TEJ Basic Computer Systems

Student activity packages | CS01-CS08 Main Quest and SQ01-SQ06 Side Quests

Technology Commons

2026-10-04

Student: _____ Class: _____ Start date: _____

This book contains eight required Main Quests and six optional Side Quests. Each package stands alone, but the Main Quest sequence should be completed in order. Google Classroom remains the submission system. Your teacher records verified achievement in the private tracker.

Evidence cycle

Predict, calculate using GUESS when numbers matter, draw, verify, build or test only when approved, compare evidence, diagnose, and explain.

Safety boundary

- Never open or probe inside a power supply.
- Shut down and unplug before opening a computer or changing hardware.
- Never create a short or invent a hardware fault.
- Use only teacher-prepared fault stations and teacher-approved parts.
- Stop for damage, liquid, swollen cells, burnt areas, smoke, unusual smell, abnormal heat, or unexpected noise.
- Confirm the target drive before any installation or recovery action that can change data.

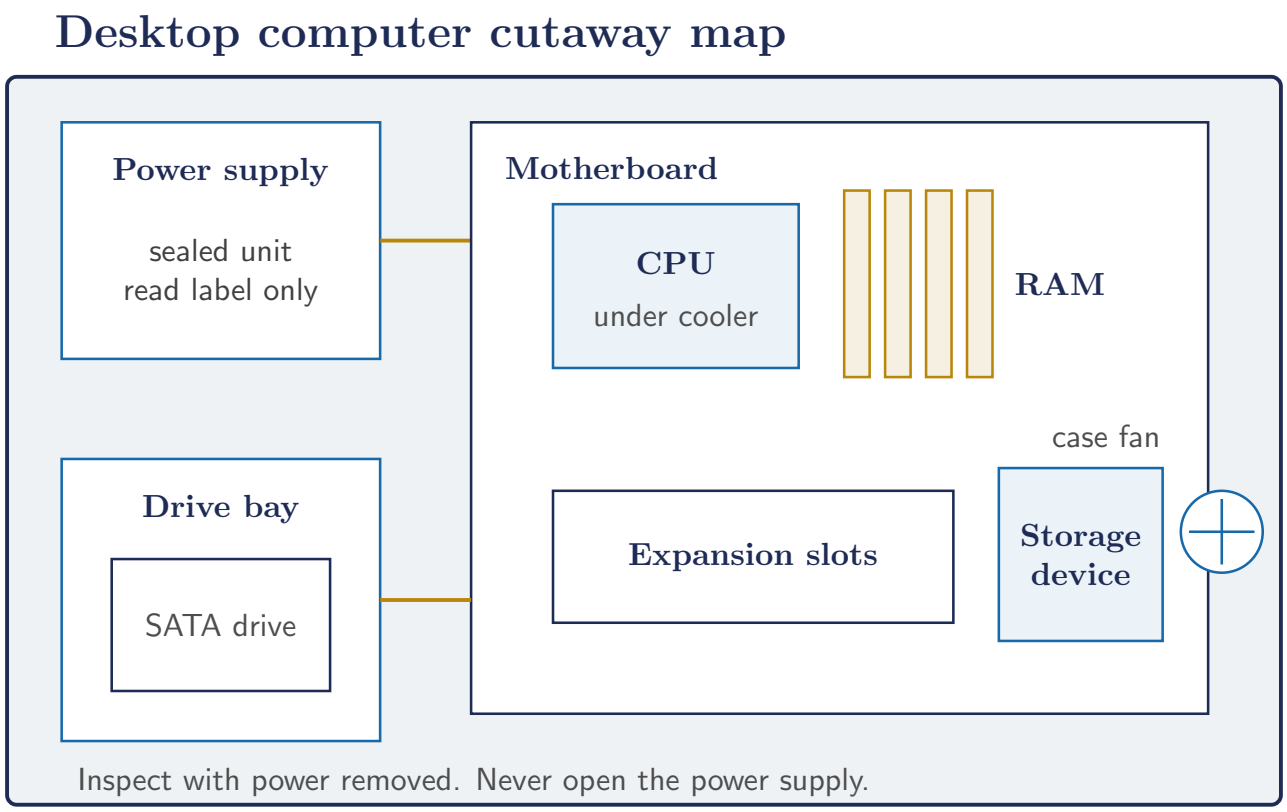


Figure 1: A labelled desktop-computer cutaway showing the sealed power supply, motherboard, CPU, RAM, storage, expansion slots, and fan.

