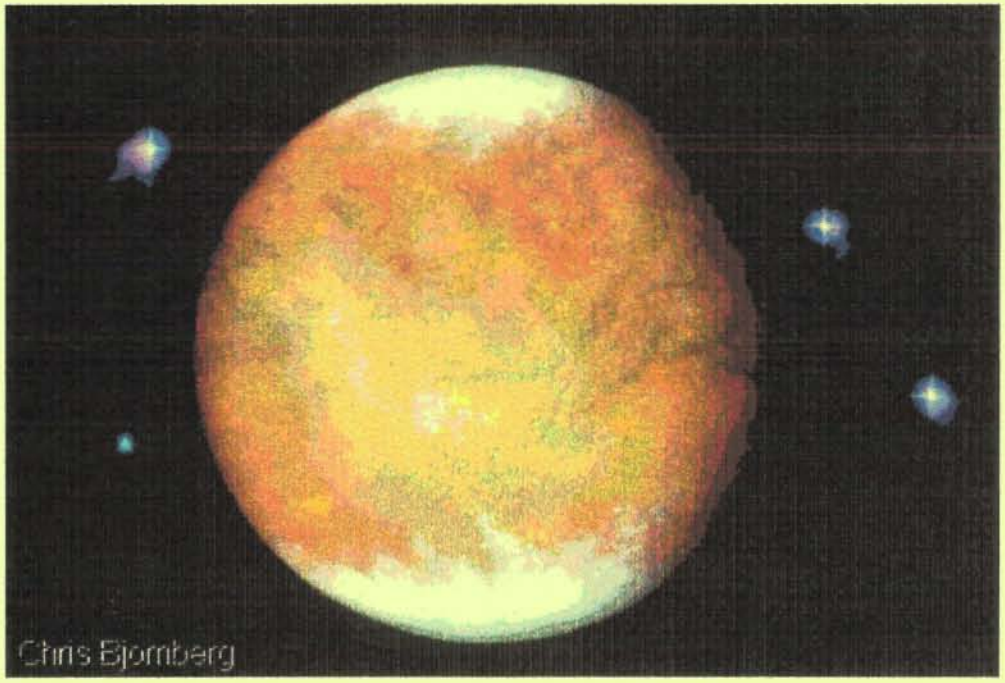
The Mathematics of Change



Mission to Mars 2000 and Beyond

Ann Street School - Math Fair 2000

MATHEMATICS FAIR
EIGHTH GRADE PARTICIPANTS
CLASS OF 2000

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Classroom 402:		Veronica Da Silva Marlin De Jesus Ricardo Gomes
Classroom 403:		Christopher Barros Andre Monge Jessica Perione Javier Renjifo Juan Sarango Carlos Villalobos
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Math Fair 2000

With the topic of "Mathematics of Change: 2000 and Beyond", our goal was to create a descriptive and detailed simulation of what a biosphere that could support life on Mars would look like. The structure would consist of a Recreational Center, Living Quarters, Agricultural Center, Livestock Center, and a Research Center. We chose this specific project because of its relation to the technology (and controversy) that the year 2000 brings.

When we designed an early version of the biosphere, we found we needed some research to improve it. We narrowed down a large list of plants and animals to a smaller one that would be useful to us. We found the amount of time it takes for seeds to germinate and grow, and we created a list of those that would survive best in such a harsh atmosphere.

When the Living Area was made, we thought about how to make an efficient yet comfortable way to live in our biodome. Simple things such as bathrooms, chairs, tables, and a refrigerator were all necessary for both survival and comfort. We also added exercise equipment to the Living Area, and scientific equipment to the Research Center.

In our Research Center, we will research new technologies, monitor the biodome's systems, and examine the things we find on Mars and even the surface of Mars itself. A special air filter system will purge all toxic

fumes from all areas and maintain good quality breathing air. There is also an airlock for exploration of the surface. In a nutshell, if all goes well, this plan will become a reality.

Mars

Mars is a red planet smaller than Earth, and yet, it seems more important to us. We have acquired a large amount of knowledge about the conditions of Mars, its atmosphere, and many other things thanks to scientists studying pictures diligently from the two satellites in Mars's orbit.

