Los **A**ngeles **U**nified **S**chool **D**istrict
Office of Curriculum, Instruction and School Support
Elementary History-Social Science and
Elementary Science Divisions

Days 8 and 9
Colony Structures

ESSENTIAL QUESTION: What do human beings need to survive and thrive in a new environment?

FOCUS QUESTION: How does shelter design fulfill physical, social and economic needs?

Objective

Students are expected to determine types and functions of structures their space colony will have. They need to consider all they have learned during the past 7 days. Through analysis of 17th century documents about Jamestown and Plymouth colonies, and their notes on location, survival needs, economic purpose, occupations and government, students will now be able to plan their space colony.
They will create a 3D model of their colony. Using the engineering design process they will revise their model based on feedback from other students and artists' interpretations of space colonies.

Quick Look

- Conceptual Flow: Students will now apply knowledge gained in days 2-7 to build a model of their space colony.

- Summary: This lesson takes place over 2 days. The students will consider the kinds of structures the 17th century colonists built and then consider all the needs that they have explored on days 2-7. They build a 3D model of their colony using cubes and other model materials. After looking at each other's models and other illustrations they revise their models and transfer them to 2D maps. They then create a final map of their colony in a smaller scale.

- Time: 7 - 8 hours over 2 Days

- Science Content Standards
  - *Engineering Design Process*

- *Common Core State Standards
  - SL 1,2,4,5
  - W 2,7,8
  - RIT 1,3,9,10
    *See appendix A

- **Visual Arts Content Standards**
  - VPA5.2 Identify and design icons, logos, and other graphic devices as symbols for ideas and information.
- Student Products
  - Space colony structures worksheet
  - Journal Entries
  - 3D model of colony
  - Reduced scale map of colony
  - Written explanation of colony
  - Entries on Space Colonization Application

BACKGROUND

This lesson provides students with an opportunity to apply their knowledge by designing a model space colony. They are then challenged to transfer their three dimensional model to a smaller scale two dimensional map. The cognitive demands of transforming a 3D model to a "bird's eye view" map is developmentally appropriate for this age. By explaining their models to others and providing supportive feedback, students develop their oral presentation skills. The process of revising based on feedback is a major focus of the engineering design process.

Vocabulary

archetype, structure, function, model, map, grid, transparency, revise, legend, landscape

Materials

- Digital Orbit Photographic Atlas of the Moon http://www.lpi.usra.edu/resources/lunar_orbiter/bin/lst_nam.shtml
- NASA's Mars Exploration Program http://mars.jpl.nasa.gov/gallery/atlas/index.html
- Moon Terrain video: http://www.lpi.usra.edu/nlsi/moonVideo/index.shtml
- Mars Terrain Video: http://www.huffingtonpost.com/2013/10/29/mars-flyover-video-red-planet-terrain_n_4173025.html
- PowerPoint "Day 8 Shelter Model (Teacher Resource 8.15)
- FOSS Landforms Overlay Grid Master (Teacher Resource 8.14)

For each colony group:

- Space colony structures worksheet (Student Handout 8.1)
- **From FOSS 4th Grade Kit, Solid Earth**
  - ☐ FOSS Landforms trays
  - ☐ FOSS sand/ powdered clay mixture
  - ☐ Basins (to hold the material)

- *Optional*
  - *Substitute with homemade playdough (Teacher Resource 8.1)*
  - *Substitute with sand/cornstarch matrix (Teacher Resource 8.2)*

For the classroom
- Space Colony Pictures:
  - Space Colony Structure A (Teacher Resource 8.5)
  - Space Colony Structure B (Teacher Resource 8.6)
  - Space Colony Structure C (Teacher Resource 8.7)
  - Space Colony Structure D (Teacher Resource 8.8)
  - Space Colony Structure E (Teacher Resource 8.9)
  - Space Colony Structure F (Teacher Resource 8.10)
  - Space Colony Structure G (Teacher Resource 8.11)
  - Space Colony Structure H (Teacher Resource 8.12)
  - Space Colony Structure H (Teacher Resource 8.13)

- Rainbow cubes/Unifix cubes/base ten blocks
- Three 1-inch transparency grids
- Transparency markers
- Tape
- Paper /post its
- Colored pencils/markers/crayons
- Red food coloring for Mars models
- Model Revision Organizer (Student Handout 8.2)
- Travelers and Talkers Protocol (Teacher Resource 8.3)
- Engineering Design Process (EDP) Visual (Teacher Resource 8.4)
- Reduced scale map grid (Student Handout 8.3)

Optional
- Austin's Butterfly Drawing video http://www.youtube.com/watch?v=hqh1MRWZjms
- Materials for landscape drawing

PART I
LOOKING BACK

Engage/Introduction

Teacher reviews the historical colony chart with the class. Remind students of the various sources of information they have studied over the last few days that have provided evidence for the chart entries.

Explore/Analysis

Call their attention to the Historical Archetype portion of the application. Facilitate a discussion around the question –What had the greatest impact on the early colonies?

Explain/Conclusion

- **Space Colonization Application entry (Teacher Resource 1.2)**
  Teacher will say:
  - *All **Space Colony Teams** will review the application that will be submitted to Congress.*
  - *Work with your team to prepare the information to enter in the section: **"Historical Archetype"**.*
  - *In preparation for filling out this section, the team must* come to consensus about the most significant factor(s) that impacted the early colonies.

PART II
LOOKING FORWARD

Objectives

Students will determine appropriate terrain for their space colony and create a model of the colony based on physical, social and economic needs.

Engage/Introduction

Refer back to the Mars Map and Terrain/Moon Map and Terrain information sheets from Day 2. Review the various landforms that exist on the Moon and Mars.

Teacher will ask:

- *Where on the surface of the Moon or Mars do you think you should build your colony's structures? Consider the advantages or disadvantages of being in a canyon, flat area, steep area, crater, high area or low area.*

- Use the Digital Orbit Photographic Atlas of the Moon http://www.lpi.usra.edu/resources/lunar_orbiter/bin/lst_nam.shtml and
- NASA's Mars Exploration Program http://mars.jpl.nasa.gov/gallery/atlas/index.html to help make this decision.
- In addition, refer back to the Moon and Mars terrain video clips:
  - Moon Terrain video: http://www.lpi.usra.edu/nlsi/moonVideo/index.shtml
  - Mars Terrain Video: http://www.huffingtonpost.com/2013/10/29/mars-flyover-video-red-planet-terrain_n_4173025.html

Explore/Analysis

- Give each colony group copies of the Colony Structures Worksheet (Student Handout 8.1). Ask them to list the kinds of work and living areas they would need in their colony. Remind them of the physical, social, (including personal, governmental and occupational factors) and economic needs that were determined earlier.

- **Journal Entry**:
  After the group completes the worksheet each student will write a journal entry summarizing their reasons for building the structures they have chosen.

