Strengthened Senior High School

DepED
DEPARTMENT OF EDUCATION

Lesson Exemplars for Photovoltaic Systems Installation

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I. OBJECTIVES	
A. Content Standard	The learners demonstrate an understanding of the concepts and principles of solar energy system in Photovoltaic (PV) Systems Installation.
B. Performance Standard	The learners perform site assessment with safety precautions.
C. Learning Competencies	Discuss the concepts and principles related to Photovoltaic Systems Installation.
II. REFERENCES and MATERIALS	**References:** • Department of Energy (DOE) Philippines. (2022). *Philippine Renewable Energy Roadmap 2020-2040*. • Republic Act No. 9513: Renewable Energy Act of 2008 (Philippines). • Photovoltaic Systems Installation NC II Curriculum Guide (TESDA). • Solar Energy International (SEI). (2021). *Photovoltaic Systems Fundamentals*. **Materials:** • Laptop/projector/TV for slide presentation • Whiteboard and markers • Printed copies of RA 9513 (Excerpts) • Sample site photos (rooftop, open field, shaded area) • Quiz handouts **Tech Integration:** • Google Earth or Google Maps (for visualizing site orientation) • Interactive polling (Mentimeter or Kahoot for activation)

III. CONTENT	• **Overview of Renewable Energy and Solar Power: Definition, types (solar, wind, hydro), why solar is ideal for the Philippines.** • **RA 9513 (Renewable Energy Act of 2008): Key provisions: promotion of RE, net metering, incentives.** • **Site Selection Criteria for PV Systems: Orientation (south-facing in N. Hemisphere), tilt angle, shading analysis, structural integrity, safety access.**	
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. Identify at least three key provisions of RA 9513. 2. Explain why solar power is a strategic renewable energy source for the Philippines. 3. Analyze a given site photo and identify potential shading or orientation issues. 4. Articulate the basic principles of a photovoltaic system using correct technical terms (irradiance, array, module).	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** Teacher says: "Good morning, class. Before we talk about solar panels, let's do a quick mental exercise. Write down on a scratch paper: What are three ways our school or your home uses electricity every single day? Now, imagine a 12-hour blackout. Which ONE appliance would you miss most? Why?" Teacher asks: "Now, who can tell me what 'renewable' means?" (Accept answers: not used up, comes from nature, etc.). Teacher says: "Today, we connect that need for reliable power to the sun."	This activates the schema of energy dependency. The blackout question creates cognitive dissonance (need vs. lack of power), making the relevance of solar immediate and personal. **Facilitation Note:** Allow 2-3 students to share. Do not correct wrong answers yet—just surface prior knowledge.

	2. Establishing the Purpose of the Lesson Teacher says: "Today's lesson is the FOUNDATION of everything you will do as PV installers. You cannot install a single panel correctly unless you understand *why* solar matters legally (RA 9513) and *where* to place it (site assessment). By the end of this hour, you will be able to look at a roof and say, 'That is a good or bad spot for solar'—and cite the law that makes it profitable for the homeowner." Teacher writes on board: *LEARNING TARGETS: 1. Quote RA 9513. 2. Spot shading. 3. Explain net metering.*	Connects the legal/technical content directly to the Performance Standard (site assessment) and future job role. Using "profitable" hooks practical-minded students. **Facilitation Note:** Point to each target on the board twice.
B. Instituting New Knowledge	**1. Presenting Examples** Teacher projects 3 images (printed or slide): 1. A house with a large, south-facing roof, no trees. 2. A commercial building with a north-facing roof, nearby tall palm tree casting shadow. 3. An open ground area with adjustable racking. **Teacher says:** "Look at Image 1. Raise your hand if you think this is good for solar. Why?" (Student: "No shade."). "Look at Image 2. Show me a thumbs DOWN if it's bad. Why?" (Student: "Tree shadow."). "Image 3. Thumbs sideways—it's okay but requires land." **Teacher states:** "These quick judgments? That's a basic site assessment. Today we learn the science and law behind that judgment."	Low-stakes, visual, non-verbal responses (thumbs) ensure 100% participation. This is a "concept attainment" strategy—students infer criteria before formal instruction. **Facilitation Note:** Do NOT explain net metering yet. Let them wonder why Image 3 might be less ideal (land use cost).

	2. Discussing New Concept Teacher lectures directly from this script (using slides): Slide 1: What is a PV System? "PV stands for Photovoltaic. 'Photo' = light, 'Voltaic' = voltage. It's a device that converts sunlight DIRECTLY into electricity using semiconductors—usually silicon. No moving parts. No noise." Slide 2: RA 9513 – The RE Act of 2008 "Open your printed excerpt. In 2008, the Philippines passed a law that changed everything. Key sections you must memorize: - Sec. 2 (Declaration of Policy): The State shall accelerate the exploration and development of renewable energy. - Sec. 7 (Net Metering): If your solar panels produce extra electricity, the utility company (like Meralco) buys it from you or credits your bill. This is how solar pays for itself. - Sec. 12 (Fiscal Incentives): Tax holidays on importing solar equipment." Slide 3: Why Solar in the Philippines? "We are located near the equator. Average solar irradiance is 4.5-5.5 kWh/m²/day—that's HIGH. Compare to Germany (3.0), a solar leader. We have more sun, but we install less. Your job is to close that gap." Slide 4: Site Selection – The 5 Non-Negotiables "Write this acronym: S.O.I.L. - Shadows: No shadows between 9 AM – 3 PM (peak sun hours). - Orientation: In the Philippines (northern hemisphere), panels face TRUE SOUTH for maximum yearly output. - Inclination: Tilt angle = latitude (e.g., Manila 14° = tilt 10-	This script ensures fidelity of instruction. The acronym (SOIL) provides a mnemonic for long-term retention. Linking local data (PH irradiance) to global context (Germany) builds analytical thinking. **Facilitation Note:** Pause after each slide. Ask one concrete question: "What does 'net metering' do for a homeowner?" (Answer: Credits extra power).