Mars is much smaller than you may think it actually is. Compared to Earth, it is only about 11% of Earth's total mass, and only about 53% of the Earth's total radius. The climate is incredibly harsh compared to our own. For example, the temperature can dip as low as –189 degrees Fahrenheit (-137 degrees Celsius) and rise only as high as 63 degrees Fahrenheit. It is very cold and it seems to be a dull and useless place.

Conversion to Celsius

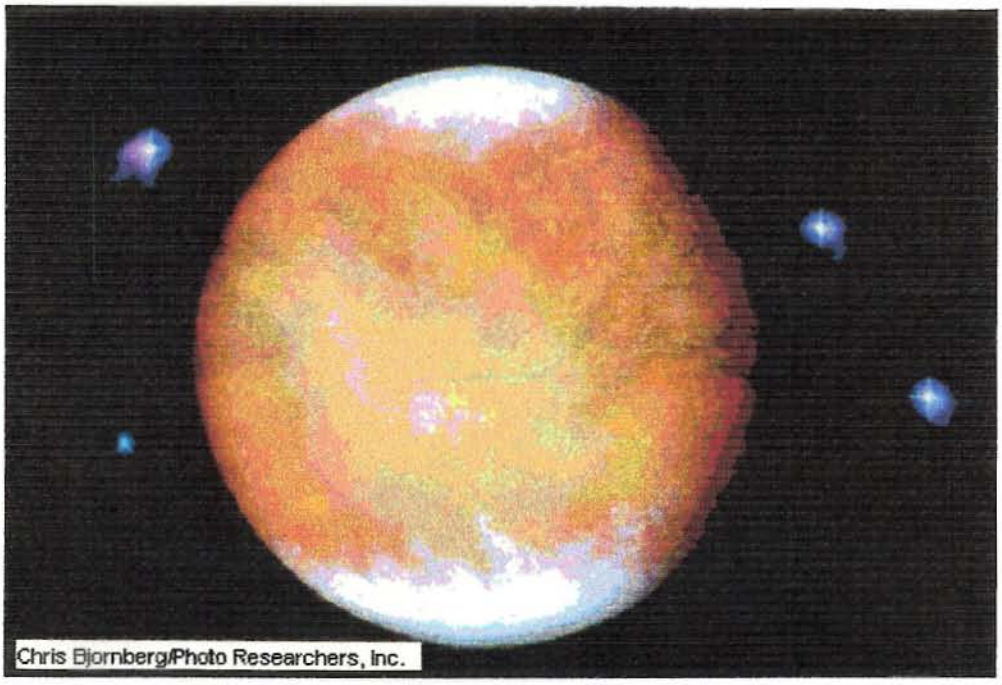
C=(5/9)F-32
C=(5/9)(-189)-32
C=-137

C=(5/9)F-32
C=(5/9)(63)-32
C=3

But what is it about Mars that intrigues scientists most? There is nothing really special about a 24.6 hour day, with a 686.2 day year. The atmosphere consists of a few chemicals that make Mars resistant to life (Carbon Dioxide, Nitrogen, Argon, Oxygen, Krypton, Neon, Carbon Monoxide, Xenon, and Water Vapor). But did you notice the one thing that confuses some people? Look carefully, and you'll see Mars' atmosphere

contains Oxygen. People believe all humans breathe is Oxygen, but they are very incorrect. Around 12% of our atmospheric gases are Nitrogen.

So it seems like this planet is just a big, useless hunk of matter. So why are so many people infatuated with a red planet that can't be used? Well, I must admit I've lied a little bit. Mars has polar ice caps. These are frozen masses of water at each of Mars' poles. Also, there are many projects in the experimental stage for the colonization of Mars. Domes, underground passages, people living on Mars; it's not as far away from the present as you perceive it.



Significant Necessities Needed On Mars to Survive

The most significant things needed on Mars to survive are oxygen, food, and water. Mars's atmosphere is 95% carbon dioxide, 3% nitrogen, and 2% argon, which contains little amounts of oxygen, carbon monoxide, water vapor, and other gases in it. Since Mars has hardly any oxygen, we are going to depend on our plants in the agricultural area.