- Give each group the FOSS Landforms trays or other flat containers filled with the FOSS sand/powdered clay mixture. Provide various materials such as rainbow cubes, unifix cubes, base ten blocks, etc. Each group will create a model of their colony. (Add red food coloring to water. Use a small glue bottle to squirt the water on the Mars terrain) Show the PowerPoint "Day 8 Shelter Model" (Teacher Resource 8.15).
  - In preparation, you can view the FOSS Landforms video *Part 1:Schoolyard Models, Part 2:View From Above, Part 3 Mapmaking*. The procedure is basically the same, we have altered it to fit this unit.
    http://lhsfoss.org/fossweb/schools/teachervideos/5_6/Landforms_flash.html

- Have group members count off A-B-C-D. Form "traveling groups" of all As, Bs, and Cs. Ds will stay with their model. Divide the A, B, and C groups in half creating 6 groups of 4. Place paper or post-its by each model so students can provide feedback. Groups will do a "Talkers and Travelers" (Teachers resources 8.3) activity where they observe each other's models. When they arrive at a specific colony the member of that colony will explain their model. Other students can comment and make suggestions. Remind students of appropriate feedback statements and questions. (Optional: Show students the video, Austin's Butterfly Drawing, to model effective critiquing: http://www.youtube.com/watch?v=hqh1MRWZjms).

BREAKPOINT (end Day 8)

Explore/Analysis (continued)

- Show students the artist's interpretations of space colonies. (Space Colony Structures A-H) Post pictures on butcher paper and conduct a gallery walk. Discuss how they are similar to their models and how they are different.
- Show EDP cycle (Teacher Resource 8.4) Point out that they have been following this process over the last few days. They have asked lots of questions about past and future colonies, imagined what it could look like, planned and created a model. They are now at the revision stage. Using the feedback from their classmates, and the pictures that others have imagined, students complete their model revision chart. (Student Handout 8.2).
- Students will modify their 3D model making the changes they discussed.
- When revisions are complete, students will transfer their 3-D model to a 2-D map grid 8.6. Tape 3 transparency grids over the FOSS trays. Use overhead markers to trace the outline of their colonies structures. Label the structures.

- Change scale. Each student recreates the map on a smaller grid paper. (Student Handout 8.3) including a legend indicating type/purpose of structures.
    - Make three copies of Student Handout 8.3.
    - Cut the grids out and tape them together side by side.
    - Run off a copy on legal paper for each group.

- (Optional) Students may draw a landscape picture of their colony.

Explain/Conclusion

- Each student will write a journal entry that together with their map explains the design and function of their colony.
- Take pictures of model to add to the Space Colonization Application

PART III
BRINGING IT ALL TOGETHER

- Project pictures of Jamestown and Plymouth (See Day 2)and post students' space colony designs.
- Revisit the chart from Part 1. Compare and contrast the factors that influenced the kind of shelters in each period.
  Teacher will say:
    - *What were the structures of the 17th century colonies made of?* [wood] *Why?*
    - *Would your space colony structures be made of wood?* [No, not a source of building material in space; too heavy to transport]
    - *What material do you think you should use to build your structures?* [Answers will vary. Ideas can come from NASA pictures]

    - *What kind of protection did the 17th century colonists need?* [disease, unfriendly natives, cold weather]
    -
    - *What kind of protection to the space colonists need?* [harmful radiation, extreme temperatures, lack of atmosphere, gravity effects.]

    - *What is significant about the space colony location? Cite evidence.* [near mining source, water source, flat area for ease of construction, consideration of seasonal changes]

    - *How are the living quarters for the space colonists different from the living spaces of the early colonists* [no open air walkways, all structures enclosed]

    - *How are they the same? [private and public spaces, areas for work and rest]*

    - *What is the source of energy in the 17th century colonies?* [fire from burning wood] *What is the source of energy in the space colony* [solar panels; wind generators, nuclear fission]

- **Journal Entry**:
  - Students will write a journal entry answering the focus question:
    How does shelter design fulfill physical, social and economic needs?

Colony Structures Worksheet

Colony Structures Worksheet: Group _____

Colony Structure	What need does this structure address? (physical, survival, social, economic, transportation, etc.)	Comments
Example: Greenhouse	*Physical survival*	*Plants will be grown in the greenhouse to provide both food and oxygen for the colonists.*

Colony Structures Worksheet

Colony Structure	What need does this structure address? (physical, survival, social, economic, transportation, etc.)	Comments

Model Revision Worksheet

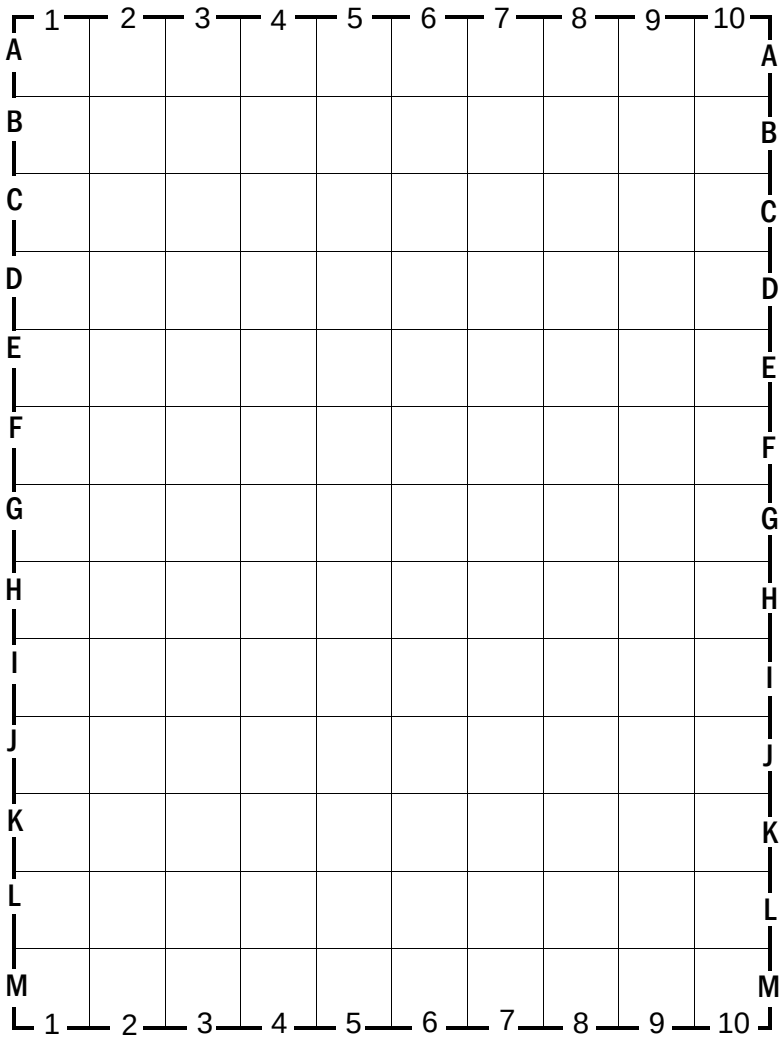
Things we like about our first model	Things we would like to change or add

Name _____

Date _____

MAP GRID

Title _____



KEY

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Playdough

Best Playdough
(I usually triple or quadruple this recipe and cook it in a large deep frying pan)

Directions:

Combine in saucepan:

- 1 cup flour
- 1 1/4 cup salt
- 1 tsp. cream of tartar

Add and whisk until smooth:

- 1 cup water
- 1 Tbsp. oil
- Food coloring (Cake decorators paste or liquid makes great colors)

Cook over medium heat until playdough is nearly set.

