EXPLORE-FIRST LESSON

Don't Replace the Part Yet

Diagnostic reasoning — the difference between fixing it and guessing expensively

Teacher	CTE Teacher	**School**	Sample Technical High School
Subject	Automotive Technology II	**Grade**	11
Class / Period	Shop block	**Date**	_____
Block length	90 minutes	**Framework**	Danielson Framework for Teaching

Phase times are targets, not stopwatches.

Standards & Objectives

1c Setting Instructional Outcomes

Standard	Student-facing "I Can"	Language objective
NYS CDOS Standard 3a — Universal Foundation Skills Students will demonstrate mastery of the foundation skills and competencies essential for success in the workplace, including basic skills, thinking skills, personal qualities, interpersonal skills, technology, managing information, managing resources, and systems.	I can work out what is actually wrong before I spend anybody's money on a part.	Students will use symptom, cause, test, verify and rule out in speech and writing. **Frames:** "The symptom is ___, which could be caused by ___ or ___." · "This test rules out ___ because ___."
NYS CDOS Standard 3b — Career Majors Students who choose a career major will acquire the career-specific technical knowledge and skills necessary to progress toward gainful employment, career advancement and success in postsecondary programs.	I can follow a diagnostic procedure and document what I found.	**Frame:** "I tested ___, the result was ___, so the next step is ___."

Industry alignment: this lesson supports the diagnostic and service-procedure competencies in most entry-level automotive certification task lists. Check the specific task numbers against the credential your program is accredited for — they differ by certifying body and are revised periodically.

Who Does This Work — and Who Got the Credit

1b Demonstrating Knowledge of Students

Who invented what you are working on. Garrett Morgan was a Black inventor and mechanic in Cleveland who left formal school young and taught himself. He patented a three-position traffic signal in 1923 — the version that added a stop-everything phase between directions — and sold the rights to General Electric. He also patented a friction drive clutch for vehicles, and, earlier, the safety hood that was a forerunner of the gas mask. To sell that hood he sometimes hired a white actor to pose as the inventor at demonstrations, then walked into the smoke himself.

And the electric starter. Before it, cars were started with a hand crank that broke wrists and arms. The electric starter is credited to Charles Kettering and to his company; the engineering teams who developed it alongside him are not named anywhere a student would see.

The pattern worth naming out loud. The trades are full of people who solved a problem and did not get the patent, or got the patent and not the credit — because of who they were, or because they worked for somebody with a legal department. If you invent something in this field, find out who owns it before you show anybody.

Who does this work now. Automotive service technicians diagnose and repair. **Diesel technicians** do the same on trucks and heavy equipment, generally at higher pay. **EV and hybrid specialists** are in short supply and the shortage is growing. **Service advisors** explain the diagnosis to the customer, which is a separate and well-paid skill. **Fleet technicians** work for municipalities and companies — steady hours, benefits, pension in many cases. **Shop owners** start as technicians.

How people enter that work: there are several routes in — high school CTE, a postsecondary certificate program, manufacturer-specific training, a registered apprenticeship, or employer-based training that pays while you learn. A postsecondary certificate is the most common

starting point, and many technicians add manufacturer training afterward. Industry certification generally requires passing the relevant test and documenting qualifying hands-on experience. Specific requirements vary by certifying body and by state.

Ask the class: "Morgan had to hire somebody to pretend to be him to sell his own invention. What would you have done?"

The Problem

3c Engaging Students in Learning

A customer complaint is on the board, written the way a customer actually writes one: "Car won't start sometimes. Mostly in the morning. Battery is new — I already replaced it twice." The vehicle is in the bay. No codes have been pulled yet.

Driving question students are working to answer:

The customer has already spent money twice and it is still broken. What do you do first — and what would you have to prove before you spent their money again?

Key Questions

3b Using Questioning and Discussion Techniques

Question, exactly as I ask it	Level	Where	Strong answer sounds like
"Two batteries did not fix it. What does that tell you before you touch anything?"	DOK 2	Launch	Infers the battery is probably not the cause — or is being drained by something else.
"You want to replace that part. What test would prove you are right — before you order it?"	DOK 3	Explore — to a stuck group	Names a specific test with an expected result. This is the whole lesson.
"Two teams suspect different components. What test would tell them apart?"	DOK 3	Synthesize	Designs a discriminating test rather than defending a guess.
"You are wrong and the customer has paid. Who pays for that part?"	DOK 3	Assess	Names more than one kind of cost — customer expense, shop rework, warranty or comeback exposure, lost time, professional standing — and recognizes that how those costs are allocated depends on the shop's policies and applicable law.