Main Quest route

CS01 Bridge, CS02 baseline and safe opening, CS03 power and connections, CS04 inspection and first boot, CS05 POST and firmware, CS06 Xubuntu commissioning, CS07 RAM upgrade, CS08 benchmark challenge. Approved storage improvements may be included when equipment is available, but an SSD installation is not required.

Side Quest route

SQ01 teardown, SQ02 teacher-prepared faults, SQ03 storage and expansion, SQ04 Linux inventory, SQ05 power and thermal control, SQ06 repair and reuse.

Classroom deployment policy

- The Computer Recovery and OS Comparison pilot selects the classroom standard between Xubuntu 26.04 LTS and Linux Mint Xfce.
- Lubuntu 26.04 LTS is the fallback for exceptionally weak hardware.
- Ubuntu Server is reserved for a later dedicated SSH and systems-administration machine.
- The comparison pilot prepares equipment and gathers evidence. It does not complete CS01-CS08 early.
- After Thanksgiving, the class uses the selected OS to commission, upgrade, benchmark, and recommend a classroom computer.

CS01 Fast Electricity-to-Computer Bridge

Pathway	Prerequisites	Time	Risk
Main Quest	H01, basic electricity, digital inputs	45 minutes	observation only

Learning goal: Treat a computer as both a powered circuit and an information-processing system.

Success criteria: Identify source, conductors, protection, controls, and loads, then identify input, processing, memory, storage, and output.

Materials: Powered-off computer, exterior photograph, cutaway visual, coloured pencils.

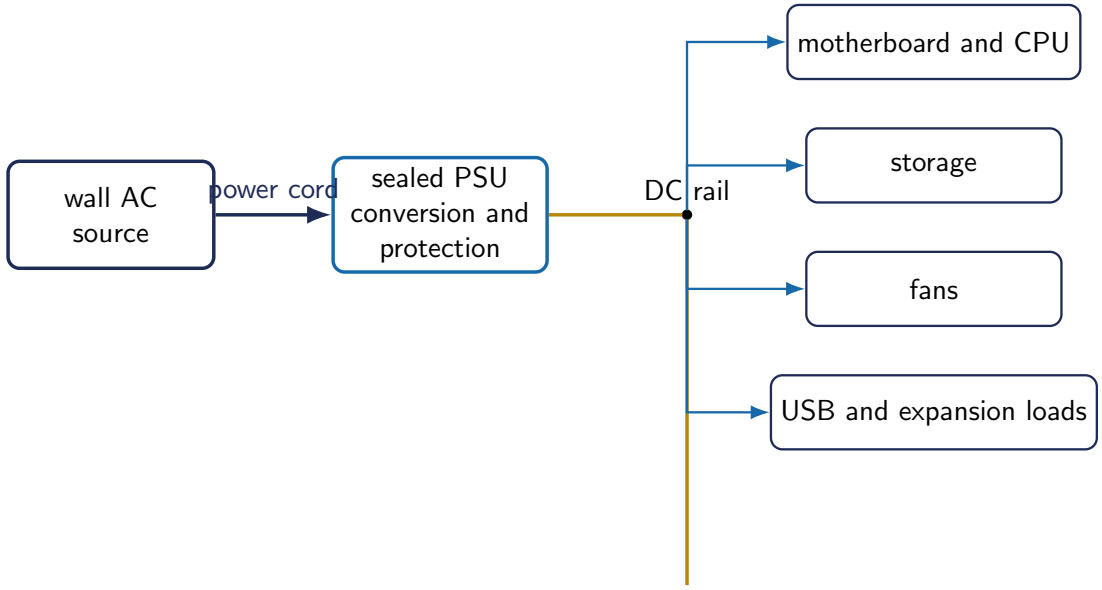


Figure 2: Functional power connections from the wall source through the sealed PSU to parallel computer loads.

