SPACE SCIENCE KIT

Space Station — Lesson 07

Enhanced Lesson Plan | Grades 6–8 | Science, Technology, Engineering

LESSON OVERVIEW

Lesson Title	Design, Build & Program: Space Station Operations Simulation
Subject Area	Science, Technology, Engineering (STEM)
Grade Level	Grades 6–8 (Adaptable for 5 and 9)
Duration	3 Class Periods × 45 Minutes (135 minutes total)
Key Themes	Space Station Design, Life Support Systems, Solar Power, Orbital Operations, Automated Station Management
Framework	5E Instructional Model (Engage, Explore, Explain, Elaborate, Evaluate)
Series Context	Lesson 07 opens a new arc: from the Moon missions of Lessons 01–06, students now shift their focus to permanent human presence in orbit

LESSON CONTEXT

What makes Lesson 07 a new chapter in the series?

- Lessons 01–06 simulated a complete lunar mission arc. Lesson 07 opens a new engineering challenge: designing and operating a structure that must function continuously in the harsh environment of low Earth orbit.
- The Space Station is not a vehicle — it is a permanent habitat and research platform. This shifts the engineering focus from propulsion and navigation to life support, power generation, structural modular design, and automated systems management.
- The programming challenge is new: instead of a timed sequence, students write event-driven and looping programs that simulate continuous station operations — solar panel rotation tracking sunlight, proximity sensor triggering docking alerts, and automated environmental monitoring.
- Students encounter a new concept: redundancy — real space stations have backup systems for every critical function. Students are challenged to build and program this principle into their model.

SMART LEARNING OBJECTIVES

By the end of this lesson, students will be able to:

#	Objective	Domain
1	Design and build a structurally modular space station model using building blocks that incorporates at least four distinct systems: solar panels, a living/lab module, a docking port, and a motor-driven rotating mechanism (simulating solar panel tracking).	Design / Engineering
2	Write and upload a MakeCode program that simulates at least two continuous station operations: (1) a rotating solar panel motor that tracks a simulated light source, and (2) a Sonar:bit-triggered docking alert that displays a status code on the LED when a spacecraft approaches within a defined distance.	Programming / Technology
3	Explain the key systems of a real space station (power, life support, structure, communications, docking), describe the challenges of maintaining a station in orbit, and connect at least two physics or engineering principles (microgravity effects, solar power generation, orbital mechanics) to their model design.	Science / Knowledge
4	Collaborate effectively in a team of 3–4 across all three days, contributing to the design, construction, programming, and testing phases, and jointly presenting a station operations demonstration with justified engineering decisions.	Collaboration / Communication

SUCCESS CRITERIA (I CAN STATEMENTS)

Students will demonstrate success when they can:

- I can sketch and label the key modules of my space station (solar panels, living module, lab, docking port, rotating mechanism) before building.
- I can build a modular space station with at least 4 distinct systems and a motor-driven rotating component.
- I can write a MakeCode program that continuously rotates a motor (simulating solar tracking) and triggers a Sonar:bit docking alert.
- I can name and explain 5 key space station systems and describe the engineering challenge of each in orbit.
- I can explain what redundancy means and identify at least one example of redundancy in a real space station.
- I can run 3 operations simulation trials, record results, and make at least one targeted improvement between runs.
- I can present my station design, operations programs, and science connections with a live demonstration.

KEY VOCABULARY

Introduce these terms using a word wall, glossary cards, or a Quizlet Live activity at the start of Day 1:

Term	Definition	Real-World Connection
Space Station	An orbiting structure designed to support human life and scientific research for extended periods in space.	ISS (since 2000), Tiangong (since 2021), planned Gateway near the Moon
Modular Design	A design approach where a structure is built from separate, standardised units (modules) that can be added, removed, or replaced independently.	ISS has been assembled from over 16 major modules launched separately over 13 years
Life Support System	The interconnected systems that maintain breathable air, water, temperature, and pressure for astronauts inside the station.	ISS recycles 90% of all water onboard, including sweat and urine
Solar Panel Array	Large panels covered in photovoltaic cells that convert sunlight into electricity to power all station systems.	ISS has 8 solar arrays producing up to 120 kilowatts of power
Docking Port	A precisely engineered interface that allows visiting spacecraft to connect to the station for crew transfer and resupply.	ISS has multiple docking ports; Crew Dragon and Soyuz use different docking systems
Microgravity	The condition of near-weightlessness experienced in orbit, where objects appear to float due to continuous free-fall around Earth.	Astronauts on the ISS lose bone density and muscle mass; all equipment must be secured
Redundancy	The engineering principle of building backup systems for every critical function, so a single failure does not cause a total system loss.	ISS has 4 computers running simultaneously; if one fails, the others take over instantly
Event-Driven Programming	A programming approach where code runs in response to a trigger event (sensor reading, button press, timer) rather than executing a fixed sequence once.	Station systems continuously monitor and respond to changing conditions, not a one-time script