	15°). - Load-bearing: Roof must hold 15-20 kg/m². Plus safety: Access for cleaning and firefighter access." Teacher says: "Repeat after me: No shadows 9 to 3. Face true south. Tilt equals latitude. Roof must be strong." **3. Developing Mastery** **Activity: "Two Truths and a Lie – PV Edition"** Teacher says: "On your notebook, number 1-3. I will read three statements. Identify the ONE lie." 1. "RA 9513 provides tax incentives for solar installers." (Truth) 2. "In the Philippines, solar panels should face north to catch the afternoon sun." (LIE – they should face south). 3. "Shading from a tree branch can reduce an entire panel's output." (Truth). Teacher says: "Stand up if you said #2 is the lie. Keep standing. Now, why is it a lie? Tell your partner."	Gamification increases engagement. Immediate peer discussion (Think-Pair-Share) consolidates the orientation concept—a common source of installer error. **Facilitation Note:** Walk around and listen to partner talk. Clarify: "True south, not magnetic south."
C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** Teacher projects a new photo: A house with a beautiful large roof, but with a chimney on the south side and a water tower casting a shadow. Teacher says: "You are the PV installer. The homeowner says: 'Put panels everywhere on that big roof.' Using the SOIL acronym, what do you say? Write a 2-sentence response." Teacher calls 3 students: "Read your response." (Expected: "We cannot place panels in the shadow of the chimney or	Direct alignment to Performance Standard "perform site assessment." Moves from theory to professional communication. This is a workplace simulation. **Facilitation Note:** Praise students who say "no" to the client. Assertiveness in rejecting bad sites is a safety competency.

	water tower from 9-3. We can place them on the west or east section, but output will be lower.") **2. Making Generalization** Teacher asks 3 culminating questions: 1. "What is one right that RA 9513 gives to a solar homeowner?" (Net metering / incentive). 2. "What is the most destructive enemy of a solar panel?" (Shade). 3. "If a roof faces north, can you still install?" (Yes, but lower output; or re-rack to ground). Teacher says: "Complete this sentence in your notebook: 'Site assessment is not just about finding a roof, it is about finding the right…' (Finish it: '…orientation, structure, and sun access.') **3. Evaluating Learning** Teacher distributes printed quiz. Quiz: Concepts & Principles of PV Systems Instructions: Write the letter of the best answer. 1. What does "PV" stand for in PV Systems? a. Power Voltage b. Photovoltaic c. Philippine Voltage d. Passive Ventilation	Explicit summarization using incomplete sentences forces cognitive closure. The final phrase links the day's content directly to the course title. **Facilitation Note:** Collect 3 random notebooks to check sentence completion. Quiz is content-valid (maps directly to objectives: RA 9513, orientation, shading). Question types are recall and simple application—appropriate for first lesson.

	2. Which Philippine law promotes the development of renewable energy sources, including solar? a. RA 7920 (Electrical Engineering Law) b. RA 9513 (Renewable Energy Act) c. RA 8749 (Clean Air Act) d. RA 9003 (Ecological Solid Waste Act) 3. In the Philippines, for maximum annual energy production, solar panels should ideally face which direction? a. North b. South c. East d. West 4. What is “net metering”? a. Measuring the physical size of a solar panel b. A billing mechanism that credits solar system owners for excess electricity they add to the grid c. The process of grounding a PV array d. A type of solar inverter 5. During a site assessment, what is the critical time window to check for shading? a. 6 AM – 6 PM b. 9 AM – 3 PM c. 12 NN only d. Sunset only	**Facilitation Note:** Grade immediately in class via peer checking. Read answers aloud.

	ANSWER KEY: 1. b 2. b 3. b 4. b 5. b **4. Additional Activities** **For Enrichment:** "Go to Google Earth. Find your own house or a relative's house. Use the ruler tool to measure your roof's orientation (N,S,E,W). Write a 3-sentence report: 'My roof faces [X]. It is good/poor for solar because…'" **For Remediation:** "Re-read the handout on RA 9513 Sec. 7 (Net Metering). Then draw a simple diagram: House with panels → meter → grid. Label 'export' and 'import' arrows."	Differentiated tasks. Enrichment uses authentic tech (Google Earth) for real-world practice. Remediation uses drawing—a lower linguistic load but high conceptual clarity. **Facilitation Note:** Post both tasks on your LMS or board. Do not frame one as "for weak students."
VI. ASSESSMENT	**Performance Task Title:** ***The Solar Site Assessor's Report*** Scenario: You are a junior PV installer at "Sikat Solar," Inc. A homeowner in your barangay has sent three photos of their property (provided by the teacher: Photo A – south-facing roof with a satellite dish; Photo B – east-west roof with a large acacia tree; Photo C – a sturdy metal garage roof, no shade, facing southwest). The homeowner wants panels installed but does not know where. Task: Write a 1-page Site Assessment Memo addressed to the homeowner. Your memo must include: 1. Site Ranking: Rank the three locations (Best, Acceptable, Not Recommended) using the SOIL criteria.	

2. Legal Justification: Cite one specific provision of RA 9513 (e.g., net metering) to explain how they will benefit financially.
3. Safety Note: Mention one safety precaution you will take during installation (e.g., "We will use a fall arrest system because the roof pitch is steep.").
4. Recommendation: Recommend ONE site and explain why in 2 sentences.