- Add:
  1 1/2 Tbsp. imitation vanilla extract.

Stir until vanilla is blended, then remove and knead when cool. Store in Ziploc bag or airtight container.

Note: This is the best playdough recipe I have ever found. The vanilla extract seems to improve the texture and adds a nice scent as well.

Matrix Recipe

Ingredients

- 1 box-cornstarch
- 3 ½ cups of water
- 1 saucepan
- Food coloring (red or grey)
- Ziplock bag

MAKE CORNSTARCH MATRIX

A matrix can be used to hold the sand together and form a dough from which Moon or Mars terrain can be shaped. Make this matrix *the day before* you use it. The following recipe makes enough for 24 students.

Directions:

1. Stir constantly while adding one box of cornstarch gradually to 3.5 cups of cold water in a saucepan.
2. Heat the mixture over medium heat, *continuing to stir.* Keep stirring until about half the matrix has thickened to the consistency of soft mashed potatoes. The rest will be soupy. This should take about 5–10 minutes.
3. Remove the matrix from the heat, and stir it until it is consistent and cool. It may get bag, or jar.
4. If the mixture as thick as pudding. Store it in a covered container, zip
5. gets too thick to pour, stir in a little water to thin it.
6. Keep the matrix refrigerated; it will keep for up to a week.

Travelers & Talkers Protocol

Overview:

This is an activity that can be used to share progress. Participants may be given time at the event to prepare a display to highlight their progress or they may be given instructions in advance to bring a display to the event. Mixed groups then circulate around the room, with a set amount of time at each display. One member of the group who created the display (The "Talker") stays at the display and talks about the information on the display with the visiting participants (The "Travelers"). The "Travelers" ask questions, and record new ideas gained.

Outcomes:
Participants will engage in and learn a tool for sharing progress, and promoting discussion of key topics.

Materials:
Chart Paper
Markers

Steps:

Part 1 - Preparing for Sharing (15 minutes)
You will have 15 minutes to work as a group to:

- Review your Talking Points related to the topic(s) being shared
- Prepare your display (3D Model)
- Select a member of the team to be the "Talker" who will share the information on the display with the "Travelers" from other teams

Part 2 - Travelers & Talkers Protocol (20 minutes)

- "Talkers" stay at the display created by their team
- "Travelers" move clock-wise or counter clock-wise as a team
- "Talkers" spend 3 minutes sharing information from the display
- "Travelers" 2 minutes for questions/suggestions (“Travelers” can write suggestions/questions on post-its.
- Either "Travelers" or "Talkers" can add post-its to the display

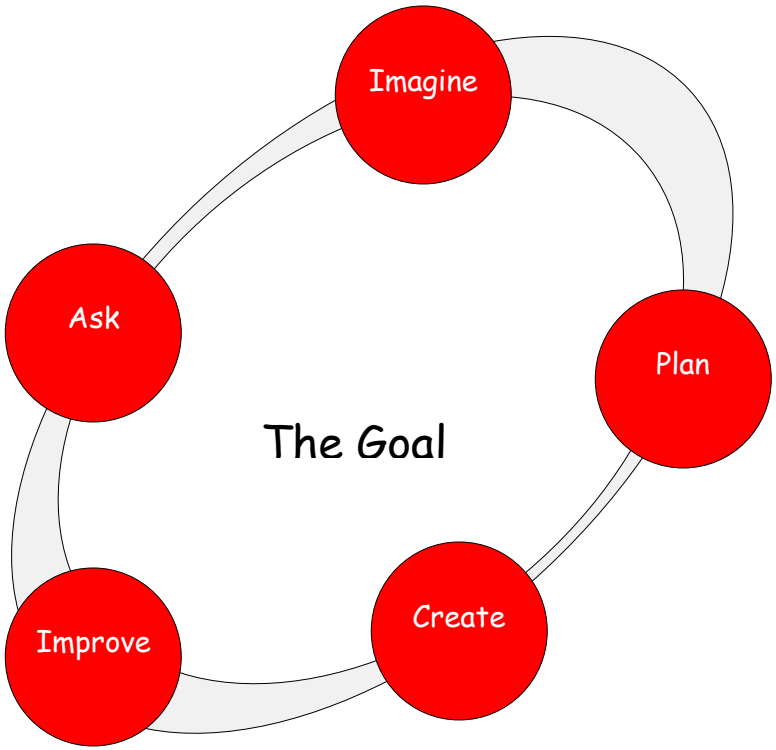
Part 3 - Team Time (15 minutes)

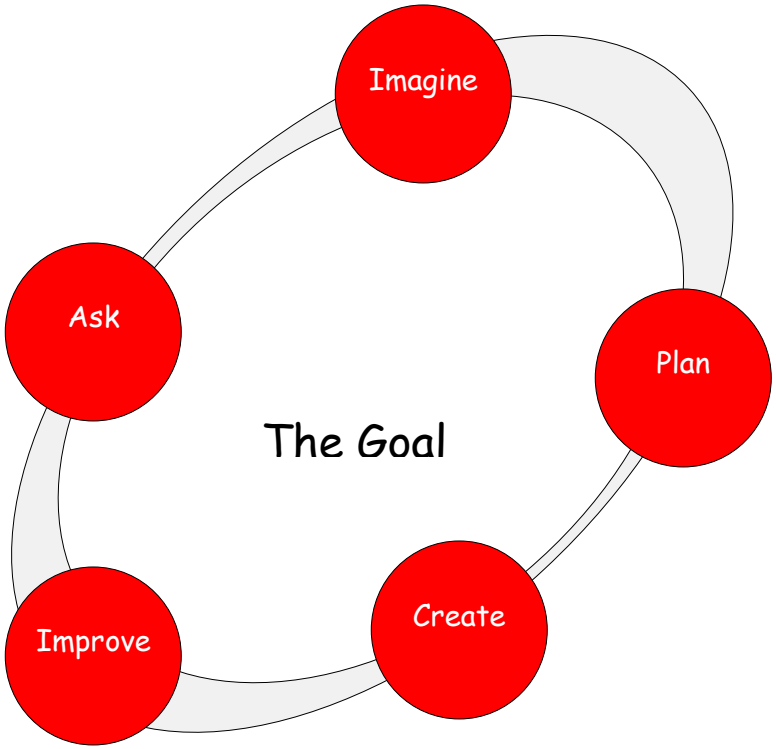
- Review suggestions

(At this point time can be allotted for talkers to get together as a group to discuss their progress.)

