

# Science Club

There are basically two ways to use Science Club. Either play with materials or do a science project. Two favorite things to play with are *Glass* and *Knives*. Two favorite Science Projects are *The Bed of Nails* and *Dimensional Analysis*.

## TUITs

Science Club students: Earn a *Round TUIT Certificate* by showing proficiency with your lab skills. Students who have achieved a ***Fire TUIT*** can enjoy all of the privileges of working with propane torches whenever they 'get around to it' (get it? a - round - to - it). The ***Glass TUIT*** gives you unlimited access to hot glass in the lab. The ***Knife TUIT*** allows the use of any and all of the knives for woodcarving and whittling. The ***DA TUIT*** earns the right to teach Dimensional Analysis to other classes.

If there is time, we may introduce more.

- The ***Gas TUIT*** authorizes gas collection and basic chemistry rights.
- The ***E&M TUIT*** sanctions electromagnetic experimentation.
- The ***Circuitry TUIT*** gives consent to build electrical circuits.

TUITs are like tickets or maybe ... Science Club money.

## Science Projects

Science Club Students:  
**Project Criteria** for



If you wish to use your time to work on a project, check out the **Science** such work. There are also some starter ideas for projects.



# Projects Criteria

## ----- Rules -----

**Rule #1.** If you do your *Homework*, you may work on your Project.

**Rule #2.** If there is ever any excuse for not doing your *Homework*, read Rule #1.

INTERACTIVE GROUP

A DIVISION OF JOHN BICKART, INC.

# Projects

## **The Bed of Nails** [A *Demonstration Project* recommended for 3 to 4 people.]

With ancient roots in healing, **The Bed of Nails Demonstration** makes an exciting science demonstration on three levels (see [Bed of Nails Worksheet](#)).

It looks quite dangerous – *until you do the math!*

It opens the door to discussion on *methods of healing*.

It appeals to your sense of stepping outside your comfort zone to *move on to new versions of yourself!*



**Nails Demonstration** makes a great project; but it makes an even better show. You can bring this to other classes, schools, or places where people are looking for self-improvement. It makes a great addition to a school assembly program if you put teachers and administrators on the bed in front of a large audience.



**The Bed of**  
science fair  
traveling  
other  
for self-

The completion of **The Bed of Nails Demonstration** must have a minimum set of *Homework Assignments*. Hand in a written page that can be displayed at a Science Fair or Conference on the following.

1. HISTORY – Hand in your own interest in the *history* of beds of nails.



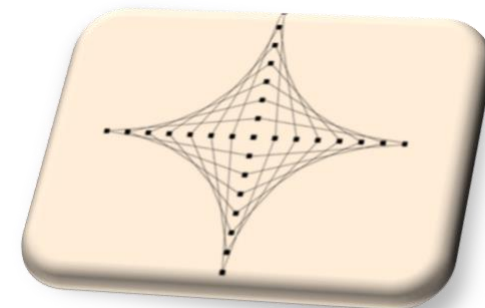
2. MATH – Hand in your own *pictures and/or calculations* to show how each nail holds some of the weight.
3. DRAMA – Hand in your plan of showing the *force* of each nail!
4. HANDS-ON – Hand in your sketch of the *actions* you will take with **The Bed of Nails Demonstration.**



## **DIMENSIONAL ANALYSIS** [A Tutoring Project recommended for 2 to 4 people.]

Individuals will tutor other adolescent students, or even adult students, in the art of **Dimensional Analysis**. This effort is aimed at reducing ‘The Algebra Gap’. This a fun method of doing straight, linear thinking – like in math. It balances creative, lateral thinking – like in art and music. First, the tutors have to get good at **Dimensional Analysis**, then they will go to their students and perform a three-step process.

1. Do a little **Straight Line Thinking** exercises.
2. Do a few **Estimations**.
3. Teach them **Dimensional Analysis**.



$$\frac{60 \text{ min}}{1 \text{ hr}} \times \frac{24 \text{ hrs}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ yr}} = \frac{6 \times 10^5 \text{ min}}{1 \text{ yr}}$$

At the very least, we will have fun; but we just might improve our students’ abilities to do Algebra!

