Lunar Habitat Programme

Maurits Roijen | AR4ETA010 | 28/11/2025

WEEK 3

Extra-/Terrestrial Architecture Graduation Studio

Personnel Size

ARTEMIS III MISSION

CREW SIZE	MISSION DURATION	LAUNCH
4	**~30 Days**	**MID-2027**

https://www.nasa.gov/mission/artemis-iii/

Examples Last Year

Program: minimum size

Room	m3 (1 person)	%	Same time use	Multiply factor	m3 (6 persons)	%
Private crew quarters	2,5	3%	Yes - but separate	x 6	15	3,5%
Living quarters	13,5	15%	Yes	x 6	81	19,5%
Kitchen	2,5	3 %	Not all	x 2	5	1%
Research facility	11	13%	Yes	x 6	66	16%
Garden	13,5	15%	Yes	x 6	81	19,5%
Gym	8	9%	Not all	x 3	24	5,5%
Bathroom	5	6%	Not all	x 2	10	2,5%
Medical facility	8	9%	Not all	x 2	16	4%
EVA antechamber	8	9%	Not all	x 3	24	5,5%
Storage general	8	9%	Yes	x 6	48	11,5%
Subtotal:	**80**	**91%**			**370**	**88,5%**
Meditation space	8	9%	Yes	x 6	48	11,5%
Total:	**88**	**100%**			**418**	**100%**

Example by **Sophia Benfield**

Examples Last Year

Design Programs

program requirements

(Min. 80m3 per person)

1. Public open spaces
Atrium/ playground
Vertical garden/ food gallery
Kitchen & dining
Semi-outdoor space

2. Circulation
Climbing walls for encouraged main Circulation

PROGRAM	MIN. VOLUME PER PERSON (M3)	%	MIN. HEIGHT (M)	MAX. CAPACITY	CONNECTION ORIENTATION
PRIVATE QUARTERS (BED)	6	4 %	1.5	1 (EACH)	HORIZONTAL
PRIVATE QUARTERS (STUDY)	25	17 %	4.5	3 (EACH)	VERTICAL
PRIVATE QUARTERS (HYGIENE)	4	3 %	3	1 (EACH)	-
KITCHEN & DINING	15	10 %	4.5	3	HORIZONTAL
GYM	10	7 %	4.5	3	HORIZONTAL
WORK FACILITIES	20	14 %	6	6	VERTICAL
MINIMUM HABITABLE	80				
PLAYGROUND	30	21 %	10	>6	VERTICAL
FOOD GALLERY	20	14 %	10	>6	VERTICAL
CLINIC	4	3 %	4.5	3	HORIZONTAL
STORAGE	5	3 %	3	-	HORIZONTAL
SERVICE	5	3 %	3	-	-
TOTAL	144	100 %			

3. Specific working spaces
Research lab
Desk stations
Control centre
Clinic
Gym

4. Personal solitude spaces
Bedroom
Study
Hygiene

5. Service spaces
Life support storage
Airlock chambers
Donning & doffing area
Storage

miro

Derived From: NASA & Space Architecture Education for Engineers and Architects (Book)

