OBJECTIVE
Develop a concept for the initial human habitation of Mars.
- Identify all functions required, and in what sequence.
- Carefully plan the small “village.”
- Lay out the sequence of deployment, over several years.
- Design selected module(s); one or more [e.g. habitat, laboratory, rovers, etc]
- Design selected utilities and subsystems [e.g., power, water, wastewater, environmental control, recreation, health, safety].
- Develop a program plan, including a detailed budget and schedule.
- Provide a physical model of your village.

The task should include a pictorial layout of the entire Mars village which satisfies the above requirements. Commercially available software (such as Moonbase or gaming software) can be used to simplify the task, determine locations of various modules, and route the utilities. It will then be left to the team’s discretion to select one or more modules for more detailed analysis and design. Study products should include a model of the Mars village, as well as the required periodic and final reports on the project. The task should include a physical model of the modules designed, (e.g., 3D printed).

BACKGROUND
Long range NASA plans call for the human exploration of the planet Mars. Mars must be made the second safest place in the solar system for humans to live. All facilities for safe, healthy, human habitation must be pre-deployed prior to the commitment of humans to a Mars mission. A mission must be designed which is capable of being deployed with existing US launch systems, specifically the Delta IV Heavy, SLS launch, Space X Falcon 9 Heavy, and BFR vehicles.

SPECIFICATIONS
- Autonomous deployment and self-checkout on Mars, with potential intervention from Earth after time delay of at least 1/2 hour.
- All facilities for safe and healthy human habitation for up to 1000 days (plus deployment time) will be provided. These include:
  - Food and water [Food carried from Earth, water in-situ from Mars underground sources or carried from Earth].
  - Power [small nuclear reactor will be the primary source].
  - Safety from solar events and cosmic radiation.
  - Rovers for EVA exploration [pressurized]. (These will be provided, and are not included in your task.)
  - Health maintenance, exercise and recreation. Competitive games to be considered.
  - Repair and routine servicing of Space Suits and Rovers, with spare parts.
  - Medical and hospital facility; provisions for major surgery.
  - Sleep and privacy: separate crew compartments with personal provisions, including work stations and communications to Earth.
  - Hygiene: toilets [non-polluting], showers, washing facilities.
  - Laundry for clothing.
- Other facilities identified in the course of the study as essential to human survival, health, safety, and return to Earth.
A deployment process and sequence will be developed which considers the shelf-lives of all deployed items, and provides for robotic joining of all facilities prior to human arrival.

- Mass properties, volumes, power profiles, launch packaging are required.
- Detailed schedules, deployment sequences and cost estimates (required).
- Deployment of the initial “village” will take place over several Mars “opportunities,” spaced 26 months apart.
- Use of derivatives of existing launch vehicles [e.g.: Delta IV Heavy, SLS, Space X Falcon 9 Heavy and BFR] is encouraged.

**DESIGN TEAM PROFILE**

<table>
<thead>
<tr>
<th>NASA MENTOR:</th>
<th>Hum Mandell</th>
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<tbody>
<tr>
<td><strong>LEVEL:</strong></td>
<td>Undergrad students of any level [FR, SO, JR, SR]; or mixture of undergrad/graduate students</td>
</tr>
<tr>
<td><strong>MAJOR / DISCIPLINES:</strong></td>
<td>Open to all majors / disciplines. Recommend the inclusion of a team member majoring in aerospace engineering, electrical engineering, software engineering, and/or mechanical engineering/mechanisms.</td>
</tr>
<tr>
<td><strong>TEAMS:</strong></td>
<td>Mentor may accept more than one team for this project.</td>
</tr>
<tr>
<td><strong>DURATION:</strong></td>
<td>One or Two-Semester Project</td>
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<tr>
<td><strong>PARTNERS:</strong></td>
<td>Partnerships with private industry are encouraged [e.g.: for rover or module design].</td>
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</tbody>
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