Project-Based Learning and Assessment (PBLA) – Math Exemplar 2025–2026

Grede	05
Stream	Advance & Mainstream- Reveal
Scenario Title	**Green Pages Project:** Saving Books and Trees
Scenario Statement	At the end of every school year, many used **notebooks and textbooks** remain at home even though students no longer need them, instead of being recycled or reused. This leads to unnecessary waste and increases the amount of **water, energy, and carbon emissions** required to produce new paper. Your mission is to design a **Paper Recycling Plan**: collect last year's school books and papers from home or class as a group, **measure and convert** their weights (**Note:** you need a digital or a manual scale **set to grams (g)**), **estimate the total number of papers collected,** and **predict** the water and energy saved by recycling. Finally, share your findings and propose **simple, sustainable actions** that students, families, and the school community can follow to **keep the paper cycle sustainable every year**.
Lessons	L1: Division Patterns with Decimals and Powers of 10 L2: Estimate Quotients of Decimals L3: Represent Division of Decimals by a Whole Number L4: Divide Decimals by Whole Numbers
Learning Outcomes	• Use place-value patterns to divide a decimal by a power of 10. • Explain patterns when dividing a decimal by a power of 10. • Explain how to estimate quotients of decimals. • Estimate quotients of decimals to determine if calculations are reasonable. • Use an estimated quotient to make predictions about a calculated solution. • Represent division of decimals by whole numbers using equal sharing or equal grouping. • Use place-value understanding and equivalent representations to divide a decimal by a whole number.

Stage 1 – Sub-Stage: Understand (Week 1 | 2 Periods)			
Purpose : To understand the environmental impact of leaving unused books at home and how recycling protects natural resources. To introduce the unit **Divide Decimals** as tools to measure and communicate real-world waste.			
Teacher Role and Key Actions	Period and Time	Student Role and Learning Tasks	Evidence in Students' Portfolio (Examples)

• **1. Introduce the PBLA concept and use driving questions to build curiosity and connect the scenario to real-life contexts and curriculum links**
  • "This term, we will work on a PBLA project to explore and solve a real-world problem using mathematics. Think about your old schoolbooks from last year. Where are they now? Why do many families keep them? What might happen if we never reuse or recycle them? How does this affect our environment?"
 	
The teacher presents images comparing:
 	
  • Paper factory water + energy use
  • Recycled paper production
 	
Mini-lesson introduces **L1: Division Patterns with Decimals and Powers of 10**, showing how **÷ 1,000** converts grams to kilograms.
Teacher models **explaining reasoning**, not only calculating.
 	
The teacher guides students in completing a **KWL chart**, helping them form questions about why recycling matters and how math helps measure impact.
		(No direct student task – this is the teacher's introduction and motivation stage.)	• Annotated scenario with highlighted problem statements.
			• KWL chart: What I Know / Want to Know / Learned about recycling and measurement: Table, chart, or reflection sheet.
			• Vocabulary map (gram, kilogram, estimate, quotient, fair share).
			• Mini conversion exercise (g → kg; W → kW).
			• Short reflection paragraph: "Why paper recycling matters to me."

• **2. Ask students to read the scenario carefully and guide group reading for collaborative comprehension.** **Instruction:** "Read the scenario and underline sentences that describe the impact of not recycling our old books and papers." Guiding questions: • "Who is affected by this problem?" • "What natural resources are used when new paper is made?		**1. Read the scenario statement in groups to identify the main problem and key ideas.** **Task:** Students work collaboratively to read the scenario and highlight sentences that describe the core issue.	

• "Why is storing old books at home also a form of waste?" **Differentiation**: • **Approaching Level:** Provide highlighted key words: recycle, reuse, waste, resources, energy, carbon footprint. • **On Level:** Students annotate the scenario and explain in their own words the environmental impact. • **Beyond Level:** Students infer underlying causes (habit, awareness) and identify additional stakeholders (family, community, environment).			
3. Avoid defining the problem details for students; instead, guide and support their inquiry process to collect relevant information without providing direct solutions. Support students in exploring the problem causes rather than suggesting solutions. **Task Prompt:** "At this stage, we are not solving the problem yet." We understand it. Your task is to identify: • What causes this issue? • Who is affected? • What information helps us explain the problem clearly?" **Differentiation**: • **Approaching Level:** Provide a Cause-Effect Graphic Organizer to map the issue visually. • **On Level:** Students write a short explanation of the problem using complete sentences and classroom vocabulary. • **Beyond Level:** Students evaluate multiple possible causes and connect the problem to wider environmental systems (e.g., carbon cycle, resource depletion).		**2. Discuss within the group and draft guiding questions needed to collect more information.** **Inquiry prompt:** Students work together to generate **inquiry questions** that help them explore **why unused books accumulate, what resources paper requires, and why recycling matters**. Students focus on **understanding the problem**, not solving it yet. **3. Engage in group discussion to explore possible reasons and contexts related to the scenario.** Guiding discussion questions: • Why do households keep books instead of donating or recycling them? • What happens to unused books over time? Do they provide value or just take space? • What natural resources do paper production require? (focus: **water**, **energy**, **trees**) • How does recycling reduce the need to produce new paper? • Who benefits the most if we recycle? (students, families, environment, school, community)	• Cause-Effect Map or Concept Map showing why old books are kept and why recycling matters.

