helium	2	2
Lithium	3	3
Beryllium	4	4
Boron	5	5
Carbon	6	6
Carbon – 14	6	8

How to Build an Atom

The materials below represent the different elementary particles of matter:


Up Quark ***+2/3 charge***


Down Quark ***-1/3 charge***


Electron ***-1 charge***

To group quarks into protons and neutrons, place them in a small Tupperware container. To add the protons and neutrons into an atom, place their small Tupperware containers in a larger one. To add electrons, simply screw the lid of a big container on over the string connected to the ping pong balls so the end with the ball is hanging out.

Here's an example to get you started. Notice which quarks go together to form a proton, and which go together to make a neutron

Deuterium

1 proton:  *Charge: 2/3 + 2/3 – 1/3 = +1*

1 neutron:  *Charge: 2/3 – 1/3 – 1/3 = 0*

1 electron:  *Charge: -1*

You can see the deuterium atom set up on the table

Can you build some of the atoms in the table to the left?

Nuclear Fusion

In the center of stars, it is possible for the nuclei of atoms to combine in a process referred to as **nuclear fusion.** In our Sun the most common fusion process that occurs is the fusing of hydrogen into helium. Since hydrogen has one proton, fusing that proton with another would form a nucleus with two protons. Because this new atom would have a different number of protons, it is now a new element – helium. But helium also contains neutrons. Where do they come from?

Quark Transformation

Sometimes, quarks can change from one type to another. Through this process, a neutron is able to become a proton, or vice versa. This is accomplished through a down quark in the neutron transforming into an up quark. During the transformation, an electron and a nearly undetectable neutral particle called a neutrino are given off. When hydrogen fuses into helium, the helium gains its neutrons through quark transformation. In the Sun, nuclear fusion reactions combine four protons to form one Helium nucleus, giving off two neutrinos and two antimatter electrons. The same process can transform Tritium into Helium-3 (see the table to the left).

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Let's build some atoms from chocolate!