Component explanation

Part	Electrical role	Information role
PSU	converts and distributes power	reports or supports power state
motherboard	distributes rails and signals	connects CPU, memory, storage, and interfaces
CPU	electrical load	executes instructions
RAM	electrical load	holds active data and instructions
storage	electrical load	retains files and the operating system
display, USB, network	loads and signal paths	input, output, or communication

Required evidence

1. Label the five circuit roles on one computer photograph.
2. Label input, processing, memory, storage, and output on a functional block diagram.
3. Explain why most computer loads behave like parallel branches rather than one series loop.
4. Compare the power button as a control input with a switch that directly carries load current.
5. Explain why the PSU label may be read but the enclosure must remain closed.

Verification: Compare your labels with the real machine while it remains powered off.

Optional extension: Trace one user action, such as pressing a keyboard key, from input through processing to output.

Evidence checklist: annotated photograph, block diagram, five responses, one verbal check.

CS02 Parts, Baseline Testing, ESD, and Safe Opening

Pathway	Prerequisite	Time	Risk
Main Quest	CS01	75 minutes	supervised hardware

Learning goal: Establish a known-good baseline before service, then open the case without introducing damage.

Success criteria: Record identity and startup behaviour, complete a controlled shutdown, use ESD controls, and identify major parts after opening.

Materials: Assigned computer, camera, asset record, ESD mat or approved grounding procedure, parts labels.

Baseline record

Evidence	Before opening	After reassembly
asset number and model		
display and startup result		
unusual sound or smell		
visible ports and damage		
operating system and login status		

Safe opening sequence

1. Record the powered baseline without changing settings.
2. Shut down through the operating system.
3. Unplug external power and all peripherals.
4. Move to the approved ESD work area.
5. Photograph cable locations and the closed case.
6. Open only the chassis panel directed by the teacher.
7. Touch components by their edges and keep the PSU closed.

Required evidence

1. Explain why the baseline comes before the first hardware change.
2. Label PSU, motherboard, CPU cooler, RAM, storage, fans, and power/data cables in your photograph.
3. Distinguish an ESD hazard from an electrical-shock hazard.
4. List three observations that require an immediate stop and teacher check.
5. Complete the after-reassembly baseline and report any difference.

Physical lab: L21 baseline, parts, and safe opening.

Optional extension: Create a removable fastener and cable map for this chassis model.

Evidence checklist: baseline table, labelled photograph, safety sign-off, after-check.

CS03 Computer Power and Connections

Pathway	Prerequisites	Time	Risk
Main Quest	CS02, H08, H10, H14	75 minutes	no energized internal probing

Learning goal: Trace power and data paths, read a PSU nameplate, and calculate a bounded power value without confusing rating with actual use.

Success criteria: Identify key connections, respect connector keying, and complete GUESS with units and significant figures.

Worked GUESS example

A labelled 12.0 V rail supplies a measured 3.25 A load.

GUESS step	Work
Given	$V = 12.0$ V, $I = 3.25$ A
Unknown	P in watts
Equation	$P = VI$
Substitute	$P = (12.0\ \text{V})(3.25\ \text{A})$
Solve	calculator gives 39.00000 W
Statement	To three significant figures, the measured load uses 39.0 W on that rail.

Casio fx-991ES PLUS C: `12.0 × 3.25 =`

> **Precision**
>
> Both measured values have three significant figures, so the final result has three significant figures. Keep the full calculator value until the final line.

Required questions 1 to 5

1. On the schematic, mark source, conversion/protection, distribution point, and four parallel loads.
2. A 5.00 V USB device draws 0.840 A. Use GUESS to calculate power.
3. A fan is labelled 12.0 V and 0.25 A. Calculate rated power and explain why startup may differ.
4. Trace one power path and one data path in the assigned computer without disconnecting anything.
5. Explain why a 500 W PSU rating does not prove that the computer currently draws 500 W.

Optional questions 6 to 10

6. Add 65.0, 18.5, 7.2, and 4.8 W loads. State the total and one limitation of this estimate.
7. A connector shows heat damage. Give a safe diagnosis plan without powering the computer.
8. Compare keyed motherboard power, SATA power, fan, and data connectors by shape and purpose.
9. Propose a connection map that separates power paths from data paths.
10. Explain how an overloaded or poorly seated connection can produce heat even when the PSU rating appears adequate.

Physical lab: L22 power connections and ready-to-power preparation.

Evidence checklist: schematic labels, PSU record, two GUESS solutions, connection map, safety explanation.