## Carbon Dioxide Five Ways [A *Demonstration Project* recommended for 1 to 2 people.]

This is great fun for the demonstration person and for the audience! You start showing  $\text{CO}_2$  in its pure form as a gas, then make it chemically, and then with dry ice. The completion of **Carbon Dioxide Five Ways** must have a minimum set of *Homework Assignments*. Hand in a written page that can be displayed at a Science Fair or Conference on the following.

1. Direct from Tank
  - Tongue
  - In Test Tube, Extinguish Flame
2. Chemical Creation of  $\text{CO}_2$ 
  - Gas Collection Apparatus
  - Little: Pour onto candle
  - Big: Floating Bubbles
3. Invisible
  - Where did the candle go?
  - Carbon Soot on Glass with propane flame
4. Dry Ice
  - Blowing Bubbles
  - Vibrating Quarter
  - Screaming Pan
  - Skating Puck
5. Homemade Soda



## **Sound Five Ways** [A *Demonstration Project* recommended for 3 to 4 people.]

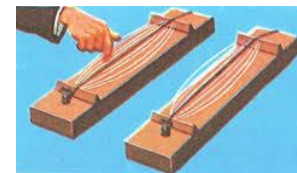
Using a Marimba Band playing a high energy grand finale, **Sound Five Ways** can make a demonstration of sound. The science of it can show how sound is made. Deeper aspects can show how sound waves are always affecting our emotions and even the matter around us.



piece for a great science show how sound waves physical

The completion of **Sound Five Ways** must have a minimum set of *Homework Assignments*. Hand in a written page that can be displayed at a Science Fair or Conference on the following.

1. What *Sympathetic Vibration* is using the strings of: guitar, violin, and a simple homemade vibrating string.
2. How Sound Waves form matter such as: Waves on Water, Powder Shapes, and Paint Pots.
3. Why Wind Instruments make sound using: Classical Musical Instruments, and a simple homemade tube that can make music.
4. The Effect of Sounds on Humans using: different Genres of Music and Special Sound Effects.
5. A flyer for the incredible Marimba Band Grand Finale!



A humorous sub-theme can facilitate this demonstration as a dramatic skit (see the 'Blue Man Group').



# The Computer [A *Demonstration Project* of computer circuitry recommended for 1 to 3 people.]

Taking a cue from one of the first computers – *Computer* – create a working model. Make it circuitry that will demonstrate if a person can answer questions correctly and have the machine determine if the person is right or wrong.

The completion of **The Computer** must have a minimum set of *Homework Assignments*. Hand in a written page that can be displayed at a Science Fair or Conference on the following.

1. The *History* of the computer.
2. The *Story of Turing* and the use of his computer to help end World War I by cracking the Enigma Machine code.
3. Build a *Cabinet* for your computer.
4. Build actual mainframe circuitry that mimics the logic of a primitive *Artificial Intelligence Processor*.



*The Turing* complete with answer a series of determine if the



# The Pendulum [A *Demonstration Project* of vibrations recommended for 1 to 3 people.]

Vibrations of musical instruments, the pendulum of a clock, and even our consciousness can travel from one to another. When these vibrations are in sympathy, we synchronize into harmony. This can be demonstrated by creating examples of **The Pendulum** physics apparatus like the metronome, tuning forks, or stringed instruments.

## Lessons from Pendula (Pendula is the plural of Pendulum)

- Close your eyes. ... Imagine no space. ... How would you know if time passed?
- Now close your eyes again. ... Imagine space is there and there are physical objects; but there is no movement or change. ... How would you know if time passed?

**\*\*\* So it seems that time goes with space, physical objects, and movement. Let's call the movement or changes of objects *vibration*. It seems that everything in this physical world is vibrating.**

- To tell time or 'keep time' we use clocks. Long ago people used their own pulse, because the heartbeat is fairly regular.

## Galileo

- As Galileo was sitting in a church, watching the chandelier slightly sway back and forth, he used his pulse to time the swings. He noted that the time for each swing was the same regardless of the width, or amplitude, of the chandelier's swing. This caused Galileo to perform several scientific experiments with a **pendulum**: a weight, or bob hung from a string, or rod (that does not have much weight), which is attached to a fixed point overhead. Galileo noted that even if you change the weight or amplitude, the period of time for each swing of the pendulum was the same.