Rubric for Site Assessment Method

CRITERIA	Excellence (4 points)	Satisfactory (3 points)	Developing (2 points)	Needs Support (1)
Technical Accuracy (SOIL)	Correctly identifies orientation, shade, tilt, and load for all 3 sites.	Correctly identifies 3 of 4 criteria for all sites.	Correctly identifies 2 criteria or misapplies one rule.	Major errors (e.g., says north is best).
Use of RA 9513	Quotes specific section (e.g., Sec. 7) and explains net metering correctly.	Mentions RA 9513 by name and describes net metering generally.	Mentions solar law but no section or incorrect effect.	No mention of the law or completely wrong.
Safety Precaution	States a specific, realistic safety precaution relevant to PV installation.	States a general safety precaution (e.g., "be careful").	States an irrelevant precaution (e.g., wear a hard hat for office work).	No safety precaution mentioned.
Professional Communication	Memo format, clear, respectful, no spelling errors.	Memo format, minor errors.	Lacks memo format, some unclear parts.	Unprofessional or confusing.

Teacher's Note: A score of 12-16 = "Pass" (ready for actual site visit simulation in Lesson 2).

VII. REFLECTION	**To be filled out by the teacher after the lesson.** 1. Which part of the lesson (e.g., the SOIL acronym, the quiz, the site photo analysis) engaged students the most? Cite specific student behaviors. 2. Did any student struggle with the concept of "true south" vs. "shadows"? What misconception appeared in their quiz or memos? 3. For the next class, will I modify the lecture length, add a physical demonstration (e.g., using a flashlight and a toy house), or re-teach net metering? What specific action will I take?
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.

LESSON EXEMPLAR			
Learning Area	PHOTOVOLTAIC SYSTEMS INSTALLATION	**Lesson Exemplar**	2

I. OBJECTIVES	
D. Content Standard	The learners demonstrate an understanding of the concepts and principles of solar energy system in Photovoltaic (PV) Systems Installation.
E. Performance Standard	The learners perform site assessment with safety precautions.
F. Learning Competencies	Perform site assessment procedures.
II. REFERENCES and MATERIALS	**References:** • TESDA Training Regulations for PV Systems Installation NC II. • Photovoltaic Systems by James P. Dunlop (Chapter on Site Assessment). • Philippine Electrical Code (PEC) 2017 Edition (Articles on working space and PV systems). • National Renewable Energy Laboratory (NREL) PVWatts Calculator (Online tool) **Materials:** • Laptop/Projector for presentation • Whiteboard/Markers • Printed copies of a "Site Assessment Checklist" • Compass (physical or on smartphone) • Clinometer or smartphone app (e.g., "Angle Finder") • String, measuring tape • Sample photos of different roof types (flat, slanted, metal, tile) • Sample shade analysis tools (e.g., Solar Pathfinder or printed sun path diagrams) • Student Activity Sheets
III. CONTENT	**Site selection criteria**
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. Calculate shading losses, verify orientation azimuth and tilt, and test structural load capacity as critical criteria for PV site selection.

	2. Use basic assessment tools and visual inspection techniques to evaluate a site and determine its suitability for solar panel installation. 3. Present accurate site assessment findings with objectivity, attention to detail, and proper justification of observations.	
V. PROCEDURES		**ANNOTATIONS**
D. Activating Prior Knowledge	**1. Activating Prior Knowledge** **"Think-Pair-Share"** Teacher says: "Good morning, class! To start us off, let's have a quick Think-Pair-Share. Think about this: You're planning to install solar panels on your own home. Where is the first place on your roof you would not want to put them? On a whiteboard or a piece of paper, quickly sketch a simple house and put an 'X' on the spot you think is the worst for solar panels. (Give students 1 minute to think and sketch). Now, share your sketch with your seatmate and explain your choice." After the pair discussion, the teacher calls on 2-3 students to share their partner's reasoning. Common answers may include "north side" (in the Northern Hemisphere), "under a big tree," or "where there's a chimney." **2. Establishing the Purpose of the Lesson** Teacher says: "Excellent observations! You've intuitively touched on the most critical part of our job as PV installers. You can have the most expensive, high-efficiency panels in the world, but if you put them in the wrong place, they will not perform. Today, we are going to move from 'gut feeling' to a professional, systematic process. By the end of this lesson, you won't just guess where to put panels; you will be able to conduct a proper site assessment. This is the foundation of a successful and safe PV installation. The	Facilitation: This activity activates prior knowledge by asking students to connect personal experience (or intuition) to the concept of site suitability. Rationale: It surfaces common misconceptions (e.g., assuming any roof is good) and creates a "need to know" for the formal criteria that will be taught. The sketch allows for non-verbal expression and immediate engagement. Facilitation: The teacher explicitly connects the student's prior knowledge to the professional skill of "site assessment." The phrase "move from 'gut feeling' to a professional, systematic process" sets the tone for the rigor of the lesson. Rationale: This establishes relevance and purpose, increasing student motivation. It frames the lesson not

	skills you learn today are exactly what you will use on the job to determine if a project is even feasible before you start."	just as an academic topic but as a core professional competency.
E. Instituting New Knowledge	**1. Presenting Examples** **"Rate the Site!"** Teacher says: "Let's look at some real-world examples. I'll show you four pictures. For each one, I want you to give me a thumbs-up if you think it's a good site for solar panels, and a thumb-down if it's a bad site." (Teacher shows images) 1. A south-facing, clean, asphalt shingle roof with no visible obstructions. *Image generated by google Gemini (OpenAI), March 27, 2026, from the prompt "Create an image for this solar panel: A south-facing, clean, asphalt shingle roof with no visible obstructions.".* 2. A beautiful roof covered by the large shadow of a neighboring building. *Image generated by google Gemini (OpenAI), March 27, 2026, from the prompt "Create an image for this solar panel: A beautiful roof covered by the large shadow of a neighboring building."* 	Facilitation: The teacher uses visual examples and a simple, low-stakes polling method to engage the entire class. Rationale: This activity scaffolds the concept by moving from simple visual judgments to the underlying principles. It allows the teacher to identify misconceptions (e.g., a structurally sound roof is not automatically a good solar site) and primes students for the detailed discussion that follows.

