My Favorite STEM Activity

The Lunar Space Station / Planet Terraforming Water System

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My Favorite STEM Activity

From Dr. Jim Cain (with a Ph.D. in Mechanical Engineering)
STEM = Science, Technology, Engineering and Mathematics

When I was a kid, we didn't have STEM activities. We didn't have 'make-fairs.' Sure there were erector sets to build things with, and Tinkertoys and Lego blocks. What we did have was NASA. Every time NASA shot a rocket into space, school children gathered around black and white televisions in school gymnasiums around the country and we watched and marveled at what scientists and engineers could do. We read books about going into space and traveling to other planets. We were inspired by what technology could create and that inspiration lasted a lifetime. Many of my classmates wanted to be astronauts. I wanted to be an engineer (or at least I did until I found out that a Mission Specialist could be both!)

In 1996 I had the opportunity to combine two of my life's great loves, engineering and teambuilding, by facilitating a program at the NASA complex in Houston, Texas. If you have seen the scene in the movie Armageddon where Bruce Willis' character first arrives at NASA, that is where I was. I worked with the 'lunar-mars' team as they prepared for a three-month test of living conditions inside a sealed cylinder that monitored their every breath. During my time in Houston, one NASA employee asked me if I wanted to see the mock-up of the international space station. Of course I did! The activity I present here was inspired by that visit to NASA twenty-years ago. Perhaps by inviting the young people in your group, you can inspire them to consider STEM or STEAM (Science, Technology, Engineering, Arts and Mathematics) vocations.

On the following pages, you'll find my favorite STEM activity (with two versions for you to choose from), which involves assembling a collection of PVC tubes and connectors to form a closed system. Participants will need problem solving skills, visual spatial awareness, leadership, creativity and teamwork to successfully complete this task. When complete, teams are also invited to self-evaluate their contributions using the Team Performance Evaluation Questions provided.

The collection of PVC tubes and connectors used for this activity are called Teamplay Tubes and were created and designed by Dr. Jim Cain of Teamwork & Teamplay. With this collection of PVC parts, facilitators, teachers, trainers and group leaders of all kinds can challenge audiences in ways that encourage exactly the kind of thought processes that engineers, technicians, scientists and mathematicians use every day. The first step to being an engineer is to think like one!

You can order Teamplay Tubes kits (and tons of other teambuilding props and books) from Training Wheels, Inc. of Littleton, Colorado, USA. You will need one kit for every group of six to eight people. Each kit also includes activity instructions for more than a dozen additional activities using Teamplay Tubes. To place an order, visit the Training Wheels website at: www.training-wheels.com or call them at 1-888-553-0147.

Version I

The Lunar Space Station

STEM scientists could use your help. Your team has been asked to use the equipment available (a collection of 50 PVC tubes and connectors) to construct a new model of a space station platform to orbit the moon. Use every part. Each tube will have a connector at each end. Each connector will have a tube in each opening. You will construct one interconnected model, with no holes left open. Here are three recommendations from the STEM team. First, use the connectors with the most holes first. Second, use both long and short tubes in the beginning so that you will still have both lengths available at the end. Third, you should not have to force connections. If the model does not go together easily without stress, it is trying to tell you something!

Optional Constraints – STEM scientists are always working under constraints (time, schedule, budget, staffing, system limitations, the basic laws of physics, etc). If you would like a higher level of challenge for this activity, you may choose to include one (and only one) of the following design constraints:

> The entire model must fit inside of a box that is 25 x 25 x 25 inches.
> (25 inches = 64cm)
>
> The maximum dimension (longest distance from any one point to any other) on the model must not exceed 32 inches (81cm).
>
> Any tube in the system must have a different connector at each end, with the exception of 90-degree elbows. Some tubes can have 90-degree elbows at each end.

When you have completed assembling your model, STEM scientists have asked that your team complete the Team Performance Evaluation Questions.

Good luck.
The STEM Space Station Team

Version II

Closed Water System
Planet Terraforming Team

While terraforming (planet shaping) a suitable planet, your STEM team discovers that the assembly plans for your water purification system have been unfortunately deleted from your computer's database. Updated computer information will take more than a week to reach your location, and you need the water system operational today! You will need to assemble all 50 pieces of this system in such a way so that no holes are left, preventing any water leakage. Luckily, a STEM engineer left a hand-written note inside the box containing the water system parts.

My Recommendations.

As a member of the design team, I've assembled this water system four times as part of the quality control check. The fifty pieces included should be assembled per the instructions found in the Planet Terraforming Database (revision year 2035), under subsystem code XG5105 – 71208. But even with these instructions, I've discovered a few things that dramatically improve the assembly of this system. First, start with the connectors with the most holes. Next, use both long and short tubes throughout the build (i.e. don't build with only long or short tubes at any one time). And finally, never force connections. They should go together easily. Stressed connections eventually leak, and given the atmospheric conditions on the planet where you now reside, you'll need every drop of water there is.

Good Luck Team!
Jim Cain, Ph.D.
STEM Engineer
Planet Terraforming Team
December 20, 2035

When you have completed assembling the water system, STEM scientists have asked that your team complete the Team Performance Evaluation Questions.

Good luck.
The STEM Planet Terraforming Team

Team Performance Evaluation Questions

(please write your answers below each question)

1. What role did each member of the team demonstrate?
   Leader, decision maker, creative genius, worker bee, problem solver, organizer, etc.

2. Was there an obvious leader in the group, or did the group share leadership?

3. Which of the following styles of problem solving were used by your team (circle one):

A.	B.	C.
Trial & Error	Analyze, Plan, Perform	A really good guess and a whole lot of luck

4. After your group decided on a plan, did the group change the plan during the activity?
   If so, why?

5. How many ideas were considered during the early stages of the activity?
   Was each idea and each person given an opportunity to be heard?

6. Describe how each member of the group was given an opportunity to contribute to the success of this project?

7. How would you rate your group's overall completion of this task?

8. If you had the opportunity to perform this task again, what would you do differently?

9. If you were asked to give advice to a new team trying to accomplish this assignment, what information would you provide to help them be successful?

10. If you were going to hire an employee to complete this task, what skills would you be looking for?

11. Some of the best things we learned during this activity were:

The photographs shown on the first page are actual teambuilding groups working on the challenges presented in this document. The extremely large (orange) set of Teamplay Tubes was constructed for a teambuilding program in northern Italy. As Karl Rohnke once said, "anything worth doing is worth overdoing!" This activity has long been one of my favorites and many organizations now involved in afterschool programs, summer camps, school science projects, youth development and teambuilding programs are using this and many of the teambuilding activities I've created over the years. I hope you enjoy this activity. Please email me and let me know how it is going. I'd love to hear from you.

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If you like inspiring young people with STEM activities, here are two of my favorite books that should be on their reading list. *The Martian* by Andy Weir is available as both a book and a movie. Version II of the activity presented here was inspired by this book. *Ready Player One* by Ernest Cline (a book now and hopefully a movie soon). Inspire the young scientists in your world, give them a book to read!

I have written about the PVC Space Station activity in three of my teambuilding activity books so far. *Essential Staff Training Activities* (ISBN 978-0-7575-6167-2), *Teambuilding Puzzles* (ISBN 978-0-7575-7040-7) and *A Teachable Moment* (ISBN 978-0-7575-1782-2) are all available from Kendall Hunt Publishers (1-800-228-0810 or www.kendallhunt.com). The book *Teamwork & Teamplay* (ISBN 978-0-7872-4532-0) also from Kendall Hunt Publishers, not only includes dozens of unique teambuilding activities, but also instructions to build the equipment for each of these activities.

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