**\*\*\* It was then that Galileo realized that a pendulum makes an excellent clock.**

## Sympathetic Vibration

- Christiaan Huygens, (1629 – 1695) invented the pendulum clock around 1657. One day in 1665 he noticed that two heavy pendulum clocks hanging from the same house beam would synchronize. That is, they would end up ticking at the same time, even if they were started at different times.

## Connection





- The vibrations of pendula are connected to such diverse subjects as: the individual human heartbeat, the eras of humankind at large, planets, stars, and to the Platonic solids.
- Some ancients said that a harmonious person would live 72 years and would have 72 heartbeats per minute. They said that the heart was like a pendulum that swung back and forth to make 1 cycle. This cycle occurs with each breath, which is once per 4 heartbeats. How many heart cycles (or breaths) would the harmonious person have in one day? It turns out that the harmonious person would have 25,920 heartbeats in a lifetime.
- Plato said that humankind changes consciousness every 2,160 years. This is now called a Platonic month. One Platonic year is therefore 25,920 years (12 x 2,160). He compared the collective life of humanity on earth to the perfect shape of cubes. Interestingly, the Platonic Month of humankind is the same number as the total number of degrees in all of the corners of a CUBE.
- But the Platonic year is also related to the time it takes for one rotation of the ecliptic or said another way, the rotation of the 12 signs of the zodiac. It is the same 25,920 years.

So, this leads to an important question ... *if pendula can synchronize through sympathetic vibrations, and if humans are like pendula, maybe we humans can synchronize through sympathetic vibrations?*



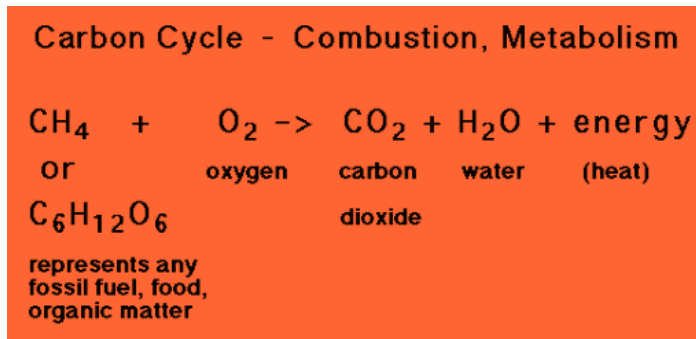
The completion of **The Pendulum** project must have a minimum set of *Homework Assignments*. Hand in a written page that can be displayed at a Science Fair or Conference on the following.

1. The *History* of the pendulum.
2. Dramatization of the *Story of Galileo*, perhaps using the 'close your eyes' and the 'church story' to lead up to the use of his pendulum to create the first clocks.
3. A series of *Metronomes* that demonstrate sympathetic vibration.
4. A few variations on the simple *Pendulum*.

# Science Fair Projects

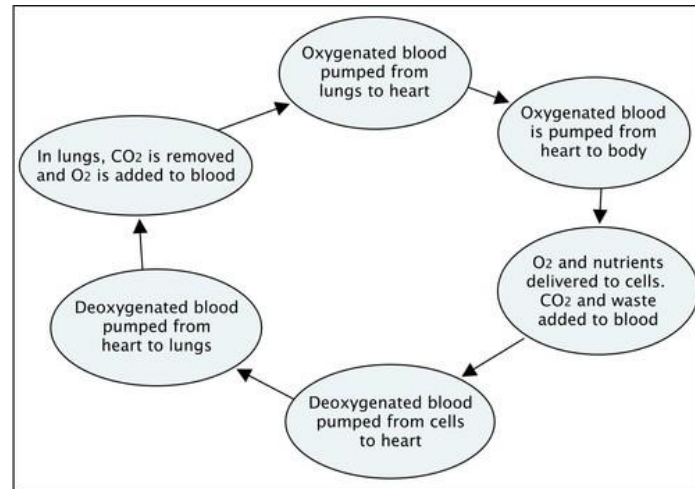
## *Digestion of Minerals in the Stomach*