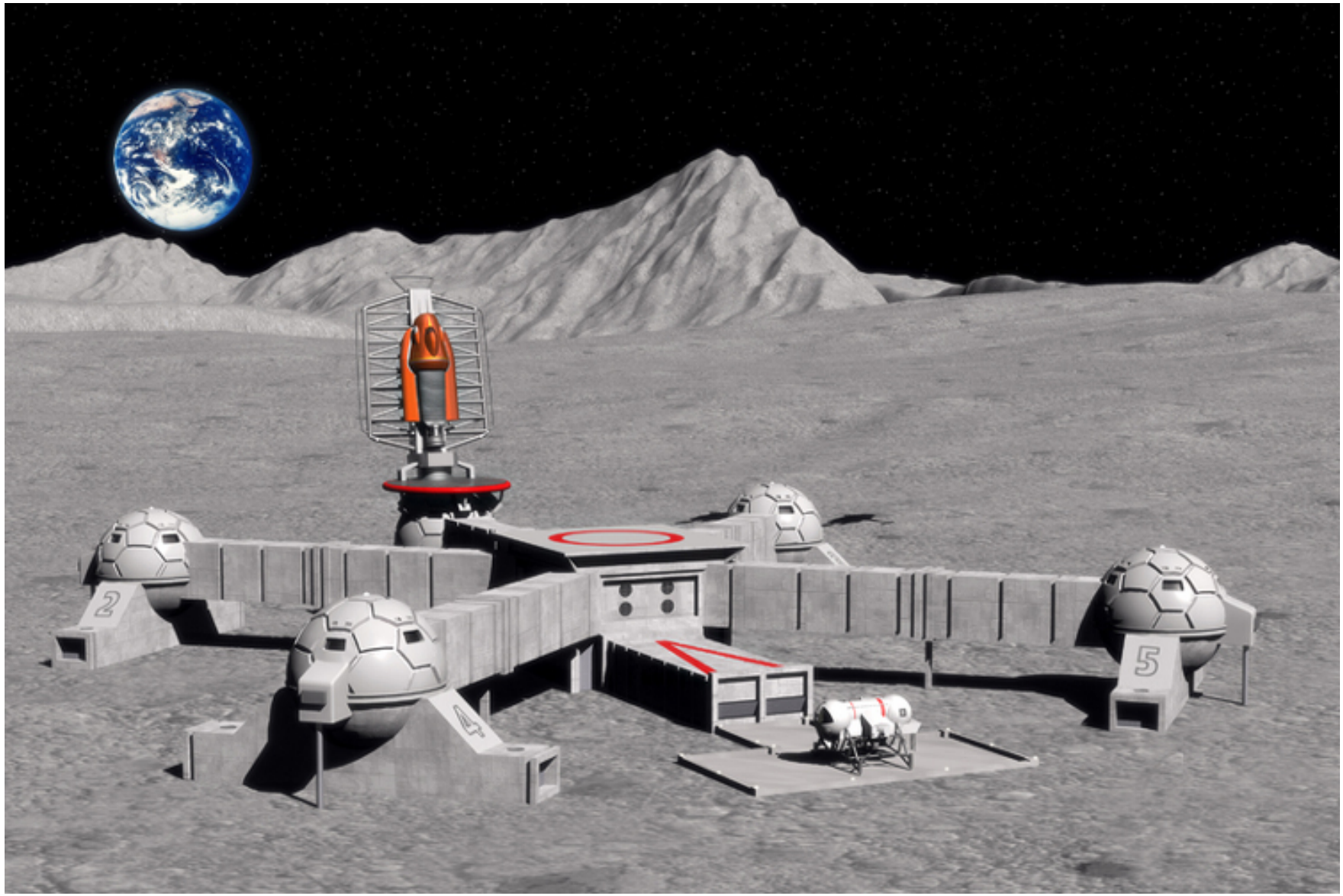
The Engineering Design Process

The Engineering Design Process

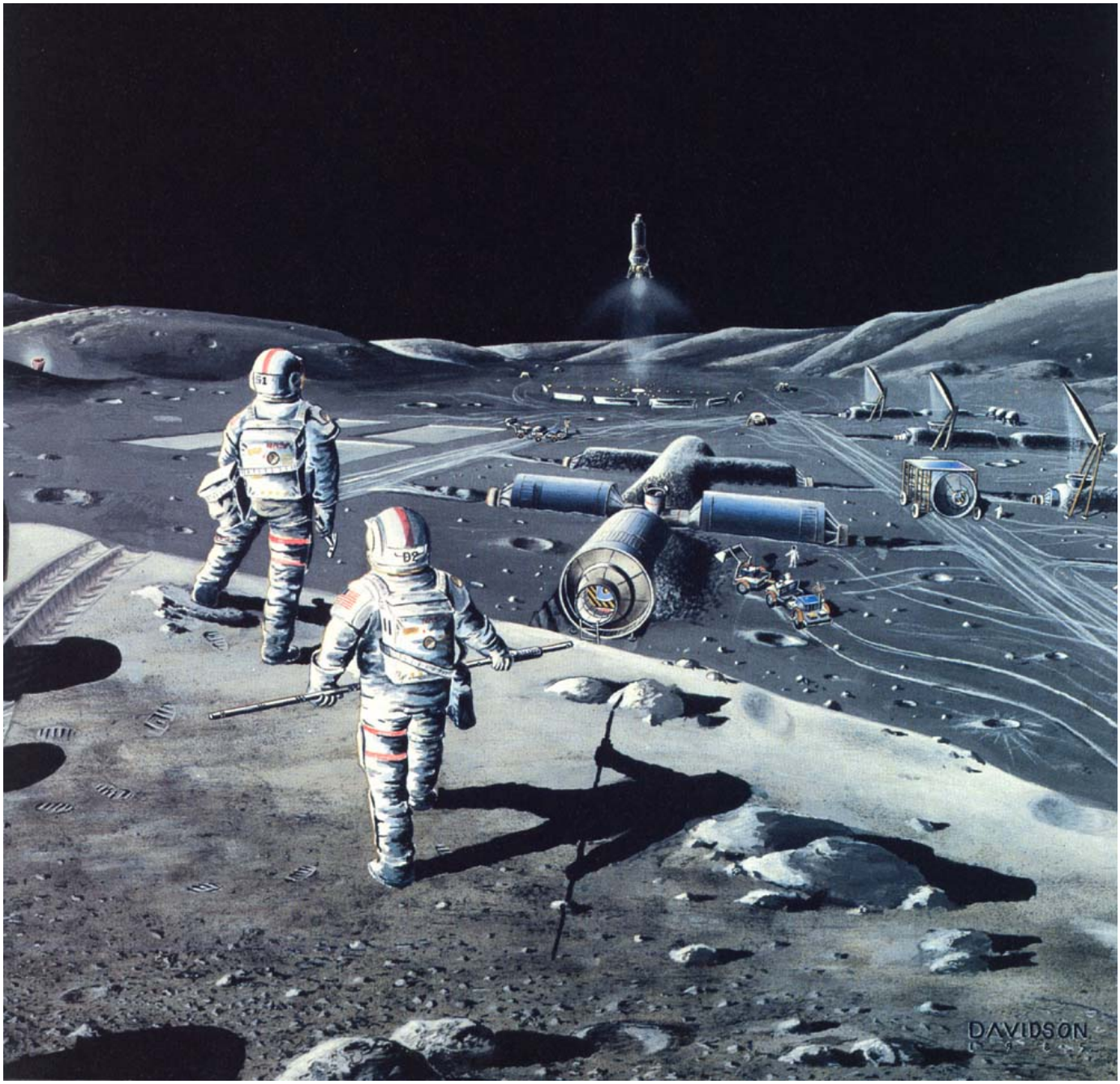




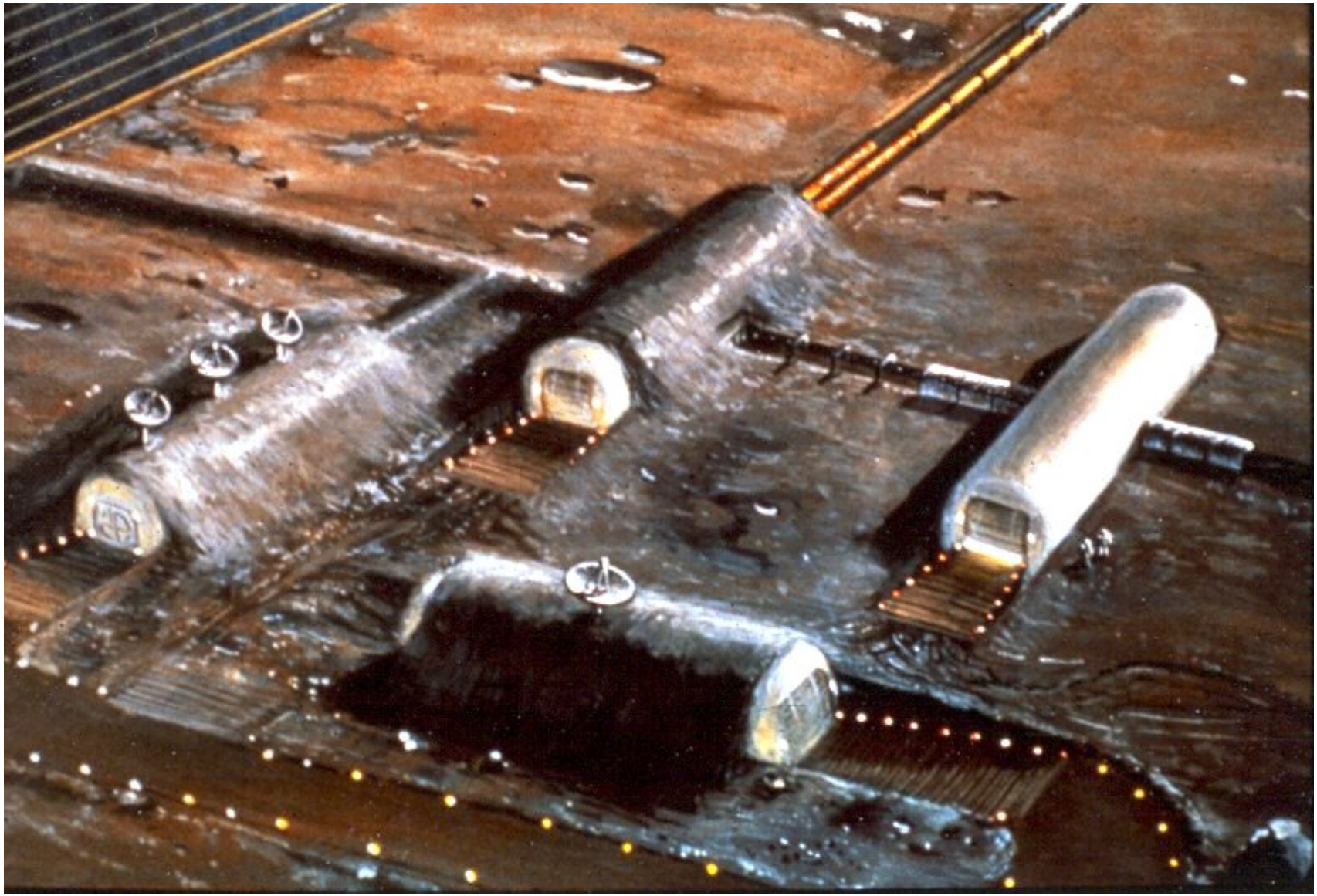