	3. A flat commercial rooftop with HVAC units and other equipment scattered around. *Image generated by google Gemini (OpenAI), March 27, 2026, from the prompt "Create an image for this solar panel: A flat commercial rooftop with HVAC units and other equipment scattered around."* 4. A north-facing roof (in the Northern Hemisphere) that appears structurally sound. *Image generated by google Gemini (OpenAI), March 27, 2026, from the prompt "Create an image for this solar panel: A north-facing roof (in the Northern Hemisphere) that appears structurally sound."* After each image, the teacher pauses, asks for thumbs, and calls on a few students to explain their reasoning. Teacher asks: "For image 4, many of you gave a thumb-down. But why? The roof looks new and strong. What's the problem?" This leads to a discussion about orientation. **2. Discussing New Concept** Teacher says: "Now let's get into the specifics. The four pictures we just saw represent the four pillars of site selection criteria. I want you to take notes in this format on your activity sheet."	Facilitation: The teacher presents the information in a structured, lecture-based format but uses a conversational tone and real-world examples. Key terms are emphasized verbally. Rationale: This section provides the detailed, technical knowledge base required for the competency. The lecture is organized into four clear pillars, which helps students categorize and retain the information. The teacher explicitly links back to the examples used earlier, reinforcing the learning. The inclusion of regional context (magnetic declination) and local codes (PEC) grounds the learning in the students' context.

	(Teacher displays a slide or draws on the board: SITE ASSESSMENT CRITERIA) 1. Solar Resource & Shading Analysis - Teacher says: "This is the most important. It answers the question: 'How much sunlight actually hits this surface?' We're not looking for a little bit of sun; we need a location that receives unobstructed sunlight from 9:00 AM to 3:00 PM—the peak solar window. This is non-negotiable for a viable system." - "Shading is the enemy. It's not just the tree in the yard. We look for 'shading objects': trees (especially evergreens that don't shed leaves), chimneys, vent pipes, dormers, power lines, and even the shadow from an adjacent building. A tiny bit of shade on one panel can reduce the output of the entire string of panels. We use tools like the Solar Pathfinder (a reflective dome that shows the sun's path) or digital tools like SunEye or Helioscope to quantify shading." 2. Structural Integrity & Roof Condition - Teacher says: "Solar panels are heavy. A typical system adds 3-5 lbs. per square foot. Can the roof support that? We need to assess the roof's age and material. If a roof is older than 10-15 years, it might need replacement *before* we install panels. We wouldn't want to install a 25-year system on a roof that needs to be replaced in 5 years." - "We also inspect the roofing material. Asphalt shingles are the easiest. Clay or slate tiles are more complex and require special mounting hardware. We must also check for any signs of existing damage, like sagging, rot, or water stains in the attic."	

	3. Orientation & Tilt - Teacher says: "This is about pointing the panels in the right direction. Here in the Northern Hemisphere, the sun is always in the southern part of the sky. Therefore, true south is the optimal orientation. Using a compass, we find *magnetic* south, but we must account for 'magnetic declination'—the difference between true north and magnetic north—which is about 2-3 degrees east here in our region. A roof facing due south is ideal." - "Tilt is the angle of the panels relative to the ground. The optimal tilt angle is generally equal to the latitude of the location (e.g., about 14 degrees here). We use a clinometer or a smartphone app to measure the roof's pitch. While a perfectly optimal tilt is great, a roof that is off by 15 degrees in orientation or tilt will only reduce production by about 5-10%." 4. Accessibility & Safety - Teacher says: "Finally, we must consider how we will do the work. Is the roof accessible? Do we need a boom lift, or can we safely use ladders? Are there electrical lines nearby that pose a hazard? There must be adequate working space around the main electrical panel as required by the Philippine Electrical Code (PEC). We also need a safe, clear pathway to mount and install the panels and run conduit. If we can't install it safely, we can't install it at all." Teacher concludes the lecture: "These four criteria are interconnected. A south-facing roof with a great tilt is worthless if it's shaded. A structurally sound roof is not an option if it's unsafe to access. Our job as assessors is to weigh all these factors together."	Facilitation: The teacher facilitates group work by providing clear scenarios and a structured checklist. The teacher acts as a coach, asking Socratic questions to deepen student analysis rather than giving direct answers. Rationale: This activity moves students from passive listening to active application. The checklist scaffolds their analysis, ensuring they consider all four criteria. The scenarios present realistic, non-ideal situations that require critical thinking and justification, moving beyond simple recall.

	3. Developing Mastery Teacher says: "Now it's your turn to apply this knowledge. In your groups, you will become site assessors. I have given each group a 'Site Scenario Card' that describes a property. Using the criteria we just discussed, you will fill out the 'Site Assessment Checklist' I've provided. For each criterion, you'll note whether it's a 'Go,' 'Caution,' or 'No-Go' and write a brief justification." Group Task: - Scenario 1: A new house with a south-facing asphalt shingle roof. There's one large oak tree on the south side of the property, but it's 30 feet away and the roof peak clears its shadow after 10:00 AM. - Scenario 2: A flat, rubber membrane roof on a commercial building. It has no shading, but there is visible ponding water (puddles) and the building is 40 years old with no record of roof inspection. - Scenario 3: A north-facing roof in good condition with a steep pitch. The homeowner is insistent on installing panels because it's the "only roof they have." The teacher circulates, listens to group discussions, and asks probing questions: "You marked 'Caution' for the tree. What tool would you use to verify that the 9 AM-3 PM window is truly clear?" or "For the flat roof, why is ponding water a major concern?"	
F. Demonstrating Knowledge and Skills	**2. Finding Practical Application** Teacher says: "Let's bring this closer to home. Take out your phones and open the compass app. Or, if you don't have one, use the paper compass on your desk. Now, imagine this classroom has a south-facing wall. Where would that be? (Students find south). Good. Now, using a clinometer app or the paper protractor tool, estimate the tilt of the roof outside our window."	Facilitation: The teacher guides a practical, hands-on activity using the immediate environment and simple, accessible tools (smartphone apps). Rationale: This connects the abstract criteria to a tangible, real-world