Example by **Jonathan Jonathan**

Examples Last Year

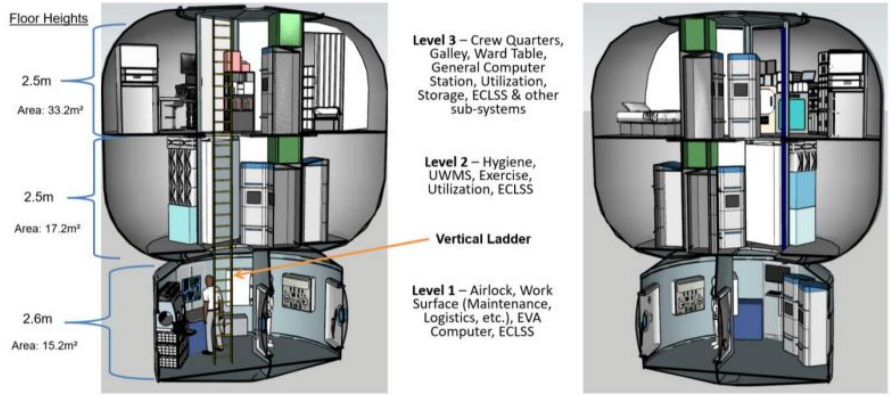
Baseline program requirements

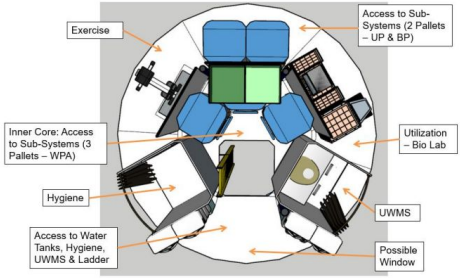
	Rooms	Size					Activity			Privacy			Movement		Protection			
		Vol for 1 (m3)	Factor	Vol for 6 (m3)	% vol	%	Category	Cross-function	Detail	Personnel	Visibility	Audio	Speed	Arrangement	Duration	Garment	View outside	Access outside
PQ	Private Quarter 1 (Single)	15.0	4	60.0	6.99%		Personal	Work	Sleep, work, personal leisure	Individual/Couple	Enclosed	Soundproof	Slow	Flexible	>8 h	Clothed	Optional	No
	Private Quarter 2 (Couple)	22.5	1	22.5	2.62%	12.52%	Personal	Work	Sleep, work, personal leisure	Individual/Couple	Enclosed	Soundproof	Slow	Flexible	>8 h	Clothed	Optional	No
Bath	Bathroom	5.0	5	25.0	2.91%		Personal		Hygiene	Individual/Couple	Enclosed	Soundproof	Slow	Fixed	< 1 h	Naked	Optional	No
Collab	Collab room	2.5	3	7.5	0.87%	0.87%	Social	Work		Small groups (2-3)	Enclosed	Soundproof	Moderate	Semi-flex	1-8 h	Clothed	Optional	No
Kitchen	Kitchen	10.0	2	20.0	2.33%	2.33%	Social	Personal	Food prep, communal	Small groups (2-3)	Open	Neutral	Fast	Semi-flex	1-8 h	Clothed	Optional	No
Living Room	Dining table	5.0	6	30.0	3.49%		Social	Work	Communal, team meeting, game night	Large groups (4-6)	Open	Neutral	Moderate	Flexible	1-8 h	Clothed	Optional	No
	Exercise area (3 equipments)	8.0	3	24.0	2.80%	10.66%	Social	Personal	Combined with adjacent 26.8 m3	Small groups (2-3)	Open	Neutral	Moderate	Flexible	1-8 h	Clothed	Optional	No
	Open area (misc)	5.0	6	30.0	3.49%		Social	Work	Communal, informal meeting, Group exercise min. 11.8 m3	Large groups (4-6)	Open	Neutral	Moderate	Flexible	1-8 h	Clothed	Optional	No
	Observation	2.5	3	7.5	0.87%		Social	Personal	can be integrated in other functions	Small groups (2-3)	Optional	Neutral	Moderate	Fixed	1-8 h	Clothed	Essential	No
Green-house	Greenhouse 1 (food lab)	7.0	6	42.0	4.89%	48.57%	Support	Social	Each person oxygen 20m2 vegetation/year; crops 67m2	Large groups (4-6)	Optional	Neutral	Moderate	Fixed	1-8 h	Clothed	No	No
	Greenhouse 2 (oxygen)	62.5	6	375.0	43.68%		Support	Social	Remaining area to achieve 50% area of the habitat for vegetation	Large groups (4-6)	Open	Echo	Slow	Semi-flex	1-8 h	Clothed	Essential	No
EVA	Airlock (EVA prep)	10.0	3	30.0	3.49%	3.49%	Work			Small groups (2-3)	Enclosed	Neutral	Fast	Fixed	1-8 h	Suited	Essential	Yes
Medical	Medical bay	10.0	2	20.0	2.33%	2.33%	Work		1 bed + minimum storage	Small groups (2-3)	Enclosed	Neutral	Moderate	Flexible	1-8 h	Clothed	Optional	No
Lab & Research	Lab	12.5	6	75.0	8.74%		Work		Geology & biology lab	Large groups (4-6)	Enclosed	Neutral	Moderate	Flexible	1-8 h	Clothed	Optional	No
	Open workstation	5.0	3	15.0	1.75%	12.23%	Work	Social	6 desks open plan	Large groups (4-6)	Optional	Neutral	Moderate	Semi-flex	1-8 h	Clothed	Optional	No
	Focus workstation	5.0	3	15.0	1.75%		Work	Personal	Monitoring, call to Earth, command control	Small groups (2-3)	Enclosed	Neutral	Fast	Flexible	1-8 h	Clothed	Optional	No
Storage	Personal storage	2.0	6	12.0	1.40%	1.40%	Support			Storage	Enclosed	Neutral	Fast	Semi-flex	< 1 h	Clothed	No	No
	Food storage area	2.0	6	12.0	1.40%	1.40%	Support		Service	Storage	Enclosed	Neutral	Fast	Semi-flex	< 1 h	Clothed	No	No
	Lab storage	2.0	6	12.0	1.40%	1.40%	Support			Storage	Enclosed	Neutral	Fast	Semi-flex	< 1 h	Clothed	No	No
Service	Maintenance	8.0	1	8.0	0.93%		Support		System maintenance	Storage	Enclosed	Neutral	Fast	Fixed	1-8 h	Clothed	Optional	No
	ECLSS	8.0	1	8.0	0.93%	2.80%	Support			Storage	Enclosed	Neutral	Fast	Fixed	< 1 h	Clothed	No	No
	Waste management	8.0	1	8.0	0.93%		Support			Storage	Enclosed	Neutral	Fast	Fixed	< 1 h	Clothed	No	No
	Outside						Work			Large groups (4-6)	Open	Neutral	Fast	Flexible	1-8 h	Suited	Essential	Yes
	TOTAL			858.5	100.00%													
	Total green			417.0	48.57%													
	Total non-green			441.5														
	NHV per person	171.00																