Space Colony Structure A



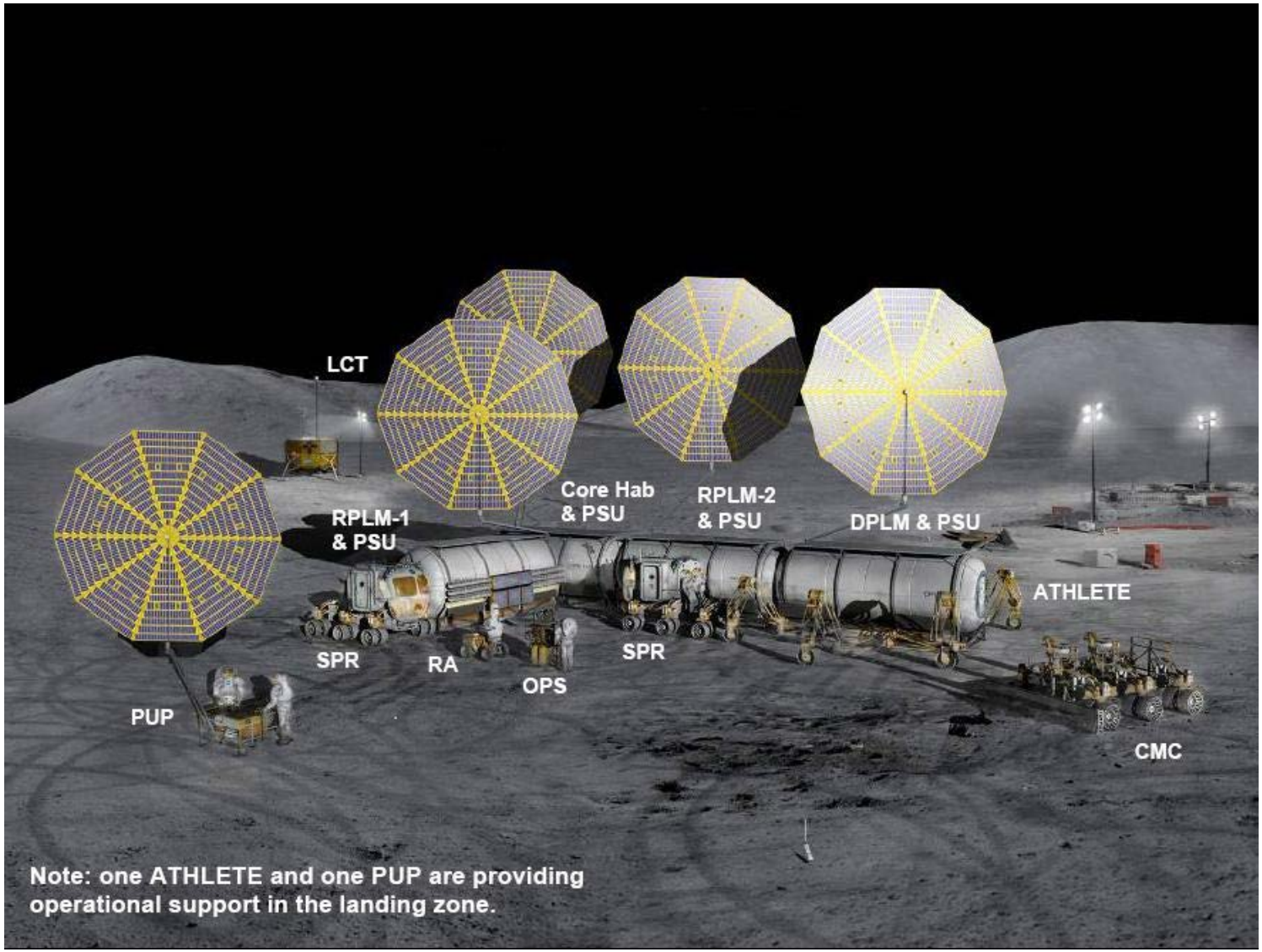
Space Colony Structure B



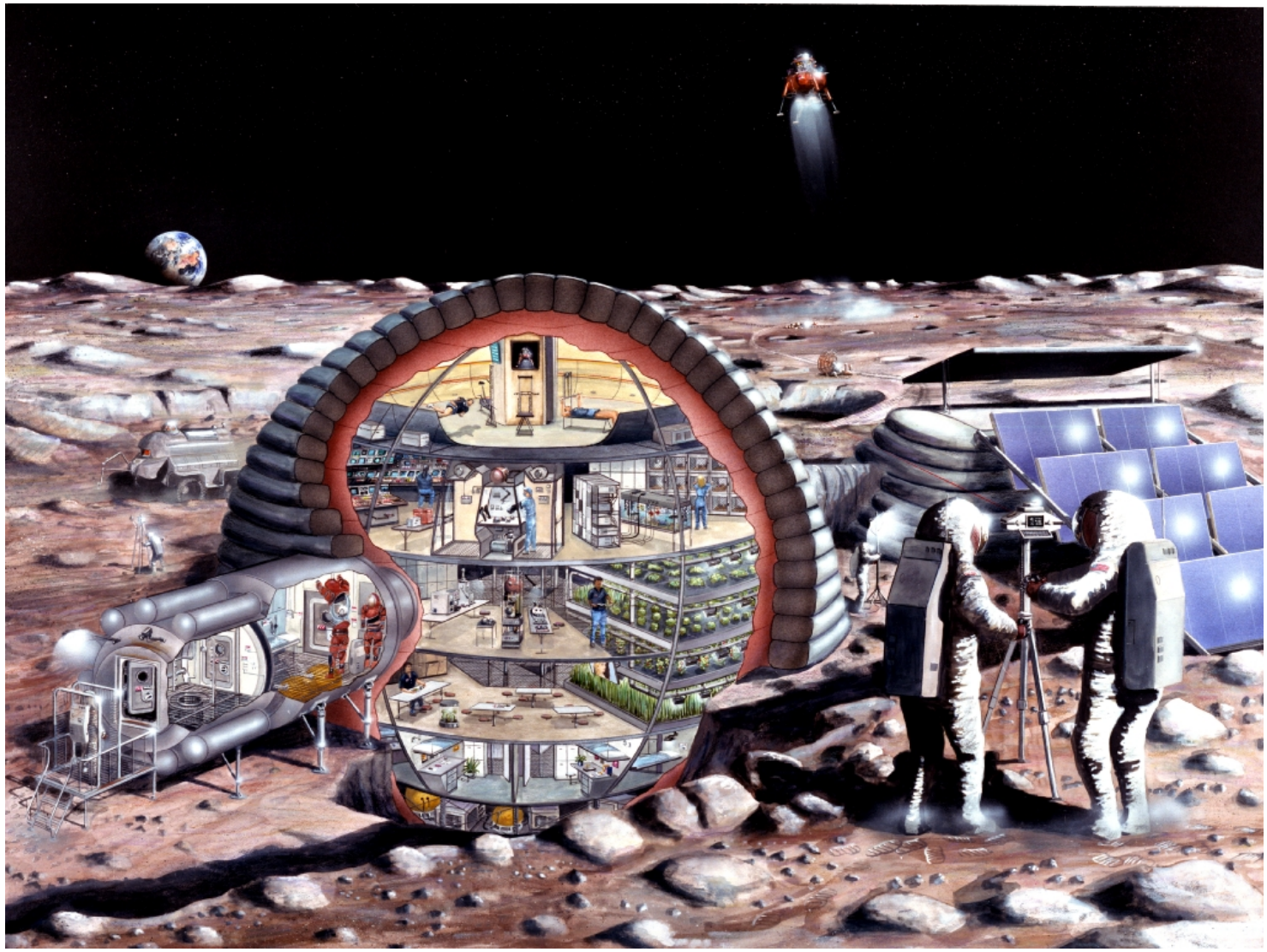
Space Colony Structure C



Space Colony Structure D