		• Are there existing recycling practices at home or school? Why are they not used regularly? • What information do we need to measure or calculate in this project? (e.g., weight of paper, number of books, total collected).	
4. Ask each student to document findings individually in their portfolio, then facilitate group discussion to summarize shared understanding. Each student records their understanding in their portfolio before the group discussion. **Portfolio Writing Frames:** • "The problem we are studying is…" • "This problem matters because…" • "The important information I collected is…" **Differentiation**: • **Approaching Level:** Provide writing stems, sentence frames, or diagram formats. • **On Level:** Students write full explanations and share in groups. • **Beyond Level:** Students include reasoning supported with simple data (e.g., "recycling 1 kg of paper saves ~10 L of water").		**4. Decide on the methodology for collecting information and write the relevant questions.** Students determine **how** they will collect the data needed for the project, focusing on **identifying, gathering, weighing, and recording old books and papers**, along with any supporting information about recycling impact. **Student Tasks:** • Discuss in groups how to identify and collect old books and papers from home. • Decide which tools will be used to weigh paper (kitchen scale, school scale, etc.). • Choose how the information will be recorded (table, log sheet, checklist).	• Planned Data Collection Method written clearly + List of Guiding Questions the student will use to gather information: Small paragraph or step-by-step action plan.
• **5. Observe students' participation, provide feedback, and verify evidence before moving to the next stage.** • The teacher circulates and provides **feedback, guiding clarity and accuracy**. **Feedback Questions:** • "What new information did you learn about paper waste?" • "How do your notes help explain the cause of the problem?" • "Which part of the scenario helped you understand the issue clearly?"		**5. Collect and record information that deepens their understanding of the problem.** Students gather **factual, contextual, and mathematical information** that helps them understand **why unused books at home contribute to resource waste**, and how **recycling reduces environmental impact**.	• Short Research Notes (facts about paper, recycling water/energy savings, reasons waste increases) written in student words. • Photos or sketches from field observations • Interview summaries or observation notes • KWL chart – What I Learned section

Differentiation: • **Approaching Level:** Provide specific corrections and re-explaining where needed. • **On Level:** Ask students to clarify and deepen explanation with examples. • **Beyond Level:** Challenge students to evaluate which information is most relevant and justify why.		**Student Tasks:** • Search for reliable information from textbooks, school library materials, or safe teacher-approved websites. • Record findings using notes, bullet points, or a simple fact table. • Share collected information during group discussion to build shared understanding.	
6. Encourage students to collaborate to reach a consensus on the collected information or the methodology they will use. **Collaboration prompt:** • Students synthesize information together before moving to the Define stage. **Collaboration Prompt:** • "Work together to agree on the most accurate description of the problem and its causes." **Differentiation**: • **Approaching Level:** Assign structured roles among each group (recorder, timekeeper, summarizer). • **On Level:** Rotate roles so all students contribute to organization and discussion. • **Beyond Level:** Allow students to lead discussion, question team thinking, and verify evidence quality.		**6. Collaborate to reach a group consensus on the collected information or research approach.** Students work together to compare information, discuss what is most accurate and relevant, and agree on the method they will follow when they begin measuring and collecting paper in the next stage. **Student Tasks:** • Share collected notes, facts, and observations with group members. • Compare information to check for clarity, accuracy, and relevance. • Decide what information is important for explaining the problem and planning the data collection steps. • Agree on a common method the group will use for collecting, weighing, converting, and recording the paper.	• Group summary sheet showing team's collective understanding • Signed consensus or decision notes
Focus Skill: **Teacher Focus Prompts:** The teacher supports inquiry and context-building by asking: • "What is the problem this scenario is asking us to explore?" • "Why is keeping old books instead of recycling them a sustainability issue?"		**Skill Indicators:** - **Research & Inquiry (Main Skill):** Students explore the context, ask questions, and gather initial information to understand *what the problem is* and *why it is important*.	• Annotated scenario text (underlined key phrases showing the problem). • Short written explanation of the problem in the student's own words.