	Teacher then asks: "Based on our quick assessment, if we were to install panels on this building's roof, what would be our primary challenge? Would it be orientation, shading from that tree, or structural integrity?" Teacher says: "This simple exercise shows you that a site assessment begins the moment you arrive at a property. You don't need a solar pathfinder to notice the big tree casting a shadow at 10 AM. This skill of observation is your most important tool." **2. Making Generalization** Teacher asks: "We've covered a lot today. In your own words, what is the single most important question a site assessment must answer? (Allow 2-3 students to answer). A great answer might be: 'Is this location safe and will it generate enough energy to meet the client's needs and be a good financial investment?'" Teacher says: "The generalization we can make is this: A successful PV installation is not just about the quality of the panels, but about the quality of the marriage between the system and its environment. A site assessment is like a compatibility test. It ensures that the location, the structure, and the solar resource are all compatible for a long-term, productive, and safe relationship. Remember, we are not just selling solar panels; we are selling long-term energy solutions, and that starts with a solid foundation—a proper site assessment."	context. It demonstrates that the skills learned are not just theoretical but can be applied immediately. It reinforces the idea that site assessment is a hands-on, observational skill. Facilitation: The teacher uses a guided questioning technique to lead students to synthesize the day's learning into a concise, memorable takeaway. Rationale: This helps solidify the core concept in the students' long-term memory. The generalization moves beyond the facts ("list the four criteria") to the overarching principle of compatibility and value, which is crucial for their professional mindset.

	3. Evaluating Learning Teacher says: "Let's take a short quiz to check our understanding." Quiz: 1. What is the "peak solar window" time frame that a site should ideally be free from shading? 2. In the Northern Hemisphere, what is the optimal orientation for a fixed-tilt PV array to maximize energy production? 3. Why is assessing the age and condition of a roof a critical part of the site assessment process? 4. Name two potential shading obstacles an installer should look for during a site visit. 5. A client has a roof that is perfectly oriented and free of shade but has a severe termite infestation affecting the roof rafters. Would you consider this site suitable for PV installation? Justify your answer. **4. Additional Activities** Remediation: For students who scored below 80% on the quiz, provide them with a copy of the lecture slides and the "Site Assessment Checklist." Ask them to re-watch a 5-minute YouTube video on "Solar Site Assessment" and then re-evaluate one of the in-class scenarios, writing a one-paragraph explanation of their findings. Enrichment: For students who mastered the quiz, assign them to research and compare two professional site assessment tools (e.g., Solar Pathfinder vs. DroneDeploy). Have them create a simple one-page infographic that compares the features, cost, and benefits of each tool for a small PV installation business.	Facilitation: The teacher administers a short, focused quiz to measure attainment of the learning objectives. Rationale: This is a formative assessment to measure individual student understanding of the core concepts. It provides immediate feedback for both the teacher and the student before moving on to the culminating performance task. Facilitation: The teacher provides differentiated activities based on quiz performance. Rationale: This ensures all students are supported. Remediation reinforces foundational concepts, while enrichment challenges advanced learners to explore the field's professional tools and technology.

VI. ASSESSMENT

Performance Task: "The Solar Site Assessment Report"

- Scenario: You are a PV system installer assigned by your company, "Solar Solutions Inc.," to conduct a preliminary site assessment for a potential client. Your manager has provided you with a Site Profile Packet containing photos, a simple map, and written notes about the property. Your task is to create a professional Site Assessment Report to present to your manager and the client.
- Task: Based on the provided Site Profile Packet (which includes: a photo of the roof from the street, a photo from the attic showing rafters, a photo of the main electrical panel, a simple sketch of the property showing the location of a large tree and a two-story neighbor's house, and notes that the client has a tile roof), you will:
    1. Analyze the site using the four criteria (Solar Resource, Structural Integrity, Orientation/Tilt, Accessibility/Safety).
    2. Fill out the "Site Assessment Checklist" provided.
    3. Write a 1–2-page formal report summarizing your findings.
    4. Conclude with a clear recommendation: "Site Suitable," "Site Unsuitable," or "Site Suitable with Conditions." If conditions are required, you must specify them (e.g., "Suitable, pending a structural engineer's inspection of the roof rafters").

Scoring Rubric for Performance Task

CRITERIA	Excellence (10-9 pts)	Proficient (8-7 pts)	Developing (6-5pts)	Needs Improvement (4-0 pts)	Score
Analysis of Criteria	Accurately and thoroughly analyzes all four criteria (Solar, Structural, Orientation, Access). Identifies subtle or potential issues.	Accurately analyzes all four criteria. Identifies major issues.	Analyzes only 2-3 criteria. May miss obvious issues or inaccurately assess a criterion.	Fails to analyze most criteria. Analysis is inaccurate or missing.	