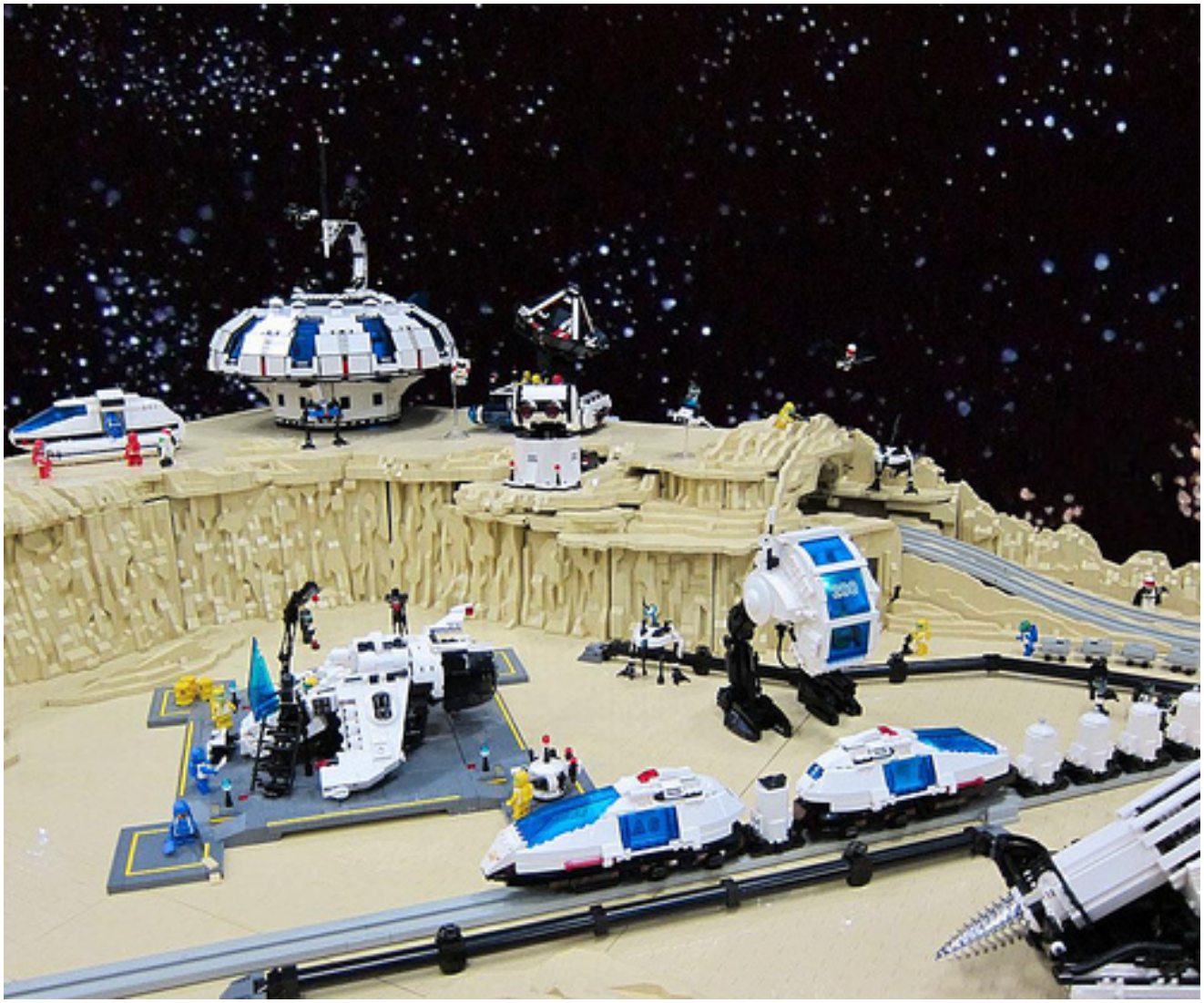


Space Colony Structure E



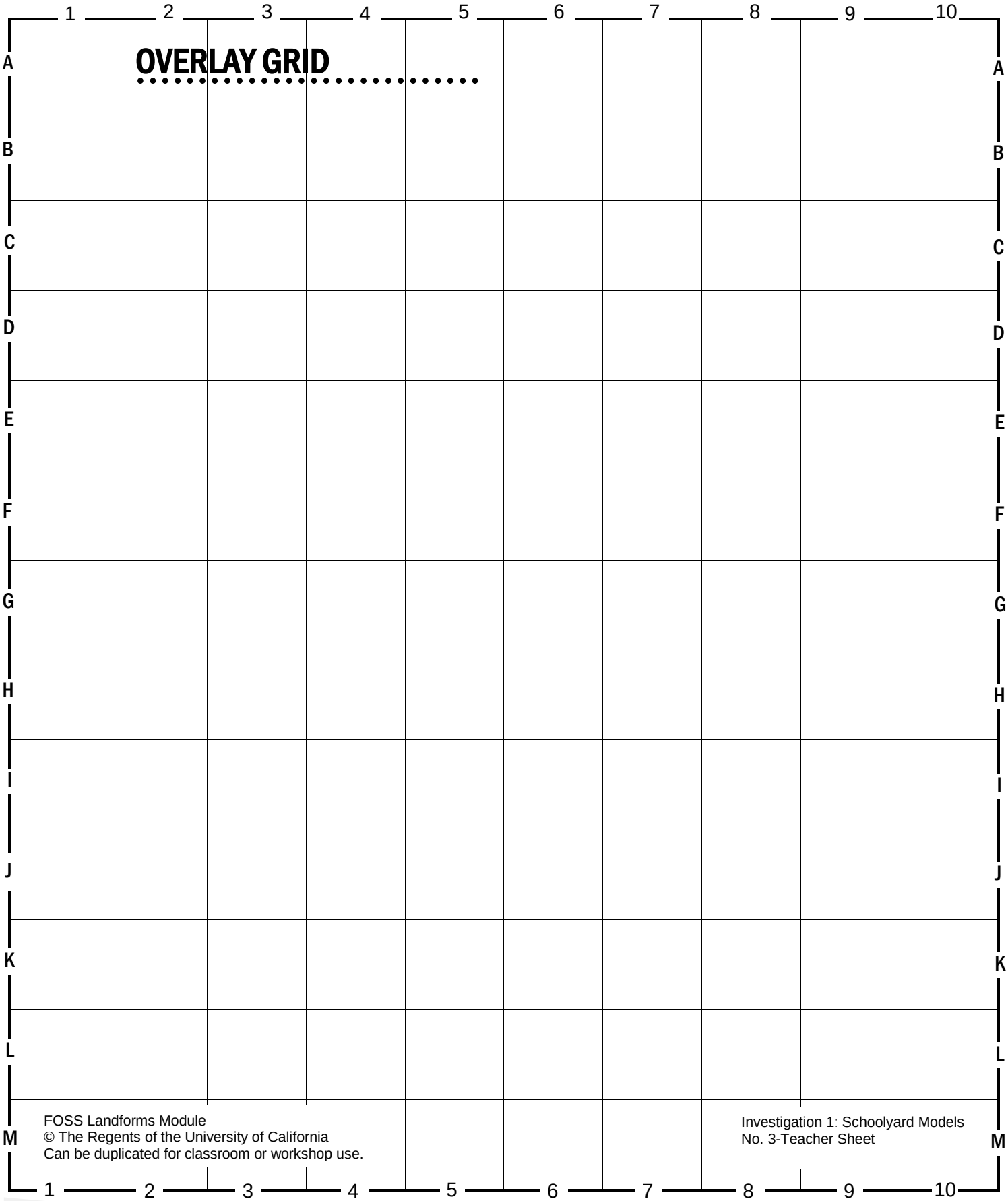
Space Colony Structure F

Space Colony Structure G



Space Colony Structure H

Space Colony Structure I