Accountable-talk stems, posted at each bay: "The symptom points to ___." · "That test rules out ___." · "What is your evidence?"

Wait time: seven seconds. In a shop the instinct is to jump in with the answer — hold it.

Materials, Prep & Safety

1d Demonstrating Knowledge of Resources

Prepare before the bell	Copies / quantity
Vehicle in the bay with a documented, reproducible fault — set before class	1
Diagnostic Path organizer (Appendix A)	24
Repair Order write-up sheet (Appendix B)	24
Digital multimeters, one per team	6
Scan tool and service information access	as available
Manufacturer specifications for the vehicle, printed — not looked up on phones	6 copies
Whiteboard pre-divided: Symptom · Possible causes · Test · Result	before the bell
Bilingual glossary cards — symptom, cause, test, verify, rule out	Spanish / English

SAFETY — STATED BEFORE ANY STUDENT ENTERS THE BAY: Eye protection is required at all times in the bay. No student enters or stays in the bay without it, and any missed safety requirement stops the activity immediately. Vehicle in park, parking brake set, wheels chocked, keys in my possession until a team is cleared to crank. Nobody works under a vehicle in this lesson. Battery terminals: negative off first, on last, and no metal tools laid across the battery — a wrench bridging the terminals will weld itself in place and burn you. Hair tied back, no loose sleeves, no jewelry, no rings. If the engine is running, nobody's hands are near the belt. Any student who is unsure

asks me and does not guess. Follow the school's shop safety plan and the manufacturer's service information for this vehicle — including any high-voltage or hybrid battery procedures, which are handled by me and not by students.

Grouping Plan

1b Demonstrating Knowledge of Students

Six teams of four. Teams rather than pairs, with rotating roles — one tests, one records, one reads the specification, one questions. Everyone does every role, and the questioner role is not a spare job. On a real bench, the person who asks "are you sure" saves the shop money.

Team	Composition	Notes
Teams 1–6	Four students, mixed shop confidence	Teams rotate through the bay; those waiting work the paper diagnostic

How the support lanes work: three versions of the organizer sit at every bench — one with the first two possible causes listed, the core version, and an extension on the reverse. Students take whichever gets them working.

Seating and access principles:

- Seat students still building English proficiency with a partner who narrates each step aloud. Procedures and meter readings cross languages faster than explanations — and the printed specification sheet is more accessible than a verbal one.
- Students with reading goals may work primarily from the meter and the vehicle and dictate the write-up. A technician who can diagnose but writes slowly is employable; one who cannot diagnose is not. Assess the diagnosis.
- A student with a physical limitation takes the specification, recording and questioning roles and directs a partner through the test. Directing a procedure accurately is a genuine competency — name it as one.

Forming teams in under a minute: team cards on the benches before the bell.

Anticipated Student Responses

Ordered deliberately.

1a Demonstrating Knowledge of Content and Pedagogy

What students will say	Why they will say it	When I call on it
"Replace the battery." (productive wrong turn)	Symptom-to-part matching is how most people think, and it is how most money gets wasted.	**FIRST.** The customer already did that. Twice. The whole lesson is why that keeps happening.
"It is the starter."	Second guess, still a guess — a different part with no test behind it.	**SECOND.** Ask what test would prove it. Watch them realize they do not have one.
"Pull the codes first."	Teams who reach for the scan tool.	**THIRD.** Right instinct, incomplete. A code tells you where to look, not what is wrong. Say that plainly.
"Why morning? What is different in the morning?"	Teams who interrogate the customer's own words.	**FOURTH.** This is diagnostic thinking arriving. The customer told them something and they listened.
"Test for a parasitic draw — something is killing it overnight."	Teams who connect two new batteries plus overnight failure into one hypothesis.	**FIFTH.** The target. Now formalize: symptom, hypothesis, discriminating test, verify.
"What if we are wrong and they already paid?"	Somebody always asks, usually a student who has watched a family member get a bill.	**LAST.** Hand it into the assessment. Comeback cost is the reason the whole procedure exists.

Adults in the Room

1e Designing Coherent Instruction

I am the only adult in this shop. In a shop the circulation plan is a safety plan first and an instructional plan second. I never lose line of sight on the bay.

Phase	My circulation plan
1 Launch	Front of shop for the safety brief and the complaint. Nobody enters the bay until I have finished and I have the keys.
2 Explore	Positioned so the bay is always in my sight. Bench teams get thirty seconds each in rotation; the bay team gets continuous supervision. Withhold every conclusion. Log which team reached which hypothesis.
3 Synthesize	Front of shop, calling teams in the sequenced order. Vehicle secured, keys in my pocket.
4 Apply	Benches only — the bay is closed for this phase. Confer first with teams who named a part without a test.
5 Assess	Benches. Collect write-ups by team number. Tools counted back in before anyone leaves.