CS04 Ready-to-Power Inspection and Supervised First Boot

Pathway	Prerequisite	Time	Risk
Main Quest	CS03	60 minutes	supervised power

Learning goal: Use an inspection gate before applying power and recognize normal startup evidence.

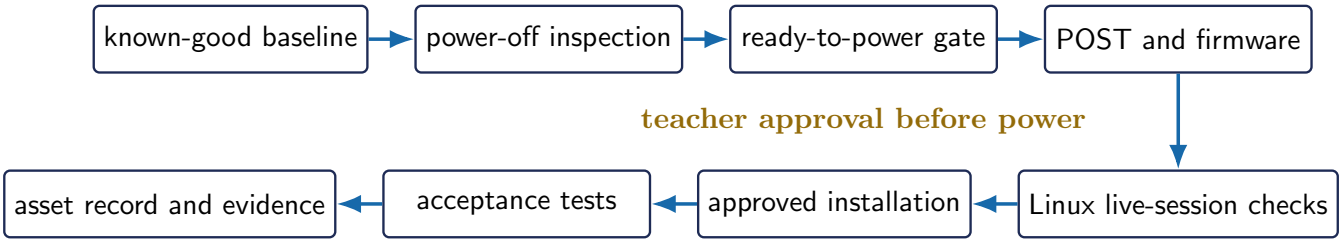


Figure 3: The commissioning flow from baseline through inspection, firmware, Linux, acceptance tests, and the final asset record.

Ready-to-power gate

Do not apply power until every item is checked and the teacher signs the gate.

Inspection item	Pass	Evidence or correction
no loose metal or tools		
RAM and approved cards fully seated		
power and data connectors aligned and latched		
CPU cooler and fans secure		
cables clear of fans		
chassis stable and panel secured as directed		
display, keyboard, and power connected externally		
teacher approval		

Required evidence

1. Predict the normal lights, fan movement, display messages, and sounds for first boot.
2. Explain why a correct power connector can still be unsafe when partly seated.
3. Complete the gate without skipping an item.
4. Observe the supervised first boot and record the actual sequence.
5. Compare prediction with observation and identify one next check if no display appears.

Stop conditions: smoke, smell, unusual noise, fan obstruction, repeated power cycling, abnormal heat, or teacher instruction.

Optional extension: Improve the checklist for the assigned chassis model without deleting any safety control.

Evidence checklist: completed gate, teacher signature, prediction, observation table, comparison.

CS05 POST and BIOS/UEFI

Pathway	Prerequisite	Time	Risk
Main Quest	CS04	60 minutes	known-good machine only

Learning goal: Explain the startup sequence and use firmware screens to verify detected hardware without changing unapproved settings.

Functional sequence

Power command, stable rails, firmware begins, POST checks essential hardware, firmware selects a boot device, bootloader starts, operating system loads.

Firmware record

Item	Detected value	Where found
firmware vendor/version		
CPU model		
installed RAM		
storage devices		
boot order		
date and time		

Required evidence

1. Draw the startup sequence as a block diagram.
2. Record how the assigned computer enters BIOS/UEFI.
3. Complete the firmware record without changing unapproved settings.
4. Explain the difference between POST, BIOS/UEFI, a bootloader, and an operating system.
5. Predict what missing RAM, a missing boot drive, or a wrong boot order could look like. Do not create any fault.

Verification: Restart normally and confirm that the known-good baseline remains unchanged.

Optional extension: Research the official meaning of one manufacturer beep or LED code for the exact model.

Evidence checklist: sequence diagram, firmware record, explanations, normal reboot.

CS06 Xubuntu 26.04 LTS Installation and Commissioning

Pathway	Prerequisite	Time	Risk
Main Quest	CS05	150 minutes	target-drive data loss

Learning goal: Install the teacher-approved Xubuntu 26.04 LTS image on the confirmed target drive and prove that the workstation is usable.

Official sources: Xubuntu 26.04 release and downloads and Ubuntu bootable USB guidance.

Installation gate

Check	Record
assigned asset and target drive	
required files already preserved	
approved installer and checksum record	
firmware sees the target drive	
teacher confirms the erase or partition choice	

Required evidence

1. Use the live session to test display, keyboard, mouse, USB, Ethernet, Wi-Fi, sound, and storage visibility before installation.
2. Record the exact target drive by model and capacity.
3. Obtain teacher approval before any erase or partition action.
4. Install the approved Xubuntu 26.04 LTS image, then apply approved updates.
5. Complete the commissioning table below.