An average human needs about 630,000 cubic centimeters or about 38,000 cubic inches of oxygen per day. Six people will participate in this mission to Mars so our plants will have to produce about 3,780,000 cubic centimeters of oxygen to survive.

630,000 cu cm * 6 people = 3,780,000 cu cm of oxygen
3,780,000 cu cm * 365 Earth days = 1,379,700,000 cu cm of oxygen per year

Along with oxygen we'll need water to survive. If we don't drink water eventually we will dehydrate and loose all strength and in time die. Water is vital to our survival on Mars because if we don't have water to drink or to use for the hydroponics used for growing our plants then we won't have any vegetables and fruits to eat on a daily basis. An average person needs to drink 0.5 gallons or about 8 cups of water per day. Since there are six people going up into Mars, there will be around 3 gallons of drinking water used per day.

Water for six people used during one day:

0.5 gallons = 2 quarts = 4 pints = 8 cups of water

2 pints in one quart * 2 quarts = 4 pints

2 cups in one pint * 4 pints = 8 cups of water

8 cups * 6 people = 48 cups of water per day

48 cups / 4 pints = 12 quarts

12 quarts / 4 quarts per gallon = 3 gallons of water used each day

Like a regular diet here on Earth, each person on Mars has a 2,000-calorie diet per day. Regular dry food is eaten on the way to Mars. The six people will each eat at least 1 lb. of dry food for two- hundred and seventy days on the way to Mars. There will be approximately 6 lbs. of dry space food used each day while being in the space shuttle. It will take approximately 270 days to travel from Earth to Mars so, in total there will be around 1620 lbs. of dry food used during the whole journey.

1 lb. of dry food * 6 people = 6 lbs. of dry food used per day

270 days * 6 lbs. of food ~ 1620 lbs. of food during the entire journey

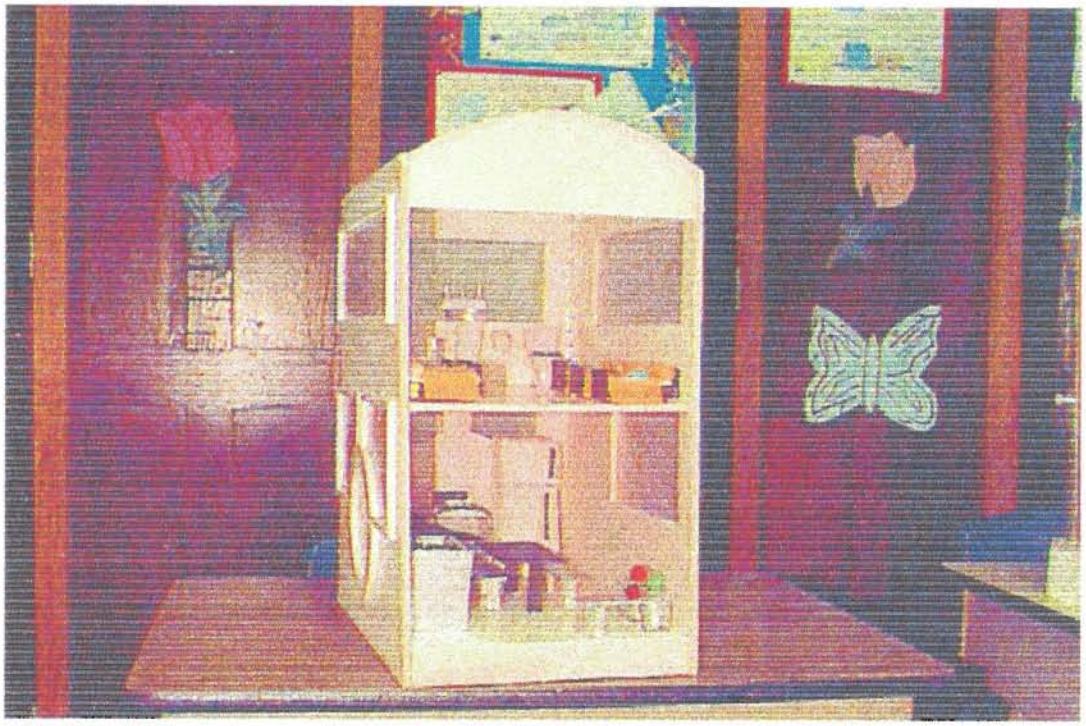
The most important things needed on Mars for us humans to survive are oxygen, food, and water. The mass of all these necessities per person for one day is approximately 3.4 kg. The total mass of all three necessities for six people is about 20.4 kg. in one day. On the journey from Earth to Mars, which is 270 days long the mass of all the needed resources to survive for all six people is about 5,508 kg.