The rule I hold myself to in Phase 2: if I name the fault, the lesson is over. Safety corrections are the exception and are immediate.

PHASE 1 — LAUNCH (about 10 minutes)

Safety brief, then the complaint. No diagnosis offered.

3c Engaging Students in Learning

Time	Teacher steps & script	Student action
0:00–10:00	**1.** Full safety brief before anything else. Eye protection distributed and on before the complaint is read. **2.** Read the complaint exactly as written. Say: **"Car won't start sometimes. Mostly in the morning. Battery is new — I already replaced it twice."** **3.** Say: **"That customer has paid for two batteries. Somebody sold them two batteries. Were those techs lying?"** Let them sit with it. **4.** Ask: **"Two batteries did not fix it. What does that tell you before you touch anything?"** Take two answers. Write both on the board. Confirm neither. **5.** Say: **"Your team is going to tell me what you would test and what you expect the result to be — before you touch a wrench. If you name a part without a test, I will ask you who pays for it."** **6.** Say: **"Thirty minutes. Bay rotation on my call. Everyone else works the paper. Go."** **7.** Confirm eye protection on every student and keys in my possession before releasing them.	• Eye protection on • Listen to the complaint • Two students answer aloud • Move to benches, assign roles, begin

PHASE 2 — EXPLORE (about 30 minutes) Level: DOK 3 · Strategic Thinking

Teams build a diagnostic path before being shown one. Questions only.

3b Using Questioning and Discussion Techniques

Time	Teacher steps & script	What I am watching and listening for
10:00–40:00	**1.** Bay in sight at all times. Bench rotation thirty seconds each; bay team continuously supervised. **2.** To a team naming a part: **"What test proves that, and what result would you expect?"** **3.** To a team with no plan: **"Read the customer's words again. What did they tell you that you have not used?"** **4.** To a team reaching for the scan tool: **"Say what you expect to find before you plug it in."** **5.** To a team measuring: **"What is the specification? Show me the printed sheet, not a number you remember."** **6.** To a team that has found a draw: **"Good. Now prove it is not normal. What does the specification allow?"** **7.** To a team asking if they are right: **"I am not going to tell you.**	• **Eye protection.** Correct instantly, every time, without discussion. • **Any tool laid across the battery.** Stop the team immediately — this is the injury that actually happens. • Which teams name parts versus name tests — I need both for the synthesis • **Any team that asks why mornings.** That is the hinge of the lesson. • Whether anyone checks the printed specification rather than working from memory

Time	Teacher steps & script	What I am watching and listening for
	What would you say to the customer?" 8. At 35:00: **"Five minutes. Your organizer needs a test, an expected result and an actual result on every line."** 9. Log which team reached which hypothesis. No fault named by me in this phase.	• Students narrating their reasoning to the questioner role rather than working silently

PHASE 3 — SYNTHESIZE (about 20 minutes)

Formalize the diagnostic procedure from their work.

3a Communicating with Students

Time	Teacher steps & script	Check for understanding
40:00–60:00	1. Vehicle secured, keys in pocket, teams at the front. 2. Call the **replace the battery** team first. Say: **"That is what the last two techs did. Somebody made that call twice and the car is still here. What did they skip?"** 3. Call the **it is the starter** team. Ask: **"What test proves it?"** If they do not have one, say: **"Then it is a guess wearing a part number."** 4. Call the **pull the codes** team. Say: **"Right move. And a code is a symptom too — it tells you where to look, not what is broken. Replacing whatever the code names is how shops lose money and how technicians lose the trust of a service manager."** 5. Call the **why mornings** team. Say: **"You listened to the customer. Most of the money wasted in this trade is wasted by people who did not."** 6. Call the **parasitic draw** team last. Have them walk it. Then write the procedure on the board as they say it: **SYMPTOM → POSSIBLE CAUSES → DISCRIMINATING TEST → RESULT → VERIFY THE REPAIR**. 7. Say: **"That is the procedure. Nobody wrote it on the board before you did the work — you built it. Now it is yours and it is what separates a tech from a parts changer."** 8. Say: **"A parts changer replaces what they suspect. A technician proves it first. Over a career, that difference shows up in what you get trusted with and what you get paid."**	• Whiteboard hold-up: name one test and its expected result for a no-crank complaint. Scanning for a result, not just a test • Cold call, no hands up: **"Why is a code not a diagnosis?"** Listening for it tells you where to look • Whether students learning English are using the glossary terms while presenting

PHASE 4 — APPLY (about 15 minutes) Level: DOK 3 · Strategic Thinking

A new complaint, on paper. Bay closed.