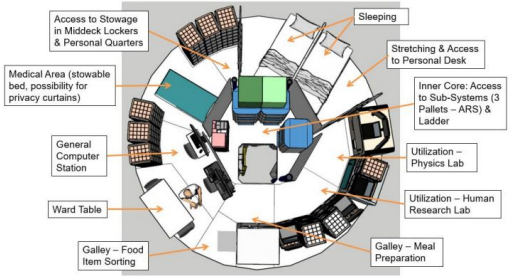
Example by **Regina Regina Tania Tan**

Artemis Surface Habitat Concept

Combined Functional Space	Recommended Min. Area (m²)	Area in Layout (m²)
Stretching	1.40	2.68 (1.34/crewmember)
Sleeping	1.82	3.70 (1.85/crewmember)
Medical	1.87	3.43
Exercise	1.5	2.09
UWMS	0.91	1.04
Hygiene	1.06	1.04
Ward Table	1.62	2.23
Work Surface	1.37	1.30
EVA Computer Station	----	0.97
General Computer Station	1.82	2.10
Galley – Work Surface	0.56	0.95
Galley – Meal Prep	0.56	1.17
Utilization	----	5.07
Translation Paths, Ladder Access & Airlock/Suitport Access	-----	8.65
Systems & Storage Access	-----	5.79
Total	14.6	42.63
Total per Crewmember	7.3	21.31
Airlock	5.00	5.18







https://ntrs.nasa.gov/api/citations/20220013669/downloads/Internal%20Layout%20of%20a%20Lunar%20Surface%20Habitat.pdf

Main Rooms

- Private quarters
  - Sleeping area
- Living quarters
  - Kitchen
  - Living/dining room
  - Social area
- Working quarters
  - Command and control
  - Research Labs
    - Geology/sample analysis
    - Life science and plant growth
    - Human health lab → combine with infirmary?
- Gym
- Bathrooms
- Medical Facility
- Antechamber for EVA's
- Storage
- System maintenance

Table with requirements

TYPOLOGY		SIZE						ACTIVITY			PRIVACY			EXTERIOR	
PROGRAMME	ROOM	MAX. CAPACITY	MIN. AREA PER PERSON (m2)	FACTOR	AREA FOR 6 (m2)	% OF HABITAT	MIN. HEIGHT (m)	CATEGORY	CROSS-FUNCTION	Details	CAPACITY	VISIBILITY	ACOUSTICS	ACCESS	VIEW
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					
X	X	X	X	X	X	X	X	/	/	x					

- Based on factors I found relevant from previous examples.
- Helps find relation to each other, the exterior and their respective proportions.