Mass of resources for one person during one day is 3.4 kg.

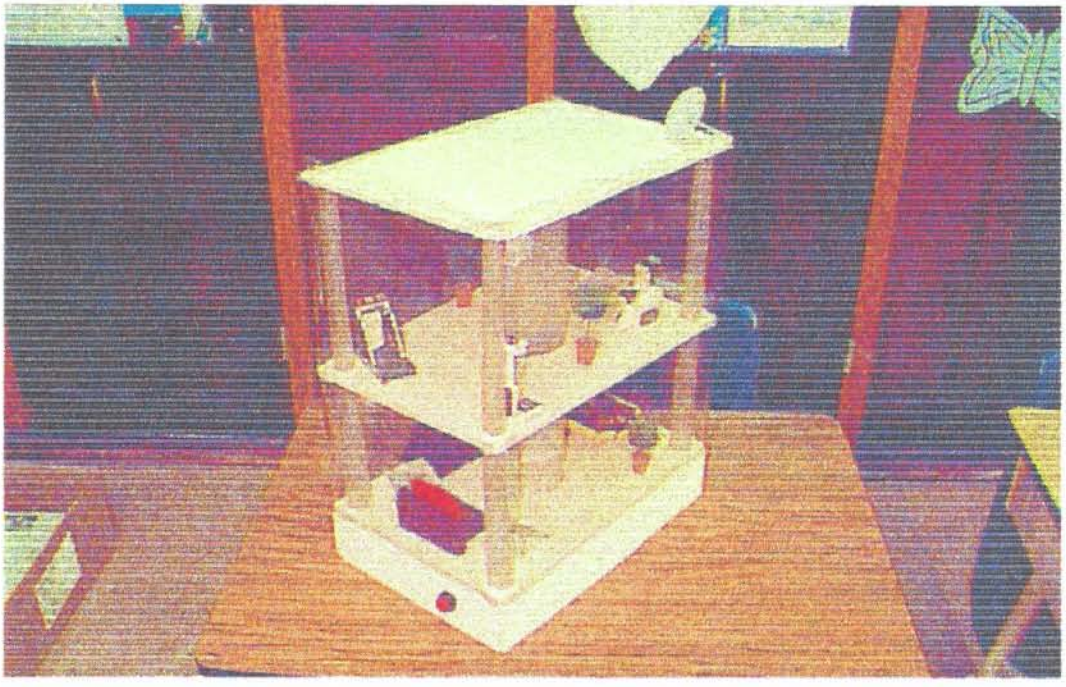
3.4 kg * 6 people = 20.4 kg.

20.4 kg. * 270 days ~ 5,508 kg.

Living Quarters



Recreational Center



Living Area:

Dimensions:

Length: 25ft Width: 30ft Height: 20ft

Conversion:

Length: 25ft * 12in = 300inches * 2.54cm = 762cm
Width: 30ft * 12in = 360inches * 2.54cm = 914.4cm
Height: 20ft * 12in = 240inches * 2.54cm = 609.6cm

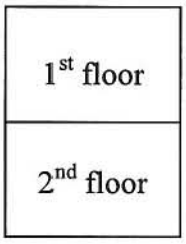
Volume in Centimeters:

762 * 914.4 * 609.6 = 424,752,698.88 cubic cm

Volume in Inches:

300 * 360 * 240 = 25,920,000 cubic inches

Recreational Center:



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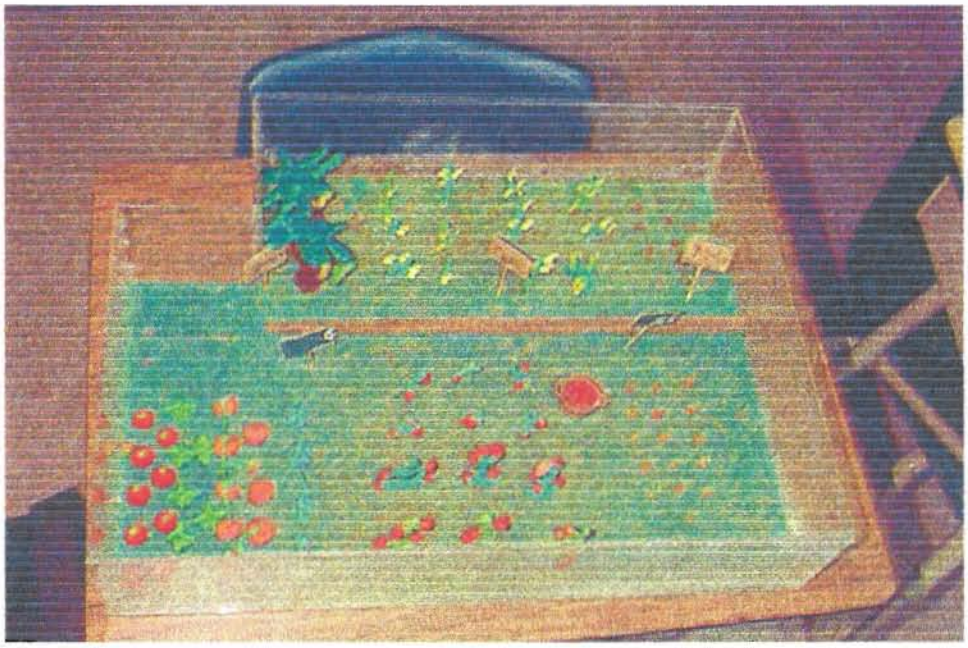
RECREATIONAL/LIVING QUARTERS

The recreational/living quarters consists of two buildings. The entire section is intended to provide a comfortable yet substantial place to support life. The first structure consists of two floors. The upper level consists of numerous beds, which would obviously be a place for rest. Conveniently next to them is a standard bathroom, which has one toilet, one shower, and one sink. On the lower level, there is a standard kitchen suitable to provide for all needs. In it, are numerous stoves, a refrigerator, and dining tables. This concludes the living quarters.

The second building, which is the recreational center, also has two floors. The upper level consists of a gymnasium. Among the equipment for exercise there is a treadmill, stationary bike, and dumbbells. A scale is provided to monitor the explorers' body mass. Television monitors are also located on the top corners of the room to provide entertainment during their workout. On the lower level, there are randomly placed sofas to "lounge" in as well as numerous televisions. This room is mainly used for relaxation.

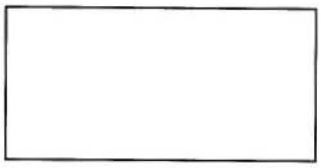
The above captioned were designed to provide an environment otherwise foreign to this planet.

Agricultural Center



Livestock Center

Agricultural Center:



Dimensions:

Length: 50ft Width: 25ft Height: 10ft

Conversion:

Length: 50ft * 12in = 600inches * 2.54cm = 1524cm
Width: 25ft * 12in = 300inches * 2.54cm = 762cm
Height: 10ft * 12in = 120inches * 2.54cm = 304.8cm

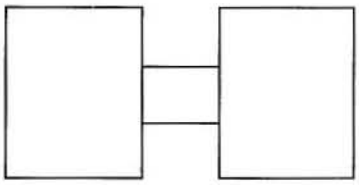
Volume in Centimeters:

1524 * 762 * 304.8 = 353960582.4 cubic cm

Volume in Inches:

600 * 300 * 120 = 21,600,000 cubic inches

Livestock:



Dimensions:

Length: 20ft (gap) 20ft Width: 25ft Height: 10ft

Conversion:

Length: 20ft * 12in = 240inches * 2.54cm = 60,960cm
Width: 25ft * 12in = 300inches * 2.54cm = 762cm
Height: 10ft * 12in = 120inches * 2.54cm = 304.8cm

Volume in Centimeters:

60,960 * 762 * 304.8 = 14,158,423,296.cubic cm

Volume in Inches:

240 * 300 * 120 = 8,640,000cubic inches

Agricultural Center

Our agricultural center consists of a variety of fruits and vegetables, essential for a human's diet. We are growing fruits such as bananas, pumpkins, tomatoes, watermelons, as well as strawberries. Vegetables include corn, lettuce, carrots, and potatoes. They all provide for many different uses and are extremely vital for good health.

All our agricultural plants are grown hydroponically except for carrot and potato crops. Hydroponics is defined as the act of growing plants without soil. We use water containing balanced concentrations of essential nutrients which provide the plant with all of its requirements. By using artificial lighting, the plants will grow in half the time than if they were grown in soil. For example, if tomatoes take 50-150 days until harvest when grown in soil, hydroponically it would only take 25-75 days.

Corn is an extremely useful vegetable which is part of the cereal and wheat group. It's the most important veggie in a person's diet. It has numerous uses such as providing food for our animals. It feeds our cattle and poultry. In fact, it is an excellent source of carbohydrates which is essential for a human as well as an animal's diet. Corn is also used and transformed into corn oil that is extracted from the germ of the corn kernel. Corn oil is then able to be utilized in cooking, salad oil, and even in margarine. Also, corn can be grinded into flour which can be later used to make daily food.

Corn takes a while to mature, or reach it's full growth. After the corn seed is planted, it will take approximately 35-45 days to mature .

Unlike corn, lettuce grows fast and is easiest to grow. It takes 20-25 days to mature. As a matter of fact, it is ready to eat 20 days after seeding.

Lettuce is also a great source of food supply for humans as well as rabbits and our daily diets.

Cabbage, like lettuce, is very nutritional and high in vitamin C which is needed for strong bones. A full cabbage head will take around 1-1.5 months to grow.

Carrots are vital for our health and are easy to grow as well. It is rich in vitamin A and can be eaten raw or cooked. Carrot seeds are slow to germinate. However, after it's germination, it will grow rather quickly. It matures 35-40 days and is best when not too big in size. In general, the smaller the carrot, the juicer and more tender it is. When the carrots are about finger size, it is ready to be harvested.

Another vegetable we are growing is potatoes. They benefit our health due to their great sources of vitamin C, Potassium, and fiber. In fact, potatoes should be included in one out of every meal we eat per day. Thereby, making it nutritious and healthy to consume.

Potatoes begin to grow 10 days after planting the seeds. However, it is ready to harvest 50-70 days after planting. Potatoes are mainly grown for human consumption and for its important source of starch. When freshly dug, they contain 78% of water, 18% of starch, and 2.2% of protein.

Tomatoes are a fruit which are a valuable source of food minerals and vitamin A and C. It has a wide variety of uses in cooking, often used as sauce, seasoning, or in salads. Tomatoes take 25-75 days to harvest. It is best to harvest tomatoes when they are fully ready, but still firm.

Tomatoes are carbon dioxide junkies and in warmer condition they consume even more than usual. This is great because Mars's atmosphere contains 75% carbon dioxide and the plants will produce more oxygen for us humans on Mars.

Bananas are known to be one of the healthiest and most nutritious fruits. In a bunch, there are about 20 bananas with approximately four bunches per tree. Therefore, one banana tree will produce around 80 bananas. Bananas are an excellent food source of potassium, vitamins A & C, and quick energy. Potassium is a mineral found in bananas that can actually regulate your blood pressure. Bananas are low in protein and fat. Bananas take 3-6 months to mature.

Strawberries are probably the most ideal fruit to grow. They are easy to grow and require little space. Twenty-five plants are able to provide enough strawberries for a least four to five people. One plant can provide about one quart of strawberries, and one cup of this fruit has 55 calories. Strawberry juice contains about 90% water, which will provide for each human's daily intake of water.