- **Premise:** Your bones and teeth need you to eat the mineral calcium. But how does this occur?
  - **Eating:** You **eat** foods to get calcium are: Cheese, Yogurt, Milk, Sardines, Dark leafy greens (spinach, kale, turnips, collard greens), Fortified cereals such as Total, Raisin Bran, Corn Flakes, Fortified orange juice, Soybean, Fortified soymilk (Not all soymilk is a good source of calcium, so it's best to check the label), Enriched breads, grains, and waffles.
  - **Digesting:** Hydrochloric acid in your stomach performs a chemical reaction to digest the food (including the minerals).
    - Most food like carbohydrates:  
 $C_6H_{12}O_6 + O_2 \rightarrow H_2O + CO_2 + \text{energy}$   
**This is cellular respiration - from eating and breathing!**



- Minerals like calcium:  
 $CaCO_3 + HCl \rightarrow CaCl_2 + H_2O + CO_2$

- **But where does the CO<sub>2</sub> go, before it is exhaled? Into the blood!**



- **Breathing:** You breathe in (oxygen sort of 'burns' the food). Then you breathe out (carbon dioxide comes out of your mouth).
- **Actions:** Simulation of the Human Body Eating
  - Measure 50 ml of hydrochloric acid (stomach)
  - measure 200 g of marble chips (minerals in food)
  - combine acid and minerals in beaker and quickly place gas capture tube
  - capture carbon dioxide (out breath) in gas capture apparatus
  - point out how mineral is dissolved (digestion)
  - test if gas (breath) pours (carbon dioxide is heavier than air)
  - test if gas (breath) puts out flame (probably carbon dioxide)

### ***Proof that even Gases (Oxygen) have Weight by Burning***

*(Priestly discovered the oxygen, then showed Lavoisier who learned how to measure that gases have weights just like solids.)*

- **Premise:** Burning is a chemical reaction where substance combines with oxygen and gives off carbon dioxide. (Maybe a cool picture of **Priestley's** apparatus.)
- **Actions:** Chemical Reaction of Wood with O.
  - measure the weight of two pieces of wood

- modify them to weigh the same
  - show chemical reaction of wood burning
  - burn one of the pieces of wood
  - weigh and compare wood ash to weight of other piece of wood
- **Actions:** Chemical Reaction of Mg with O.
  - measure the weight of two pieces of magnesium
  - modify them to weigh the same
  - show chemical reaction of magnesium burning
  - burn one of the pieces of magnesium
  - weigh and compare ash to weight of other piece of magnesium
- **Conclusion:** Why is wood ash lighter and magnesium ash heavier?
  - burning wood lets the gas escape (carbon dioxide)
  - burning magnesium captures the gas (oxygen) in the ash
  - **Lavoisier** made cool apparatus (show picture) that captured gases after the reaction was over and measured their weight. We didn't need his fancy jars because our experiment captured the oxygen in the magnesium oxide ash for us with very simple equipment.
- *Titration - the Precise Measurement of the Balance in of Opposites in Nature*
  - **Premise: Acids and Bases** are like the Yang and Yin of chemicals - opposites. They seek balance in nature to make all of our rocks (salts) and our water. **Indicators** are chemicals that turn colors when they react with acids and bases. These are responsible for many colors in flowers, leaves, and foods.
  - **Actions: Titration** measures how much chemical you have used after the experiment is over.
    - pour a large amount of water into a large container (measurement is not necessary - just large enough for a dramatic demonstration)
    - now, pour 20 ml of water into a small container
    - pour 20 ml of Congo Red (indicator) into the water
    - put a few drops of indicator into the small container of water
    - note the color of the indicator when it is in water (this is the color of neutral - meaning not acid or base - right in balance, like what nature seeks)
    - measure out exactly 500 ml of the acid and 500 ml of the base in separate beakers
    - gently and slowly find out how to change the color of the indicator by pouring first one then the other into the indicator container
    - after seeing dramatic color changes, try to get the container back to the color of the small container with water and indicator (the neutral color)

- now, by subtraction, note exactly how many ml of acid and base you used - this is a measurement of how much liquid it took to match exactly the same number of acid molecules to base molecules to combine into salt water molecules