Clustering of Rooms

BASED ON FUNCTION & INTERACTION

‘Dirty’Zone
(Airlock & Maintenance)

Core Utility Zone
(Life support)

Personal/Quiet Zone
(Privacy & Rest)

Social Zone
(Shared Activities)

Work Zone
(Research & Command)

Clustering of Rooms

‘Dirty’Zone
(Airlock & Maintenance)

Rooms near the entrance that have more interaction with the exterior and **lunar dust contamination.**

- Antechamber for EVAs
- Geology/Sample Analysis as it interacts with lunar dust
- Storage (Logistics/Spares)
- Lunar soil plants?

Clustering of Rooms

Core Utility Zone
(Life support)

Critical systems that serve the entire habitat. The core of important stuff like food, water and oxygen.

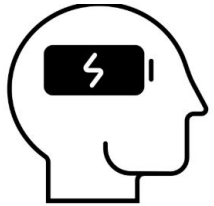
- Life Support Systems
- Storage of consumables like food and water
- Bathrooms (toilets and showers) that require recycling systems
- System Maintenance

Clustering of Rooms

Personal/Quiet Zone
(Privacy & Rest)

Zones that require more silence. Places that are more isolated from loud and high traffic areas to provide privacy, rest and recovery

- Private quarters
- Meditation or green area for mental health?
- Health lab/medical facility that requires more silence



Clustering of Rooms

Social Zone
(Shared Activities)

Louder social zone. Places that are more noisy and foster interaction between astronauts. This area helps build relationships and foster social interaction.

- Kitchen
- Dining area
- Living room
- Social space
- Gym

Clustering of Rooms

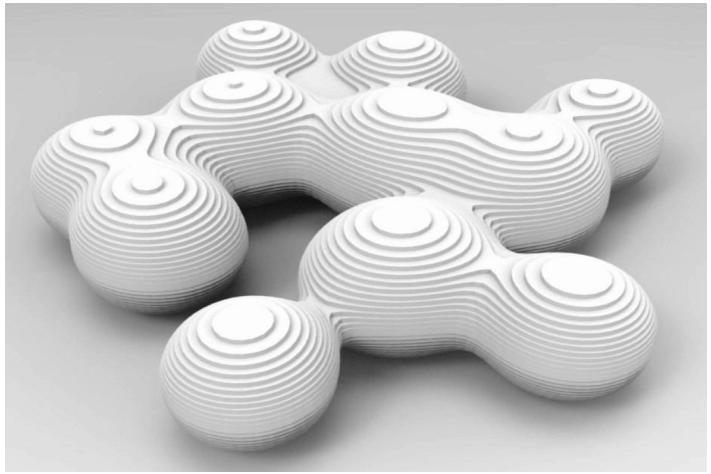
Work Zone
(Research & Command)

High intensity productive zones for research, command and communication.

- Research Labs
- Command and control
- Radio room
- Agricultural lab

Meta Balls

- Structural and pressure efficiency
- Takes advantage of 3D printing
- Shape works with extra mass for shielding
- Modular and scalable blobs for future additions
- Biophilic design
- Clustering of rooms
- Possibility of airlocks between zones



Summary

- 4 people team? Scale up to more?
- Wide variety or functions
- Cluster rooms based on functionality, utility and interactions
- Metaballs works with the separation of zones

‘Dirty’Zone
(Airlock & Maintenance)

Core Utility Zone
(Life support)

Personal/Quiet Zone
(Privacy & Rest)

Social Zone
(Shared Activities)

Work Zone
(Research & Command)