FOSS Landforms Module
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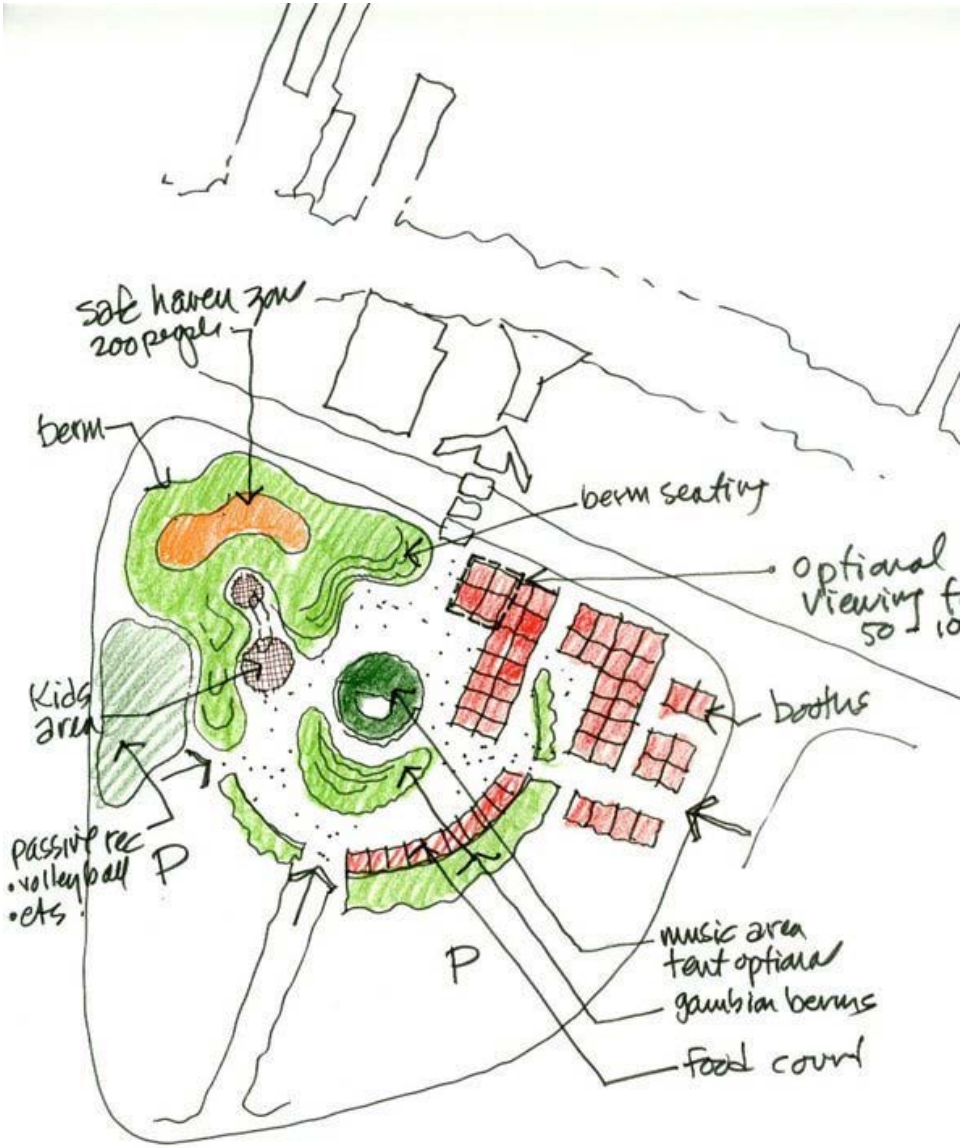
How Does Your Shelter Fulfill Your Social, Physical, and Economic Needs?