MATERIALS & RESOURCES

Category	Item	Purpose
Hardware	micro:bit v2 (1 per team)	Main programmable controller for all station operations
Hardware	Nezha Breakout Board V2	Connects micro:bit to rotation motor and Sonar:bit sensor

Hardware	PlanetX Smart Motor	Drives the rotating solar panel mechanism; simulates solar tracking
Hardware	PlanetX Sonar:bit (ultrasonic sensor)	Mounted at the docking port; triggers alert when a spacecraft approaches
Hardware	USB Cables (1 per team)	Flash programs from computer to micro:bit
Construction	Elecfreaks Bricks Pack (LEGO-compatible blocks)	Station modules: solar panels, living module, lab module, docking port, rotating mechanism
Software	MakeCode (makecode.microbit.org)	Block-based / JavaScript IDE; event-driven and looping programs
Classroom	Projector / Interactive Whiteboard	Teacher demonstrations, ISS video tour, and code sharing
Classroom	ISS Module Map (printed)	Reference diagram showing real ISS modules and their functions
Classroom	Station Design Brief & Operations Log Sheets	Planning and multi-run operations testing recording
Optional	Torch / Flashlight	Simulates sunlight for testing whether the motor rotates the solar panel toward the light source
Optional	AI Tool (e.g., Claude, ChatGPT)	Vocabulary support, ISS research, debugging guidance

LESSON STRUCTURE — 5E MODEL

Total time: 3 × 45-minute class periods. Day 1: Design & Build | Day 2: Programming & Functionality | Day 3: Testing, Iteration & Presentation.

DAY 1: DESIGN & BUILD

ENGAGE — Introduce Context, Spark Interest & Activate Knowledge (15 min)

Time	Activity	Teacher Actions	Student Actions
0–5 min	Entry Task	Display prompt: "A space station must keep 7 astronauts alive for 6 months with no resupply. List 5 systems it must have — and rank them from most to least critical." Students respond on sticky notes.	Write 5 systems and a ranked order. Post on the class board. These will be revisited in the Explain phase.
5–12 min	ISS Video Tour	Play a 3–4 min NASA virtual tour of the ISS interior and exterior (NASA YouTube channel). Pause and ask: "What do you notice about the solar panels? How does the station stay in orbit? Why	Watch and note 2 specific features observed. Discuss with a partner: which ISS system would be hardest to design?

		does everything float?" Pause at the docking port and ask: "What engineering problem does a docking port solve?"	
12–15 min	Whole-Class Brainstorm	Facilitate discussion: What are the key components of a space station? What systems are necessary for humans to survive in space? Build a class "Systems Map" on the board: Power → Solar panels; Life Support → Air/water recycling; Structure → Modules; Comms → Antenna; Docking → Ports.	Contribute to the Systems Map; record all 5 system categories with a brief function note in notebooks for use during the Design Brief.

EXPLORE — Space Station Construction (20 min)

Time	Activity	Teacher Actions	Student Actions
0–5 min	Design Brief	Distribute Design Brief sheets. Prompt teams: "Your space station must include: (1) at least 2 solar panel arms that can rotate using the motor mechanism, (2) a central living/lab module, (3) a docking port with the Sonar:bit mounted to detect approaching spacecraft, (4) any additional module of your choice (greenhouse, observatory, storage). Sketch the full station with all components labelled and systems identified."	Sketch and label the complete station design. All team members agree on module placement and the motor/sensor arrangement before picking up any blocks.
5–20 min	Station Construction	Circulate with guiding questions: "Are your solar panel arms attached to the motor so they rotate as a unit?" "Is your docking port Sonar:bit aimed outward and unobstructed?" "Is your station structurally stable even though it has multiple extending arms?" "Which module represents life support — and what does it look like?" Encourage structural ambition alongside engineering realism.	Build the space station. Builder leads construction; Coder plans the operations program structure; Recorder documents every design decision; Presenter prepares to explain the rationale for key choices including the redundancy principle.