• "What parts of this problem might require measurement or calculation later?"
• "What information do we still need to find out before we make a plan?"
By guiding students to **explore context, recognize real-world impact, and identify where math will be needed**, the teacher builds strong foundations in **Research & Inquiry**, directly supporting the **Understand** stage criteria in the Math PBLA rubric.
	- **Making Connections to the Real World:** Students link the scenario to environmental impact (water, energy, paper production, waste).
	- **Self-Regulation:** Students reflect on what they already know and what they still need to find out before planning.
	- **Subject-Specific Skill – Data Exploration:** Students identify the **mathematical elements** in the scenario, such as:
	  ○ weight of paper
	  ○ number of sheets
	  ○ water and energy usage
	  ○ measurable environmental impact
	- They recognize that **math will be needed later** to calculate the recycling impact.
		• Cause–and–effect map or short paragraph explaining why the issue matters.
		• Group consensus statement summarizing shared understanding of the problem.

- Assessment
  ○ Needs significant improvement (1-2)
  ○ Beginning (3-4)
  ○ Developing (5-6)
  ○ Proficient (7-8)
  ○ Exceeding (9-10)		

Stage 1 – Sub-Stage**:** Define (Week 2 | 2 Periods)			
Purpose: Is for students to **narrow the problem**, **formulate a clear mathematical question**, and **plan how to collect and organize data** before starting measurements.			
Teacher Role and Key Actions	Period and Time	Student Role and Learning Tasks	Evidence in Students' Portfolio (Examples)
1. Revisit the scenario and guide students to restate the problem in their own words **Teacher Action:** Invite students to review what they learned in the Understand stage and restate the problem precisely. Encourage them to think about why measuring and recycling old books is important and how math can help describe this issue clearly. **Instruction to Students:** "Look back at what you discovered in the previous stage. In your own words, explain what the problem is and why it matters. What do we need to find out or calculate to understand it better?" **Guiding Questions:** • "What exactly is the problem we are investigating?" • "Why does keeping old books at home increase waste?" • "What data could we collect to describe or measure this problem?" **Differentiation**: • **Approaching Level:** Provide sentence starters and visual cues linking problem → cause → effect. • **On Level:** Students restate the problem independently with math vocabulary. • **Beyond Level:** Students reformulate the problem into a measurable question (e.g., 'How many kilograms of paper can be recycled from our class?').		**1. Restate the problem clearly in their own words** **Student Task:** Students review their notes and discussions from the Understand stage and write a clear, short explanation of the problem. **Portfolio Entry:** • "The problem we are studying is…" • "This problem matters because…" Students focus on why unused books cause waste and why recycling matters.	• Statement clearly describes the issue (old books kept → waste of resources). • Not copied from the teacher or scenario. • Uses vocabulary such as recycle, waste, resources, and environment.

2. Guide students to develop a focused mathematical problem statement. **Teacher Action:** Facilitate a discussion on converting the general environmental issue into a **mathematical question** that involves measurable quantities (weight, conversion, estimation). **Instruction to Students:** "Now let's turn our problem into a question we can answer using math. What exactly will we measure, calculate, or estimate to understand how recycling helps the environment?" **Examples of Math-Focused Problem Statements:** • "How much paper can our class collect and recycle?" • " How can we convert the total collected weight into kilograms?" • "How many papers have we collected in total?" • "How much water and energy can be saved by recycling our old books?" **Differentiation**: • **Approaching Level:** Provide a sentence frame: 'We want to find out how ____ changes when ____'.. • **On Level:** Students compose one complete, measurable problem statement. • **Beyond Level:** Students include prediction or estimation components (e.g., 'We predict recycling $20\ kg$ saves $200\ L$ of water.').		**2. Develop a focused mathematical problem statement** **Student Task:** Students convert the environmental problem into a **math-based investigation question**. **Examples of Student-Formulated Problems Statements:** • "How much paper can we collect to recycle from our class?" • "How many kilograms of paper do we have in total?" • "How much water and energy could be saved by recycling our paper instead of throwing it away?"	One clear, measurable question the project will answer: • The question is mathematical, not only environmental. • It is measurable using weight, sheets, or savings. Example: "How many sheets of paper can we recycle from our class?"
3. Support students in identifying what data and information are needed **Teacher Action:** Guide students to list the types of information, data, or evidence they will need. Highlight the connection between **mathematical data** (weight, units, conversion) and **contextual data** (recycling impact, water/energy savings). **Guiding Questions:** • "What information do we need to collect to answer our question?"		**3. Identify the data that needs to be collected** **Student Task:** Students list the specific measurements and information needed to answer the questions they wrote.	A list of what information must be collected to answer the problem. **Example**: • List includes estimated weight, actual weight, conversion to kg, weight per