Watermelons are useful fruits. It takes a long time for a watermelon to grow. Depending on the variety, melons will take from 30 to 45 days to develop. Their weight ranges from being 12-18 lbs. They vary in shape and size, their flesh is usually red, and they're sweet. Watermelons contain extreme amounts of water which can be used to drink. As a matter of fact, watermelons have about 90% water.

Pumpkins and squash are very similar fruits with the same genus. Squash takes approximately 25 days to mature. Pumpkins can be consumed 40-60 days after they've matured.

Livestock Center

Our Livestock Center contains cows, chickens, cattle, and pigs. These animals will supply the explorers with poultry and meat. They will also provide us with the resources we need like milk and other dairy products.

The cows are one of the most important diary animals needed on Mars for the explorers to survive. We are going to be taking six cows on our mission. Each cow drinks around 15-25 gallons of water each day which means that the explorers will need to use some plants to feed this animal. Also, each one of these useful creatures eat around 55 lbs. of food like hay, corn, and wheat, which they can get from the plants we are taking and planting up there. Individually a cow weighs around 1,000 lbs. and spends thirteen hours a day lying down, and about eight hours standing up.

Six cows are taken up to Mars
Total water they will drink each day:
15 gal. * 6 = 90 gallons
to
25 gal. * 6 = 150 gallons
Total: 90-150 gallons of water

Total amount of food they will consume each day:
One cow will eat around 55lbs. of food
55lbs * 6 = 330 lbs.
Total: 330 pounds

Cows need a great amount of food and water. However, they will provide many necessities for the explorers. Cows are able to produce 1,500

gallons of milk each year. Milk is rich in protein and calcium, which helps to build muscles, and strengthen our bones. The milk can be used for a variety of purposes such as making ice cream, butter, as well as cheese.

Total amount of milk the six cows
will produce in one year:
1,500 * 6 = 9000 gallons.
Or
1,500 gal. * 4 qt. per gal. =
6000 qt.* 6 = 36,000 qt.

Cows have a lifespan of 40 years. Throughout their lifetime, they will produce 10-12 calves, or baby cows. The calves weigh 85 lbs. at birth and will begin to make milk at two years.

Total amount of calves the six cows will produce:
10 calves * 6 = 60
to
12 calves * 6 = 72
Total: 60-72 calves

Another animal we will raise is pigs. We have a total of four pigs: 2 piglets and 2 adult pigs. A piglet, or baby pig weighs 3.5 lbs. or 56 oz. at birth and will double it's weight in just 7 days. Pigs fatten very rapidly and may grow from about two pounds at birth to nearly 220 pounds in less than six months. Adult pigs may attain a height of 40 inches and weigh anywhere between 180-500 pounds. Pigs generally live to be over 15 years old. On the average, pigs give birth to 10 pigs.