Acceptance test	Method	Result	Evidence
CPU detected	system information		
RAM capacity	firmware and Linux		
storage capacity	Disks or approved command		
USB port	approved device		
sound	test output		
display	native or approved resolution		
network	local and approved Internet test		
restart and login	normal reboot		

Lubuntu 26.04 LTS may be assigned only when the teacher identifies exceptionally weak hardware. Ubuntu Server belongs on a later dedicated SSH and systems-administration machine, not on the strongest classroom desktop.

Optional extension: Write a short user handoff with login, update, shutdown, and support information. Do not include a password.

Evidence checklist: installation gate, live-session results, working desktop image, update evidence, acceptance table.

CS07 RAM Compatibility, Installation, and Verification

Pathway	Prerequisites	Time	Risk
Main Quest	CS02, CS05, CS06	90 minutes	ESD and incompatible parts

Learning goal: Research a compatible memory upgrade, install approved RAM, and verify the result in firmware and Linux.

Compatibility table

Requirement	Existing system	Candidate module	Compatible?	Source
DDR generation				
form factor				
capacity per module				
total capacity limit				
speed supported				
ECC or non-ECC				
voltage or special requirement				

Required evidence

1. Record baseline RAM in BIOS/UEFI and Linux.
2. Use manufacturer documentation or an approved compatibility source to complete the table.
3. Present the candidate to the teacher for approval before opening the case.
4. Shut down, unplug, use ESD controls, align the notch, and seat the module until both latches are correct.
5. Verify the new capacity in firmware and Linux, then repeat one baseline test.

Troubleshooting: If POST fails, power off and unplug before checking seating. Do not swap random parts.

Optional extension: Compare one-module and matched-channel arrangements using evidence supported by the system documentation.

Evidence checklist: compatibility table, before/after photographs, firmware verification, Linux verification, revised asset record.

CS08 Build-the-Best-Computer Benchmarking Challenge

Pathway	Prerequisites	Time	Risk
Main Quest	CS01-CS07	240 minutes	approved changes only

Learning goal: Define what best means for a user, run repeatable tests, improve one compatible computer, and support the recommendation with evidence.

Formal benchmarking begins only after the system is operational. USB live-session boot time is a deployment check, not a fair computer benchmark.

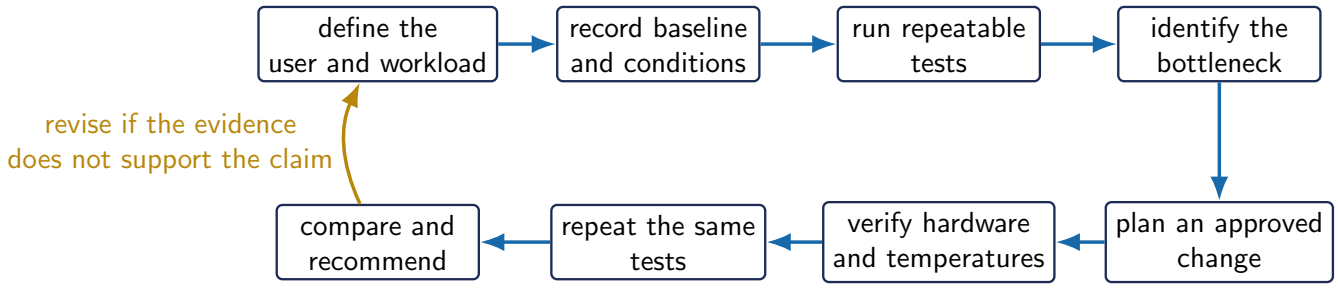


Figure 4: A repeatable benchmark loop from user needs and baseline through one approved change and a fair retest.