3c Engaging Students in Learning

Time	Teacher steps & script	Differentiated accommodations
60:00–75:00	1. Distribute Appendix B. 2. Say: **"New complaint, and this one is a write-up. 'Making a noise when I turn left. Only sometimes. Getting worse.' That is everything the customer said."** 3. Say: **"Give me three possible causes, and for each one, the test that would rule it in or out. Then write the line you would put on the repair order."** 4. Say: **"The repair order line matters. A service advisor reads it to the customer. If it says 'maybe the CV joint' the customer hears 'they don't know.'"** 5. Circulate; confer first with teams who named parts without tests in Phase 2. Ask: **"What would you write on the order right now?"**	**Scaffolded Access** 1. Sheet with two possible causes already listed; the student supplies the tests. 2. Sentence frame supplied: "Symptom ___ could be caused by ___. I would test by ___ and expect ___." **Core Task** Student gives three causes with a discriminating test for each, and drafts the repair order line. Accessible as written. **Extension / 2e Strength-Forward** 1. Order your three tests cheapest and fastest first, and justify the order to a

Time	Teacher steps & script	Differentiated accommodations
		shop owner. **2.** Write what you would say to the customer if the first test came back clean. *All three are available to any student, offered on what I hear during circulation.*

PHASE 5 — ASSESS (about 15 minutes)

Independent evidence.

1f Designing Student Assessments

Time	Assessment task	Success criteria
75:00–90:00	**1.** Say: **"Yours alone. Bay is closed, tools are in."** **2.** Display: **"A customer is told they need a part. It costs four hundred dollars. You are the tech. Write the two sentences that tell them what you found and how you know — and then answer this: if you are wrong, who bears the cost, and in how many different ways?"** **3.** Circulate; collect write-ups by team number. **4.** Tools counted back in. Eye protection collected. **5.** Say as they pack: **"Tomorrow: the customer says the noise is gone and you can't reproduce it. That is harder than today."**	**Full credit:** states the finding and the evidence in plain customer-facing language, and identifies that a wrong diagnosis creates real cost — to the customer, to the shop through comeback and warranty exposure, and to the technician's standing. How that cost is allocated depends on the shop's pay structure, its warranty policy and state law. **Partial:** explains the finding but not how it was proven, or does not address who carries the cost. **Reteach:** names a part with no test behind it. These students start tomorrow at the board with the procedure.

Sources & Local Verification

Check these against your own program before teaching.

Framework version: Danielson Framework for Teaching, 2013 component language (1a–4a). If your district uses the 2022 edition, component names differ — 1e is Planning Coherent Instruction and 1f is Designing and Analyzing Assessments.

Standards: NYS Career Development and Occupational Studies (CDOS) Standards 3a and 3b, as published by the New York State Education Department.

Historical content: Garrett Morgan's patents are documented by the National Inventors Hall of Fame and the U.S. Patent and Trademark Office — the three-position traffic signal (1923), the safety hood (1914) and a friction drive clutch. He did not patent an automatic transmission.

Career data: entry-level education and training routes for automotive service technicians are published by the U.S. Bureau of Labor Statistics. Certification requirements are set by the certifying body.

Verify locally before teaching:

- Your school's shop safety plan and PPE requirements
- Manufacturer service information and any high-voltage procedures for the vehicle in your bay
- The task numbers in the certification your program is accredited for
- Your program's policy on students working on customer or staff vehicles

Phase 6 — Post-Lesson Reflection

Completed by hand after teaching.

4a Reflecting on Teaching

What worked well?

What would I change?

Student evidence of mastery — diagnostic reasoning AND shop safety:

Adjustments for next lesson:

Appendix A — Diagnostic Path

Print one per student.

Complaint: "Car won't start sometimes. Mostly in the morning. Battery is new — I already replaced it twice."

Possible cause	Test I would run	Expected result	Actual result

What the customer told me that I actually used:

What I have ruled OUT, and how:

Appendix B — Repair Order Write-Up

Print one per student for Phase 4.

Complaint: "Making a noise when I turn left. Only sometimes. Getting worse."

Possible cause	Test that rules it in or out	Why this test and not another

The line I would put on the repair order — written so a customer understands it:

If I am wrong, who bears the cost — and in how many different ways?