	Data Utilization	Effectively uses all provided data (photos, notes, sketch) to support analysis and conclusions.	Uses most of the provided data to support analysis.	Uses some data, but may ignore or misinterpret key pieces of evidence.	Fails to use the provided data.	
	Recommendation & Justification	Provides a clear, decisive recommendation (Suitable/Unsuitable/Conditional). Justification is logical, detailed, and directly linked to the criteria and data.	Provides a clear recommendation. Justification is present and linked to the criteria.	Recommendation is vague or not fully supported by the analysis. Justification is weak.	Recommendation is missing or illogical. No justification is provided.	
	Professionalism & Format	Report is well-organized, professionally formatted, uses correct terminology, and is free of spelling/grammar errors.	Report is organized and uses mostly correct terminology. Minor errors present.	Report is disorganized or has significant errors in terminology, spelling, or grammar.	Report is poorly presented and difficult to understand.	
	TOTAL SCORE					

VII. REFLECTION	**To be filled out by the teacher after the lesson.** 1. Did the learners achieve the lesson objectives on PV site assessment? 2. Which activity was most effective in helping learners understand the lesson? 3. What challenges did learners encounter, and how can instruction be improved?
VIII. USE OF	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.

LESSON EXEMPLAR			
Learning Area	PHOTOVOLTAIC SYSTEMS INSTALLATION	**Lesson Exemplar**	3

I. OBJECTIVES	
G. Content Standard	The learners demonstrate an understanding of the concepts and principles of Photovoltaic (Solar Energy) Systems Installation.
H. Performance Standard	The learners perform photovoltaic (solar energy) systems installation with safety precautions.
I. Learning Competencies	Perform inspection of PV components, materials and measuring instruments compliance.
II. REFERENCES and MATERIALS	**References:** • Philippine Electrical Code (PEC) Part 1, Article 6.90 – Solar Photovoltaic (PV) Systems • International Electrotechnical Commission (IEC) 61215: Terrestrial photovoltaic (PV) modules – Design qualification and type approval • Underwriters Laboratories (UL) 1703: Standard for Flat-Plate Photovoltaic Modules and Panels • Department of Education. (2020). K to 12 Basic Education Curriculum: Senior High School – Photovoltaic Systems Installation. Manila: DepEd. **Materials:** • Laptop and Projector/TV • Actual PV module, inverter, charge controller, mounting structure, and DC/AC disconnect switches • Sample product labels (or high-resolution images of labels from different manufacturers) • Digital multimeter • Inspection checklist template (printed) • Safety gloves, safety glasses, and insulated tools • Markers and Manila paper for group activity
III. CONTENT	**Components and materials standards (IEC, UL, PEC)**

IV. OBJECTIVES	At the end of the lesson, learners should be able to: 5. Identify key PV components and the acronyms of major standards organizations (IEC, UL, and PEC). 6. Explain the role of IEC, UL, and PEC standards in ensuring PV system safety and compliance. 7. Inspect PV components using a checklist to verify physical condition and required certification labels. 8. Evaluate PV component labels for compliance with PEC and international standards.	
V. PROCEDURES		**ANNOTATIONS**
G. Activating Prior Knowledge	**1. Activating Prior Knowledge** **"One Word, One Purpose"** Teacher says: "Good morning, class! Before we start, let's have a quick review. Last quarter, we discussed the basic components of a PV system. On a piece of paper, I want you to list down at least three main components and write one word that describes the purpose of each. For example, 'Solar Panel: Energy.' You have 3 minutes." After 3 minutes, the teacher asks a few students to share their answers, guiding the class to confirm the main components: PV Module (Energy Source), Inverter (Conversion), Charge Controller (Regulation), and Battery (Storage). **2. Establishing the Purpose of the Lesson** **Teacher says:** "Excellent recall. Now, imagine you are a newly hired PV system installer. You are given a brand-new solar panel to install on a client's roof. How do you know if this panel is safe to install? How do you know if it will perform as promised and won't start a fire? You can't just trust the brand name. You need proof. Today, we will learn how to look for that proof by inspecting PV components for	This activity serves as a diagnostic assessment to ensure students have the foundational knowledge of what the components are before moving to how to inspect them. The use of a quick write activates prior schema and sets the stage for the lesson's focus on standards.

	compliance with international and local safety and performance standards. This is your first step in becoming a certified, professional PV installer who protects clients and ensures system reliability.”	
H. Instituting New Knowledge	**1. Presenting Examples** “**Logo & Symbol Scavenger Hunt”** Teacher says: “Before we dive deep, let's look at what we're inspecting. I'm going to pass around a real PV module and a sample inverter. As you examine them, I want you to focus on the labels at the back of the module and the side of the inverter. Don't read the technical numbers yet. Instead, look for any logos, symbols, or acronyms you recognize. Can anyone spot a logo or a set of letters that looks official or like a certification mark?” The teacher facilitates a brief discussion, encouraging students to point out markings like "UL," "IEC," "TÜV," "PEC," and CE logos, even if they don't know what they mean. **2. Discussing New Concept** **Teacher says:** “Great observations! All those logos and acronyms are the 'fingerprints' of compliance. Let's decode what they mean and why they are on your inspection checklist. I will be using this presentation. Please take notes in your activity notebook.” The teacher then presents a detailed lecture using a slide deck or whiteboard, covering the following:	This activity uses concrete, tangible objects to make abstract concepts like "standards" visible and real. By asking students to search for and identify markings, the teacher piques their curiosity and creates a "mystery" that the upcoming discussion will solve. It moves the learning from abstract to concrete.