EXPLAIN — Station Systems, Operations & Redundancy (10 min)

Time	Activity	Description
0–5 min	Key Systems & Design Comparison	Lead a brief gallery walk or projected share: each team highlights one design decision. Then introduce the 5 key space station systems using the ISS Module Map: (1) Power System — solar arrays + batteries, (2) Life Support — ECLSS (air, water, temperature), (3) Structural System — modular truss and pressure hulls, (4) Communications — high-gain antennae + relay satellites, (5) Docking — ports and approach sensors. Students annotate a printed ISS diagram.
5–10 min	Principles of Operation & Redundancy	Explain how components work together: solar panels generate power → stored in batteries → powers ECLSS + computers + communications. Introduce the concept of redundancy: "Every critical ISS system has a backup. If one computer fails, 3 others take over. If one oxygen generator fails, there is a backup. Ask: 'What happens if both fail?'" Connect redundancy to programming: students should design their operations program so if the solar motor stops, the docking alert system still runs independently. Introduce event-driven vs sequential programming: "Your station never turns off — it monitors and responds continuously."

Classroom Management Tip — Day 1 Transitions

- Assign team roles before Day 1: Builder, Coder, Recorder, Presenter.
- Use a 2-minute warning timer before each phase transition.
- At the end of Day 1, photograph each station and upload to the shared class folder before packing away.
- Prepare a torch or small flashlight for Day 2 testing of the solar tracking motor rotation.

DAY 2: PROGRAMMING & FUNCTIONALITY

ENGAGE — Review, Connect & Coding Setup (10 min)

Time	Activity	Teacher Actions	Student Actions
0–5 min	Recap Quiz	Show 3 quick questions: (1) Name the 5 key space station systems. (2) What does redundancy mean — give one real ISS example. (3) What is the difference between event-driven and sequential programming? Teams confer	Discuss as a team; hold up whiteboard answers on teacher signal. Correct any misconceptions before coding begins.

		and answer on mini whiteboards.	
5–10 min	MakeCode Setup & Demo	Demonstrate: connecting the motor (solar panel rotation) and Sonar:bit (docking port) to the Nezha board. Show a forever loop block that continuously runs the motor at slow speed. Show an if-then block reading the Sonar:bit: if distance < 20 cm, display "DOCK" on LED. Explain: "Unlike previous lessons, this program never ends — it runs continuously, monitoring and responding, just like a real station."	Connect hardware; open MakeCode with PlanetX extension. Coder confirms: (1) motor rotates continuously when a forever loop runs, (2) Sonar:bit reads and displays a distance — before beginning the full operations program.

EXPLORE — Simulate Station Operations (25 min)

Time	Activity	Teacher Actions	Student Actions
0–15 min	Core Operations Program	Display scaffold on board: forever loop → (Operation 1) run motor at slow speed for 2s, stop for 1s, reverse for 2s, stop for 1s (simulating solar panel sweep tracking), AND (Operation 2) read Sonar:bit → IF distance < 20 cm THEN display "DOCK" + LED alert ELSE display station status icon. Clarify: both operations run together in the same forever loop — the station manages both simultaneously. Circulate and support.	Coder writes the continuous operations program; Builder monitors hardware during testing; Recorder logs each programming decision with a reason and notes which operation was harder to implement and why.
15–25 min	Parameter Tuning, Redundancy & Enhancements	Prompt teams: "Test your docking threshold — try 15 cm, 20 cm, 25 cm. Which distance gives the best early warning for an approaching spacecraft?" "Can you add a third operation: use button A to trigger a simulated EVA (Extra-Vehicular Activity) alert — the motor pauses and the LED flashes for 5 seconds, then resumes?" "Can you program redundancy: if the Sonar:bit reading is zero (possible error), display a 'SENSOR ERR' message and	Tune motor speed, sweep timing, and Sonar:bit threshold. Advanced teams add the EVA alert, sensor error redundancy, or a third operation. Coder and Builder collaborate; Recorder logs all changes.

continue other operations?" Guide beginners to focus on the two core operations first.