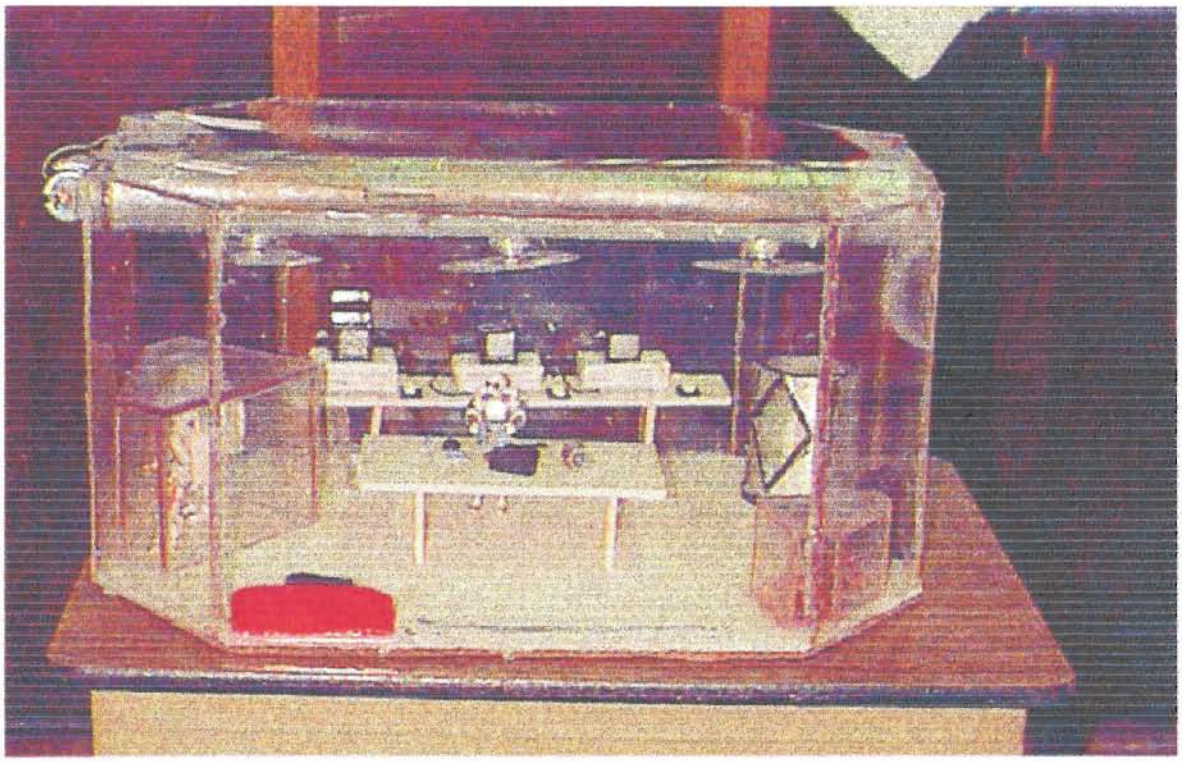
Total amount of piglets the 4 pigs
will be expected to produce:
10 piglets * 4 pigs = 40 piglets
Total: 40 piglets

They have a varied diet and will eat almost anything. They usually are fed cereals; especially corn, grains, protein feeds like soybean oil, potatoes, and skimmed milk. Pigs will also eat plants, berries, fruits, and even worms. The pig's meat is used for things such as pork, bacon, and ham.

Chickens are another useful animal we will be taking to Mars. Chickens are the easiest livestock to raise. We have 5 hens, or female chickens, and 2 roosters, or male chickens. Having chicken with different genders increases the population of our chickens because they will be able to reproduce. We will utilize the hens for their eggs and the roosters for their meat. Hens produce one egg per day, however, having 5 hens will make a total of 5 eggs each day. A female chicken can produce around 280 eggs per 0year. Only 1/10 or 28 of the 280 eggs will be hatched into new chickens.

All of these animals contained in our livestock center serve for many different purposes. Thereby, making them extremely vital for our mission to Mars.

Research Center



Research Center:

Dimensions:

Length: 40ft Width: 25ft Height: 10ft

Area of "Square":

30ft * 25ft = 750 square feet

Areas of Trapezoids:

A= (1/2) *sum of bases * height

A= .5 * (20+25) * 5

A= .5 * 45 * 5 = 112.5 square feet * 2(trapezoids) = 225 square ft

Total area of octagon:

750+225 = 975

Volume of octagon:

975 * 10 (height) = 9750 cubic ft

Conversion in volume measures:

9750 cubic ft * 1728 cubic in = 16,848,000 cubic inches

16,848,000 cubic in * 16.387064cm = 276,089,254.272cu cm

Research Center

In this section of the biosphere, constant research and development of new discoveries will be in a never-ending fashion. This will ultimately result in the improvement of our knowledge about Mars and may answer many puzzling scientific questions that have been left in "space" for so many years. In this one floor structure, a few utilities are in it. There are work stations, a storage bin for various tools that may be used for exploration on the planet, three computers (which will log down our notes), a research station, and a room for departure or small expeditions, complete with space suits rendered to the necessary specifications needed to easily walk on Mars. Also, there is a central air and gravity filtration system used to keep the entire biosphere in chemical and pressurized atmospheric balance. This concludes our research center.