	Slide 1: The "Why" of Standards - "Standards are not just bureaucratic hurdles. They are the rulebook for safety and reliability. They ensure that the solar panel on your roof won't: - **Start a fire** (due to poor insulation or overheating). - **Electrocute** the installer or homeowner. - **Fail prematurely** (lose efficiency after a few months). - **Damage** other components like the inverter or battery. - When we inspect for compliance, we are verifying that a component has passed rigorous tests to prevent these failures." **Slide 2: IEC (International Electrotechnical Commission)** - "What is it? A global, non-profit organization that develops international standards for all electrical, electronic, and related technologies. It is not a testing lab itself. - **Key Standard:** For PV modules, **IEC 61215** is the 'gold standard.' It tests for durability—things like mechanical load (hail, wind), damp heat, and temperature cycling. A module that passes IEC 61215 is certified to withstand environmental stress. - **What to look for during inspection:** The label should state IEC 61215 or IEC 61730 (for safety). Its presence means the module is internationally recognized as safe and durable." **Slide 3: UL (Underwriters Laboratories)** - "What is it? A global safety science company based in the USA. They test products for fire, shock, and other safety hazards. While it's an American standard, it's widely accepted globally and is often required by insurance companies and local building codes, including in the Philippines. - **Key Standard:** For PV modules, **UL 1703** focuses on fire safety and electrical shock hazards. - **What to look for during inspection:** The label will have	This is the core content delivery. The lecture is structured to be a direct, ready-to-use script for the teacher. It moves from explaining the "why" (purpose of standards) to the specifics of each standard (IEC, UL, PEC) and finally ties it together into a practical inspection framework. The use of

	a UL logo (a circled UL). Its presence is a key indicator of product safety, especially for fire prevention. The PEC often references UL standards." **Slide 4: PEC (Philippine Electrical Code)** - "What is it? The PEC is the law. It is the set of rules and regulations that govern all electrical installations in the Philippines, including PV systems. It is based on the US National Electrical Code (NEC) but adapted for the Philippine context. - **Key Section: Article 6.90** is dedicated to Solar Photovoltaic Systems. It dictates everything from conductor sizing to overcurrent protection and disconnecting means. - **What to look for during inspection:** The PEC itself is not a sticker on a component. Instead, the PEC *mandates* that components must be listed and labeled by a recognized testing laboratory (like UL or TÜV). So, when you see a UL or IEC mark, you are checking for **compliance with PEC Article 6.90**. An inspector's job is to ensure the installation follows PEC rules and that components are certified by a lab." **Slide 5: The Inspection Checklist** - "Now, let's put this into practice. Your inspection checklist will have two key parts: 1. **Physical Inspection:** Look for cracks, corrosion, water ingress, or loose parts. 2. **Labeling & Documentation Inspection:** Verify the presence of the marks we just discussed. - **Example Checklist Items:** - [ ] PV Module label is legible and permanently affixed. - [ ] PV Module label shows IEC 61215 and/or UL 1703 certification. - [ ] Inverter label shows UL 1741 (the standard for inverters, converters, controllers, and interconnection system equipment).	slide titles and clear subheadings makes the information digestible for students. The teacher directly connects the PEC to the UL/IEC marks, showing how the different standards interrelate.

	- [ ] All components are listed by a recognized testing laboratory (e.g., UL, TÜV, CSA)." **3. Developing Mastery** **Teacher says:** "Let's see if you can apply what you just learned. In your groups of four, you will receive a 'Component Inspection Card.' Each card has a picture of a label from a PV component. Your task is to analyze the label and answer the questions on the card. You have 10 minutes." **Sample Cards:** - **Card 1 (Compliant PV Module):** Image of a label clearly showing "IEC 61215," "UL 1703," and a TÜV logo. Questions: "Is this module compliant with international standards? Which ones? Would the PEC likely accept this?" - **Card 2 (Non-Compliant Inverter):** Image of a label with only a generic "CE" mark (which is a self-declaration, not a third-party certification like UL) and no mention of UL 1741. Questions: "What certifications are missing? Is it safe to install this inverter in a Philippine residential system? Why or why not?" - **Card 3 (Damaged Module):** Image of a module with a physical crack and a faded, partially torn label. Questions: "What are the two types of inspection failures here? Why is a legible label just as important as a physical one?" After the group work, the teacher calls on groups to share their findings, clarifying any misconceptions.	This activity moves students from passive listening to active application. By analyzing sample labels and scenarios, students develop the critical skill of interpreting certification marks. The activity also reinforces that "compliance" involves both physical condition and proper documentation. The use of a "non-compliant" card forces students to practice the skill of identifying problems, a core part of the inspection process.
I. Demonstrating Knowledge and Skills	**3. Finding Practical Application** **Teacher says:** "Now, it's time for a simulated site inspection. I have set up three stations: Station A (PV Module), Station B (Inverter), and Station C (DC Disconnect Switch). At each station, there is a real component with some of them	This activity directly simulates the performance standard: "perform PV components inspection with safety precautions." It provides a hands-on,

	intentionally 'faulty.' Using the 'PV Component Inspection Checklist' you will conduct a real-world inspection. You have 3 minutes per station. Work in your groups. One person can be the recorder, another the inspector. Remember safety first: wear your gloves and glasses, and do not touch any exposed terminals." The teacher circulates among the stations, observing the groups and facilitating by asking questions like, "Did you check for the UL mark? What does the PEC say about this?" **2. Making Generalization** **Teacher says:** "Let's step back for a moment. We started by looking at labels and ended by inspecting actual components. Let's summarize. What is the most important reason we inspect PV components for these standards? (Teacher solicits answers) **Teacher concludes:** "Exactly. We don't just inspect to follow a rule. We inspect to ensure **safety** and **reliability**. The IEC, UL, and PEC marks are not just stickers; they are a promise that a component has been tested to withstand real-world conditions and won't endanger life or property. As future PV professionals, you are the guardians of that promise. Your inspection is what separates a professional, safe installation from a potential hazard."	authentic application of the knowledge and skills developed throughout the lesson. The teacher's role shifts to a facilitator and coach, providing guidance and ensuring safety procedures are followed. This activity uses a guided discussion to help students synthesize the lesson's key ideas. The teacher's concluding statement reinforces the ethical and professional responsibility tied to the skill, elevating it from a technical task to a core professional value.