EXPLAIN — Code Sharing, Operations Discussion & Troubleshooting (10 min)

Time	Activity	Description
0–5 min	Code Showcase & Operations Discussion	Each team displays their MakeCode project for 90 seconds. The Coder explains: (1) how the solar panel rotation operation works and why the sweep timing was set as it was, (2) how the docking alert threshold was chosen, (3) any redundancy or additional operation they added. Teacher connects to real ISS: "The ISS attitude control system runs 24 hours a day, adjusting the station's orientation every few seconds to keep solar panels aimed at the Sun — exactly the continuous loop you programmed."
5–10 min	Troubleshooting Circle & Systems Connections	Build a shared "Bug Board" on the whiteboard: common issues (motor not reversing, Sonar:bit trigger too sensitive, both operations conflicting in the loop) and solutions. Also build a "Systems Board": which line of code controls which station system? This makes the programming → engineering connection explicit and assessable.

Guided Inquiry Prompts for Teacher Use — Day 2

- "Your solar panel motor runs continuously in one direction — what would happen to a real solar panel doing that? How does your sweep (forward/stop/reverse) better simulate solar tracking?"
- "The ISS docking approach has 3 alert zones: 200m, 30m, and 3m. How would you program 3 Sonar:bit thresholds to simulate this graduated approach system?"
- "If your Sonar:bit reads 0 cm (a known error state), what should your station do? How does your code handle unexpected sensor data — and what does that have to do with redundancy?"
- "Can you add a fourth operation using button B: a simulated power-saving mode that reduces motor speed to 30% and dims the LED display when button B is pressed?"

DAY 3: TESTING, ITERATION & PRESENTATION

ELABORATE — Station Operations Simulation: Test & Refine (20 min)

Time	Activity	Description
0–15 min	Full Operations Simulation — 3 Timed Trials	Teams run their station operations program continuously for a 3-minute timed trial, three times. After each trial, complete the Operations Log: Did

		the solar panel motor run continuously and sweep correctly? Did the Sonar:bit trigger the docking alert at the correct distance? Did all operations run simultaneously without conflict? Did any redundancy features activate? Make one targeted improvement between each trial.
15–20 min	Advanced Enhancements (Stretch)	Teams that complete 3 successful trials choose one enhancement: (A) Program a graduated docking approach: 3 alert zones at 25 cm ("APPR"), 15 cm ("NEAR"), and 5 cm ("DOCK") — LED displays different codes at each range. (B) Add an EVA alert: button A pauses motor + flashes LED for 5 seconds + resumes all operations. (C) Program a power-saving mode: button B reduces motor speed to 30% and dims display; button B again restores full power. (D) Build and add a physical docking arm or antenna structure from blocks and program it to extend (motor forward) when the docking alert triggers.

Operations Simulation Testing Protocol

- Trial 1: Solar panel rotation check — does the motor run continuously with the correct sweep pattern (forward/stop/reverse)? Record: Pass / Partial / Fail.
- Trial 2: Docking alert check — does the Sonar:bit trigger the correct LED alert at the set threshold distance? Record the actual triggering distance measured with a ruler.
- Trial 3: Full simultaneous operations — both operations running at once + any redundancy or extra features. Evaluate: Meets / Approaching / Not Yet.
- After 3 trials: implement the single most impactful improvement before the final presentation.

EVALUATE — Presentations, Peer Feedback & Reflection (25 min)

Phase	Time	Description
Station Demonstration & Presentation	4–5 min / team	Presenter explains: (1) design choices — which modules were included and why, how the rotating mechanism represents solar tracking, how the docking port was positioned, (2) programming logic — how both continuous operations work together in the forever loop, what threshold was chosen for docking and why, any redundancy programmed, (3) science/engineering connection — which two principles (microgravity, solar power, redundancy, modular design) are best demonstrated by the model. Live operations demo runs during the presentation.

Peer Feedback	2 min / team	Audience completes a "2 Stars & 1 Wish" card per team: 2 specific strengths + 1 targeted, constructive suggestion. Cards given to presenting teams at end.
Wrap-Up Reflection	5 min	Whole-class discussion: "How is designing a space station different from designing a rocket or rover?" "What does the concept of redundancy teach you about engineering for safety?" "If you could add one more module to your station, what would it be and why?" "How does your operations program connect to the idea of continuous automated monitoring in the real world?"