Assigned user and criteria

User or workload	Most important measures	Constraints

Benchmark table

Test	Conditions and version	Baseline	Final	Change	Units
boot or login time					s
CPU task					
memory task					
storage task					
temperature at stated load					°C
user task, such as loading Tinkercad or opening Inkscape					

Required evidence

1. Define best for the assigned user before seeing final scores.
2. Record hardware, software, test versions, temperature conditions, and baseline results.
3. Identify the likely bottleneck using the evidence.
4. Propose and receive approval for compatible part combinations, settings, or an available storage improvement. An SSD installation is optional and depends on school equipment.
5. Make the approved change, verify the system, rerun the same tests, and recommend the best build.

Optional extension: Explain uncertainty, a result that did not improve, and the next test that would distinguish two possible bottlenecks.

Evidence checklist: benchmark table, build plan, parts record, before/after images, graph, recommendation, restoration record if required.

SQ01 Controlled Teardown and Reassembly

Pathway	Prerequisites	Time	Risk
Side Quest	CS02 and CS04	120 minutes	teacher-approved parts only

Goal: Remove and reinstall approved field-replaceable parts while preserving a complete service record.

Safety: Never open the PSU. Stop for damage, liquid, swollen cells, burnt areas, or uncertainty.

Required evidence

1. Record the known-good baseline and photograph every side before opening.
2. Create a labelled fastener map and cable map.
3. Remove only the approved RAM, storage, cables, fans, or drive cages.
4. Explain the electrical and mechanical purpose of each connector or fastener removed.
5. Reassemble, complete the ready-to-power gate, POST, and acceptance check.

Design extension: Improve cable routing without blocking airflow or stressing connectors.

Evidence checklist: photo sequence, fastener map, cable map, parts tray record, successful POST and acceptance tests.

SQ02 Teacher-Prepared POST and Hardware Fault Stations

Pathway	Prerequisite	Time	Risk
Side Quest	CS05	90 minutes	teacher-prepared faults only

Goal: Diagnose a controlled fault from evidence while changing one variable at a time.

Safety: Never create a short, invent a fault, or change hardware while power is connected.

Diagnostic log

Step	Observation	Hypothesis	Safe test	Result	Next decision
1					
2					
3					
4					

Required evidence

1. Record symptoms before touching the station.
2. Predict the normal result and list two possible causes.
3. Use beep/LED information, visual inspection, firmware, or boot evidence to choose one safe test.
4. Make only the teacher-approved correction.
5. Verify return to the documented baseline and explain why the evidence supports the diagnosis.

Possible stations: improperly seated RAM, disconnected storage, wrong boot order, or approved fan connection issue. Only the teacher prepares them.

SQ03 Storage and Expansion Upgrades

Pathway	Prerequisites	Time	Risk
Side Quest	CS03, CS05, CS06	120 minutes	data and compatibility

Goal: Research, install, and verify one compatible SATA, NVMe, or PCIe device.

Compatibility table

Check	System evidence	Candidate evidence	Decision
physical form factor and space			
interface and keying			
available connector or lane			
power requirement			
firmware and operating-system support			
data backup or migration plan			

Required evidence

1. State the upgrade purpose and success measure.
2. Complete the compatibility table from primary or manufacturer sources.
3. Protect required data and obtain approval.
4. Install without forcing a connector, then inspect before power.
5. Verify the device in firmware and Linux, run an appropriate test, and update the asset record.

Troubleshooting extension: Propose safe tests for a detected device that does not appear in the operating system.

SQ04 Linux Hardware Inventory and Introductory Administration

Pathway	Prerequisite	Time	Risk
Side Quest	CS06	120 minutes	approved commands only

Goal: Compare physical labels, firmware records, and Linux reports for the same workstation.

Approved inventory commands

Use only commands approved by the teacher. Examples may include `lscpu`, `free -h`, `lsblk`, `lspci`, `lsusb`, `ip address`, `smartctl`, and `sensors`. Availability depends on installed packages and permissions.

Item	Physical evidence	Firmware evidence	Linux evidence	Agreement or question
CPU				
RAM				
storage				
network				
temperatures				

Required evidence

1. Predict which layer can report each item before using a command.
2. Capture the command and relevant output, not the entire terminal history.
3. Create one user or software-management plan without executing unapproved administrative commands.
4. Explain one disagreement among physical, firmware, and Linux evidence.
5. Produce a concise workstation inventory and one maintenance recommendation.

Optional extension: Write a read-only health-check script and explain every command before running it.