3. Evaluating Learning

Teacher says: "To check your understanding, please get a ¼ sheet of paper for a short quiz. Write your name and the date."

QUIZ: PV Component Standards and Inspection

Part I: Matching Type (5 points)
Match the standard/acronym in Column A with its correct description in Column B.

COLUMN A	***COLUMN B***
1. IEC	*A. The primary safety standard for PV modules, focusing on fire and shock.*
2. UL	*B. The governing electrical code in the Philippines.*
3. PEC	*C. The international standard (e.g., 61215) for testing PV module durability.*
4. UL 1703	*D. A global safety science company known for testing electrical products.*
5. Article 6.90	*E. The specific section of the PEC that covers Solar Photovoltaic Systems.*

Part II: Identification (5 points)
Write the correct answer on the blank.
6. What two things must an inspector verify during a component inspection, as mentioned in the discussion? (List both)

The quiz serves as a summative assessment of the day's learning objectives. It is designed with both recall (Matching, Part II) and application (questions 8-10) items to assess different levels of understanding, directly aligned with the unpacked objectives.

	7. You are inspecting a PV module label. What specific IEC standard number should you look for that proves it has passed durability tests? 8. A client wants to install an inverter with only a "CE" mark. Why is this a red flag for a PEC-compliant installation? 9. Besides checking labels, what is another critical part of the physical inspection of a PV module? 10. According to the PEC, what is the primary requirement for components regarding their listing and labeling? **Answer Key:** 1. C 2. D 3. B 4. A 5. E 6. Physical condition and Labeling/Documentation 7. IEC 61215 8. The CE mark is a self-declaration, not a third-party certification. The PEC requires components to be listed by a recognized testing laboratory (like UL or TÜV). 9. Check for physical damage such as cracks, corrosion, or water ingress. 10. Components must be listed and labeled by a recognized testing laboratory. **4. Additional Activities** **Remediation:** For students who scored below 8 on the quiz, they will be assigned to create a simple 3-column table comparing IEC, UL, and PEC, including their purpose, what they test for, and what to look for during an inspection. They will submit this at the start of the next lesson.	This provides differentiated instruction to cater to varying levels of mastery. Remediation reinforces foundational concepts, while enrichment challenges high-achieving students to delve deeper into specific standards, fostering advanced understanding and research skills.

	Enrichment: For students who scored 9 or above, their task is to research one specific IEC standard (e.g., IEC 61730 for PV safety) or UL standard (e.g., UL 1741 for inverters) and write a one-paragraph summary explaining what the standard specifically tests for and why it's crucial for the Philippine setting (considering climate, installation practices, etc.). They will share their findings in the next lesson.	
VI. ASSESSMENT	**Culminating Performance Task: PV Component Inspection Simulation** • **Objective:** To assess the learner's ability to perform a comprehensive inspection of PV components, verifying compliance with IEC, UL, and PEC standards while strictly adhering to safety precautions. • **Scenario:** You are a PV systems installer conducting a pre-installation inspection for a new residential solar project. Your lead electrician has provided you with three PV components: a PV module, a grid-tied inverter, and a DC disconnect switch. Your task is to conduct a full inspection, documenting your findings on the official inspection report. The client's approval and the system's permit depend on your report's accuracy. • **Task:** Working individually, you will proceed through three inspection stations. At each station, you will: 1. **Wear appropriate Personal Protective Equipment (PPE):** Safety glasses and gloves. 2. **Conduct a Physical Inspection:** Visually and physically (where safe) inspect the component for any signs of damage, defects, or improper assembly. 3. **Conduct a Labeling & Documentation Inspection:** Carefully examine the component's label. Verify the presence of required certification marks (e.g., UL, IEC) and any other relevant information. 4. **Complete the Official Inspection Report:** Record your observations, findings, and final disposition (PASS/FAIL) on the provided form, citing the specific standard or code (e.g., "FAIL: UL 1703 mark not present, non-compliant with PEC 6.90").	

Scoring Rubric for Performance Task

CRITERIA	Excellence (5 points)	Satisfactory (3 points)	Needs Improvement (1 point)	SCORE
Safety Protocol	Consistently wears appropriate PPE before starting. Demonstrates safe handling of components at all times.	Wears PPE but may handle components slightly unsafely (e.g., poor grip).	Fails to wear PPE or handles components in a clearly unsafe manner.	
Physical Inspection	Identifies all relevant physical defects (e.g., cracks, corrosion, loose parts) with high accuracy.	Identifies major physical defects but may miss minor or non-obvious ones.	Fails to identify obvious physical defects or misinterprets normal wear as defects.	
Label Compliance Verification	Correctly identifies all relevant certification marks (IEC, UL, etc.) and links them to their significance (PEC, safety, performance).	Identifies the main certification marks but may miss secondary ones or not fully explain their significance.	Fails to identify or misidentifies key certification marks.	
Documentation & Report	Report is complete, accurate, and clearly written. Findings are correctly justified with citations to specific standards (e.g., "IEC 61215").	Report is mostly complete but may have minor omissions. Justifications are general (e.g., "no UL mark").	Report is incomplete, inaccurate, or missing. No justifications provided.	

	Final Disposition	Correctly determines PASS/FAIL status for all components based on the evidence and standards.	Correctly determines status for most components but may be indecisive on one.	Incorrectly determines status for a component (e.g., passes a clearly non-compliant part).	
VII. REFLECTION	**To be filled out by the teacher after the lesson.** 1. Were the learners able to correctly identify and explain the importance of IEC, UL, and PEC standards during the inspection activities? 2. Which part of the lesson helped learners most in understanding PV component compliance and safety procedures? 3. What teaching strategies or activities can be improved to enhance learners' skills in conducting PV component inspections?				
VIII. USE OF	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.				