DIFFERENTIATION STRATEGIES

Learner Group	Strategy	Concrete Example
Beginning / SEN	Scaffolded tasks with visual supports	Pre-built starter station chassis to modify; illustrated step-by-step coding guide; visual flowchart of the forever loop with both operations labelled
Beginning / SEN	Reduced scope	Focus on one operation only (solar panel rotation) with a simple forever loop; use sentence starters for reflection; annotate printed code screenshots instead of writing from scratch
ELL Students	Language support	Bilingual vocabulary card for all 8 key terms; permit labelled diagrams instead of written explanations; pair with a bilingual peer where possible
ELL Students	Comprehensible input	Physical demonstrations alongside all verbal instructions; ISS Module Map with annotated images; hardware setup cards with clear connection diagrams
Average Learners	Core task completion	Complete both continuous operations (solar rotation + docking alert) in a single forever loop; explain 5 station systems and 2 engineering principles; demonstrate both operations simultaneously in the presentation
Advanced Learners	Open-ended extensions	Add graduated 3-zone docking approach; program EVA alert; add power-saving mode; build a physical docking arm attachment; reference specific ISS data in the presentation

Gifted / High Ability	Challenge by choice	Program a full automated station management sequence with 4 operations; research ISS power consumption and calculate how many solar panels are needed; explore JavaScript view in MakeCode; write a brief engineering report comparing their model to the ISS

ASSESSMENT — FORMATIVE & SUMMATIVE

Formative Assessment (Ongoing — During the Lesson)

Method	When	What to Look For
Entry Task: 5 Systems Ranked	Day 1, 0–5 min	Surface understanding of station systems; identify misconceptions about what is most critical for survival
Class Systems Map	Day 1, 12–15 min	Check depth of understanding of all 5 station systems before building begins
Design Brief Review	Day 1, Build phase	Assess whether sketches include rotating solar mechanism, Sonar:bit at docking port, and at least 4 labelled modules
Mini Whiteboard Recap Quiz	Day 2, 0–5 min	Verify retention of 5 systems, redundancy definition, and event-driven vs sequential programming from Day 1
Forever Loop Confirmation	Day 2, Setup phase	Confirm motor runs continuously and Sonar:bit reads distance before the full operations program begins
Operations Log Review	Day 2, Explore phase	Check that Recorder documents both operations separately with tuning decisions and reasons
Code Sharing Spot-Check	Day 2, Explain phase	Verify both operations appear in the same forever loop and run without conflict; Sonar:bit threshold is logical
3-Trial Operations Log	Day 3, Elaborate phase	Assess iterative thinking — did teams identify specific operation failures and make targeted improvements?
Exit Ticket (3-2-1)	End of Day 3	3 station systems/principles learned; 2 programming decisions made; 1 connection to a real space station or future orbital habitat

Summative Assessment (End of Lesson)

Criterion	Beginning (1)	Developing (2)	Achieving (3)	Exceeding (4)
Design & Build	Station is incomplete or does not	Station is recognisable but rotating	Station has 4+ labelled modules, a functional rotating	Station is detailed and creative;

	include rotating mechanism or docking port Sonar:bit	mechanism does not function or Sonar:bit is incorrectly placed	solar panel mechanism, and a correctly positioned docking port Sonar:bit	includes a 5th module with a described purpose; design reflects real ISS engineering principles including modular expansion
Programming	Code does not run or neither operation works	Code runs but only one operation works, or operations conflict and cannot run simultaneously	Both operations (solar rotation + docking alert) run simultaneously in a forever loop; threshold is logical and tuned	Code includes graduated docking zones, EVA alert, power-saving mode, or sensor error redundancy; shows advanced event-driven logic
Science Knowledge	Cannot name station systems or explain their purpose	Names 1–2 systems or the concept of redundancy with prompting	Explains 5 station systems, the role of redundancy, and 2 physics/engineering principles independently	Connects design and code to real ISS data; references specific ISS power output, water recycling rates, or computer redundancy specifications
Collaboration	Does not contribute meaningfully across all 3 days	Contributes minimally; needs frequent prompting to participate across days	Contributes consistently across all 3 days; all team members participate in design, coding, testing, and presentation	Leads or mentors peers; documents decisions systematically; introduces the redundancy principle into both design and code decisions

Presentation	Presentation is unclear; operations demo does not run continuously	Presents with some clarity; limited explanation of how both operations work together or science connections	Clearly explains both continuous operations, their real-world equivalents, and 2 engineering principles; live demo runs successfully	Presents with confidence and technical vocabulary; explains event-driven logic; references specific ISS data; responds well to questions