SQ05 Power, Efficiency, Cooling, and Thermal Behaviour

Pathway	Prerequisites	Time	Risk
Side Quest	CS03, CS06, control-system basics	120 minutes	enclosed wall meter only

Goal: Relate electrical power, energy, temperature, fan response, and feedback control using measured data.

Safety: No internal live probing. Keep cooling hardware installed. Stop for abnormal temperature, smell, sound, or fan failure.

Worked GUESS example

A workstation averages 74.6 W for 2.50 h.

GUESS step	Work
Given	$P = 74.6$ W, $t = 2.50$ h
Unknown	E in Wh and kWh
Equation	$E = Pt$
Substitute	$E = (74.6\text{ W})(2.50\text{ h})$
Solve	186.50000 Wh $= 0.18650000$ kWh
Statement	To three significant figures, the session uses 187 Wh or 0.187 kWh.

Casio fx-991ES PLUS C: `74.6 × 2.50 =`

Required questions 1 to 5

1. Predict the relative power at shutdown, standby, idle, and approved load.
2. Record power, CPU temperature, and fan evidence under identical timed conditions.
3. Use GUESS to calculate energy for a stated interval.
4. Draw the feedback loop with temperature sensor, controller, fan, computer heat, and measured temperature.
5. Compare prediction and measurement, then state one limitation.

Optional questions 6 to 10

6. Estimate daily energy for 6.00 h at the measured average power.
7. Compare two approved power settings using the same workload.
8. Explain why a higher fan speed can reduce temperature while increasing fan power and noise.
9. Evaluate one approved cleaning or configuration change with before/after data.
10. Propose a safer or more repeatable thermal test and justify the change.

Evidence checklist: GUESS work, measurements, graph, control block diagram, before/after comparison, limitations statement.

SQ06 Repair, Reuse, File Recovery, and Advanced Commissioning

Pathway	Prerequisites	Time	Risk
Side Quest	CS06 and one earlier Side Quest	180 minutes	teacher-approved scope

Goal: Use evidence, compatibility, performance, energy, cost, maintainability, and lifecycle to return a computer to useful service or justify another responsible outcome.

Decision table

Criterion	Evidence	Weight	Option A	Option B
safety				
required workload				
repair or upgrade cost				
data and privacy				
energy and expected life				
repairability and parts				

Required evidence

1. Define the user need and current machine condition.
2. Choose an approved scope: return to service, upgrade proposal, approved file recovery, or responsible reuse plan.
3. Build a bill of materials and test plan before changing hardware or data.
4. Complete the approved work and repeat acceptance tests.
5. Deliver a commissioning report with results, remaining risks, user notes, and disposition of removed parts.

Safety and privacy: Follow school data-handling and e-waste procedures. Do not reuse damaged power parts or unknown batteries. Mount recovery drives only as directed.

Evidence checklist: decision table, bill of materials, service log, tests, user handoff, reflection.

Common assessment rubric

Category	Level 1	Level 2	Level 3	Level 4
Mathematical reasoning and GUESS	limited setup or unit use	partly correct method	correct method and units	precise, efficient reasoning with independent checks
Schematic quality and conventions	major symbol or connection errors	mostly readable with some errors	correct, labelled, and readable	exceptionally clear with purposeful layout and complete references
Simulation or verification evidence	limited or incomplete evidence	some valid evidence and comparison	complete evidence with comparison	well-chosen evidence that tests assumptions and limitations
Physical construction and safe practice	frequent prompting required	generally safe with some prompting	safe, organized, and approved work	consistently anticipates hazards and supports team safety
Testing and troubleshooting	guesses without a test plan	partial plan using some evidence	logical tests identify the likely cause	efficient tests distinguish alternatives and verify the repair
Design decisions	choice has limited justification	some criteria support the choice	clear criteria and trade-offs support the choice	constraints, evidence, and iteration produce a strong decision
Documentation and communication	incomplete or difficult to follow	understandable with gaps	clear tables, labels, results, and conclusion	concise, polished communication makes the evidence easy to audit

Submission map

- Main Quests appear as regular Google Classroom assignments.
- Side Quests appear under the Classroom topic **Side Quests**.
- Submit student evidence in Classroom. Students do not edit the master tracker.
- The teacher records verified achievement from 0 to 4 in the private tracker.
- The Leaderboard is a teacher-only progress view, not a public competition.

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