Procedure



- Begin planning out your colony by making a sketch that includes the information you wrote on the Colony Structures Worksheet
- Be sure to include areas for:
  - Work
  - Living
  - social
  - economic needs etc.

Procedure

- With your group decide:
  - What type of terrain will you create (think about what the terrain is like on the Moon or Mars)
  - What structures will you need in your model

<u>*A limitation to your project will be the height of your model: It cannot rise above the rim of the stream table.**</u>

Procedure

- Cover the area with newspaper where you will be working
- Next, collect the materials your teacher has provided to begin building a model of your colony based on your team's plan

Materials per team:

- Newspaper to keep area clean
- 1 Green tray
- Sand/clay mixture
- Cubes (Rainbow, Unifix cub
  etc...)
- Craft sticks
- Wooden angle
- Playdough or Matrix

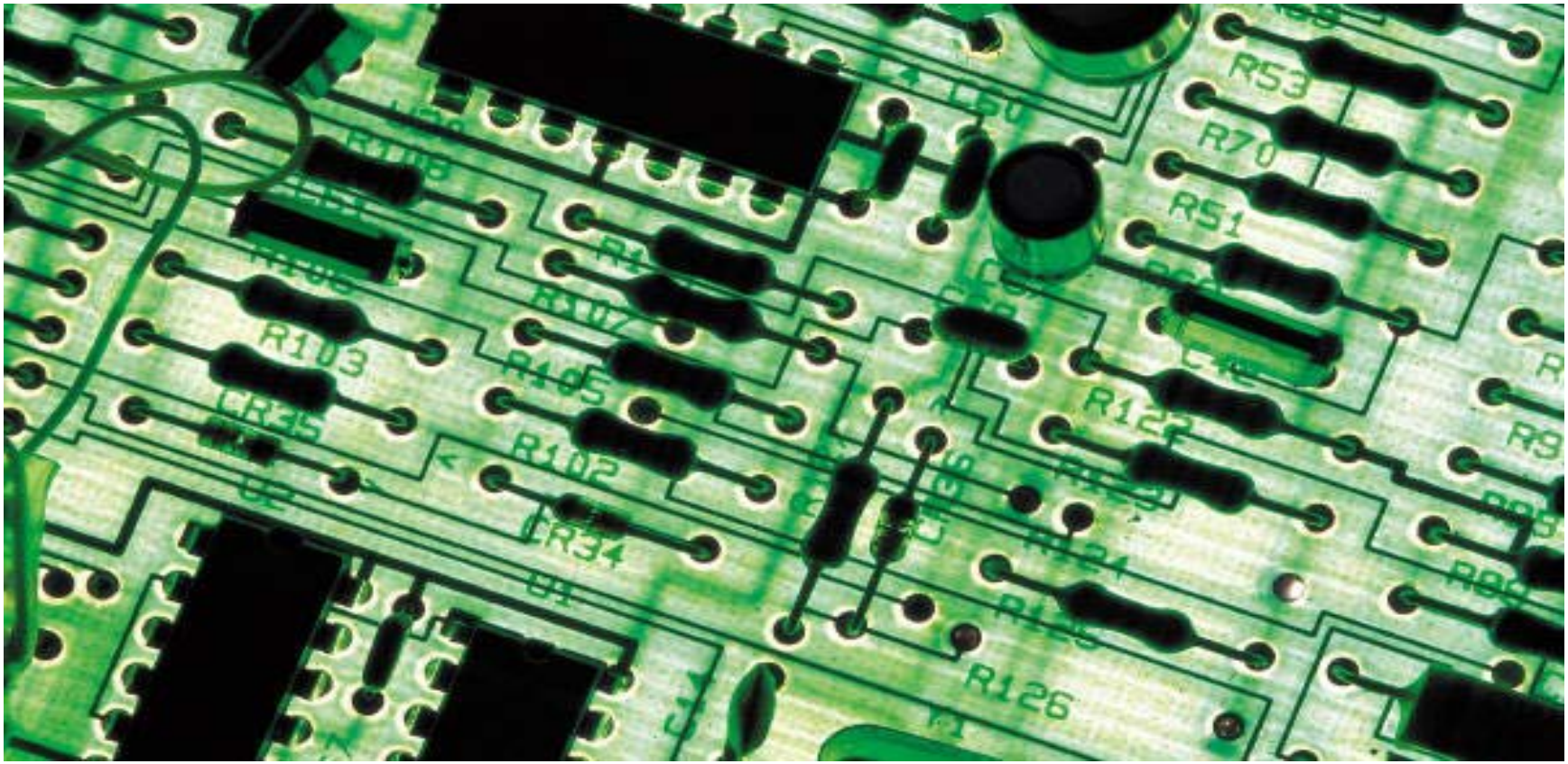
Procedure

- Begin building a model of your colony based on your team's plan using only the materials your teacher has provided

Moving From 3D to 2D

- Tape three plastic grids over the top of your model
- Use an erasable marker to outline a top view of your model onto the grid

Transfer the information to the "Reduced Scale Map Grid" student handout and include a legend



Revising

- Introduction of new ideas
  - Connections to Artwork
  - Travellers and Talkers

Evaluation/Reflection

- Complete the “Model Revision Chart”
  - Take a look at other groups models, auxiliary resources, and informational text
  - Decide with your team if you will make any modifications to your model.

Austin's Butterfly

- Collaboration
- Evaluation
- Revision
- Austin's Butterfly
- http://www.youtube.com/watch?feature=player_detailpage&v=hqh1MRWZjms