TECHNOLOGY & AI INTEGRATION

Tool / Platform	How to Use in This Lesson
MakeCode (makecode.microbit.org)	Primary coding environment; the forever loop is the key new structural concept; block view for beginners, JavaScript view for advanced; use the simulator to preview both operations before flashing to hardware
micro:bit v2 + Nezha Board + Motor + Sonar:bit	Full physical computing stack; motor drives the solar panel rotation mechanism; Sonar:bit monitors the docking port; both run in the same forever loop simultaneously
Torch / Flashlight (Optional)	Students can test whether the solar panel motor rotation moves the panels toward a light source — simulating real solar tracking behaviour and introducing the concept of light-seeking feedback systems
AI Chatbot (Claude / ChatGPT)	Students can ask: "How much power does the ISS generate from its solar panels?" or "Why is my forever loop making the motor and sensor conflict?" Teach responsible AI use: verify facts with NASA sources, test code yourself
NASA ISS Resources	NASA’s ISS page and the NASA Live ISS tracker (spotthestation.nasa.gov) allow students to see when the ISS will pass over their location — making the concept tangibly real
ISS Virtual Tour (NASA YouTube)	NASA’s "A Tour of the International Space Station" video provides an authentic reference for module design, solar panel scale, and docking operations
Padlet / Google Slides Portfolio	Digital gallery for station build photos, operations log screenshots, and "Systems Board" diagrams; allows structured peer comments

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AI Responsible Use Guidance for Students

- Use AI to understand vocabulary, debug forever loop logic, or research real ISS data — always verify from a NASA or ESA official source.

- Test any AI-suggested code yourself and explain what each block does before presenting.
- When referencing ISS data (power output, water recycling rates, crew size), cross-check AI answers with NASA's ISS Facts page.
- Do not copy AI-written explanations — use them as a starting point and restate in your own words.

REAL-WORLD CONNECTIONS

Connection	Discussion Prompt
International Space Station (ISS)	The ISS has been continuously occupied since November 2000, making it the longest continuously crewed space habitat in history. It has hosted over 270 astronauts from 20 countries. How does this international collaboration connect to the teamwork in your lesson?
China's Tiangong Space Station (2021–present)	"China completed its Tiangong Space Station in 2022 using 3 modules launched separately and docked in orbit. How does this reflect the modular design principle you used in your build — and what engineering challenge does launching modules separately create?"
NASA Gateway — Lunar Orbital Station	"NASA's Gateway will be a small space station in lunar orbit to support Artemis missions. How is designing a station for lunar orbit different from designing one for Earth orbit — and how does it connect to your Lessons 01–06 lunar mission arc?"
ISS Water Recycling System	"The ISS' ECLSS recycles approximately 90% of all water onboard — including astronaut urine and sweat. Why is water recycling not just convenient but absolutely essential for long-duration space missions?"
Automated Docking Systems	"Modern spacecraft like Crew Dragon dock autonomously using sensors and guidance computers — no pilot needed. How does your Sonar:bit docking alert simulate this automated proximity detection system?"
Future Commercial Space Stations	"Companies like Axiom Space and Blue Origin are designing commercial space stations planned for the 2030s. What engineering principles from your model would be most important for a commercial station that pays guests to visit?"

EXTENSION ACTIVITIES

Activity	Description	Suggested For
Space Station Research Report	Research 3 space stations (ISS, Tiangong, planned Gateway). Compare their module configurations, crew sizes, power systems, and scientific research objectives in a 1-page illustrated summary.	Average & Advanced

Specialist Module Design	Design and build a specialist module for your station (e.g., a greenhouse module with grow lights, an observatory dome, a manufacturing lab). Write a 1-paragraph mission statement for the module: what it does, why it is needed, and what scientific research it enables.	All levels
Graduated Docking Approach Simulation	Program 3 docking alert zones: 25 cm = "APPR" (approach), 15 cm = "NEAR" (near), 5 cm = "DOCK" (docked). Time how long it takes a "spacecraft" (a team member's hand) to travel through all 3 zones. Compare to real ISS docking approach timings.	Advanced / Gifted
ISS Power Calculation	Research: ISS has 8 solar arrays, each producing approximately 15 kW. Calculate total ISS power output. Then research average household power consumption and calculate how many homes the ISS solar arrays could power. Present the calculation and your reaction to the result.	Advanced / Gifted
Future Space Station Presentation	Create a 3-minute multimedia presentation on either NASA's Gateway or a commercial space station (Axiom, Starlab, or Orbital Reef). Describe its purpose, location, planned modules, crew capacity, and how it differs from the ISS.	All levels
Automated Station Management Program	Program a 4-operation station manager: (1) solar rotation loop, (2) docking alert, (3) EVA alert on button A, (4) power-saving mode on button B. Demonstrate all 4 operations simultaneously and explain the programming structure used to run them without conflict.	Gifted

HOMEWORK / FOLLOW-UP TASKS

Task	Instructions	Due
Station Reflection Journal	Write 150–200 words: What was the most challenging part of programming two operations simultaneously in a forever loop? How did your team apply the concept of redundancy to your design or code? How is designing a space station different from designing the rockets and rovers in Lessons 01–06?	Next class
Real Station Connection	Go to spotthestation.nasa.gov and find when the ISS will next pass over your location. Write 3 sentences: (1) when and where it will be visible, (2) one similarity between your station model and the real ISS, (3) one major engineering difference.	Next class
Extension (Optional)	Sketch a "Future Station Upgrade Plan": add 2 new modules to your current model. For each module, name it, describe its scientific purpose in one	Next class

sentence, and identify which station system (power, life support, structure, comms, docking) it primarily supports.

TEACHER NOTES & TIPS

Before the Lesson

- Prepare the NASA ISS virtual tour video link (NASA YouTube: "A Tour of the International Space Station") and spotthestation.nasa.gov on a dedicated browser tab.
- Test the motor rotation mechanism with a block structure attached — ensure the motor can physically rotate the solar panel arms without the structure being too heavy.
- Test the Sonar:bit at a range of distances to calibrate the alert threshold for your classroom environment.
- Pre-install the PlanetX MakeCode extension on all classroom computers.
- Print ISS Module Maps, Design Brief sheets, vocabulary cards, and Operations Log sheets for each team.
- A torch or small flashlight for each team is optional but highly effective for testing solar tracking behaviour.

During the Lesson

- The key new programming concept is the forever loop running multiple operations simultaneously — emphasise this explicitly in the Day 2 scaffold. Students often try to write two separate forever loops, which causes conflicts.
- The redundancy concept may be new and counterintuitive — spend extra time on it in the Explain phase and connect it to the "if Sonar:bit reads 0, display SENSOR ERR" code check.
- Motor rotation speed should be slow for solar panel tracking — if it is too fast, the model will be unstable. A slow, deliberate sweep is more realistic and easier to control.
- For SEN students, the Recorder role is excellent; they can document which LED code displays at each docking distance and log motor sweep timing observations.
- If the motor and Sonar:bit operations conflict in the loop, the most common cause is overlapping pause() blocks — restructure so both operations share the loop timing.
- Use the real-time ISS tracker at spotthestation.nasa.gov at the end of Day 1 or Day 3 to show students the actual ISS passing over if timing permits.

After the Lesson

- Photograph each team’s final station and add to the class digital portfolio.
- Compile the "Bug Board" and "Systems Board" into a shared class reference document.
- Use reflection journal responses to identify any event-driven programming concepts that need re-teaching before Lesson 08.
- Consider challenging the class to point out the ISS when it passes over their location and photograph it — a memorable connection between the lesson and the real world.

CURRICULUM STANDARDS ALIGNMENT

Standard Framework	Alignment
NGSS (Next Generation Science Standards)	MS-PS3-3: Solar energy conversion; MS-ETS1-1 to 1-4: Engineering Design; MS-LS1: Life functions in extreme environments; HS-ETS1-2: Complex real-world problem-solving
CSTA (Computer Science)	Level 2 (Grades 6–8): Event-driven programming, forever loops with simultaneous operations, sensor input, conditional logic, and iterative debugging in block-based and JavaScript coding
ISTE Standards (Students)	Empowered Learner, Innovative Designer, Computational Thinker, Creative Communicator, Global Collaborator
Common Core (Supporting)	Power calculation (multiplication and unit conversion); structured oral presentation with technical vocabulary; comparison and analysis of real-world data
21st Century Skills (4Cs)	Critical Thinking (simultaneous operations debugging + redundancy), Creativity (modular station design), Collaboration (team roles across 3 days), Communication (operations demonstrations with engineering justification)
Series Progression	Lesson 07 opens the second arc of the Space Science Kit series, shifting from lunar missions to orbital operations; prepares students for Lesson 08

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