• "Which units will we use?" • "Where can we get reliable information about recycling benefits?" **Differentiation**: • **Approaching Level:** Provide a template with sample data types (e.g., number of books, weight in grams, single paper weight). • **On Level:** Students identify data types and record them in a planning table. • **Beyond Level:** Students justify why each data type is needed and link it to estimation and conversion skills.		**Guiding Prompts:** • What items will we collect? • What will we measure and record? • In which **units** will we measure? **Typical Student Decisions:** • We will collect old books and notebooks. • We will estimate total weight before recording actual weight. • We will measure the weight in grams (g) and convert it to kilograms (kg) by dividing by 1,000. • We will calculate the number of papers in total. • We will later calculate **water and energy saved** using known conversion factors or by searching the internet.	sheet, number of sheets, water/energy savings. • Shows understanding of the connection between measurement and environmental impact.
4. Teach students to organize their data plan in a structured table **Teacher Action:** Model how to design a **Data Collection Table,** including headings, units, and spaces for estimated and actual values. Reinforce math vocabulary from **L1 – L4** (grams, kilograms, powers of 10, estimate, quotient, divide). **Instruction Example:** "In your data table, you need a place for each student's name, the amount of paper in grams and kilograms, and the estimated and actual totals." **Differentiation**: • **Approaching Level:** Provide a printed blank table with units labeled.		**4. Create a data collection table** **Student Task:** Students design or complete a data table where they will record weight, conversions, and estimates.	A neat table (drawn or printed) with labeled columns and correct units. Indicators: • Headings are clear and consistent. • Units are accurate (kg, g). • Includes a column to calculate sheet count. • Table space is

• **On Level:** Students create the table format independently. • **Beyond Level:** Students add extra columns for energy and water saved using conversion factors.			organized and ready for recording.
5. Encourage students to justify their plan and check for reasonableness **Teacher Action:** Ask students to explain why their chosen data and methods will help solve the problem and how they can verify the accuracy of their future measurements. **Guiding Questions:** • "Why did you choose these types of data?" • "How will you make sure your data is accurate?" • "What mistakes might happen if we don't measure carefully?"		**5. Explain how the data will be collected and recorded** **Student Task:** Students write a short explanation of how they will collect data in a consistent and fair way. **Portfolio Writing Frame:** • "We will collect data by…" • "We will weigh the books using…" • "We will record the data in our table to keep it organized." **Students may also choose who will bring scales, help weigh items, or organize group bins.**	• Clear steps listed in order. • Mentions checking accuracy (weigh twice, same scale, etc.). • Shows understanding of conversion g →kg.
6. Provide feedback and confirm readiness to move to data collection **Teacher Action:** Review each group's plan, ensuring that problem statements are clear, measurable, and realistic, and that data tables are properly structured. **Differentiation**: • **Approaching Level:** Give direct feedback using checklists. • **On Level:** Ask clarifying questions to strengthen reasoning. • **Beyond Level:** Challenge students to consider scalability (e.g., 'What if the whole school joins the project?').		**6. Collaborate to confirm a shared investigation plan** **Student Task:** Students work in groups to review everyone's proposed methods and agree on one group plan. **Group Work Product:** A shared written summary of the group's plan, such as: "Our group will bring old books from home on Monday. We will weigh them using the class scale, record the weight in grams, convert to kilograms, and check our measurements twice for accuracy."	• All group members share the same summary. • Describes what, how, and who (roles). • Shows collaborative decision-making, not individual opinion. • Clear and realistic timeline (e.g., "Bring books on Monday, weigh Tuesday").

		Each student copies the group plan into their portfolio.	
Focus Skill: To strengthen **problem formulation and clarity**, the teacher asks: • "What is the mathematical question we are trying to answer?" • "How do we know this question can be answered with measurement and calculation?" • "What information is essential for solving this question?" • "Is our plan clear enough that another group could follow it exactly?" By prompting students to **clarify and justify** their investigative question and data plan, the teacher directly supports **Critical Thinking, Communication, and Problem Formulation** -matching the **Define stage criteria** in the Math PBLA rubric.		**Skill Indicators:** - **Critical Thinking (Main Skill):** Students identify the mathematical core of the real-world problem and define a clear, measurable question that the project will answer. - **Self-Regulation:** Students plan their own steps, recognize what information they still need, and ensure the plan is realistic and manageable. - **Communication:** Students express their plan clearly using appropriate vocabulary (estimate, measure, convert, record, unit, divide). - **Subject-Specific Skill - Mathematical Reasoning / Problem Formulation:** Students identify which quantities matter (weight, sheet mass, savings) and how these relate mathematically (conversion + division).	• A **clear mathematical problem statement** written in the student's own words. • A short list of **what data must be collected** and **why** (e.g., weight → sheet count → water savings). • A **structured data table** prepared in advance with correct units (kg, g, sheets). • A **written data collection procedure** describing how measuring and recording will take place. • A **group planning summary** confirming the shared approach.

- Assessment
  ○ Needs significant improvement (1-2)
  ○ Beginning (3-4)
  ○ Developing (5-6)
  ○ Proficient (7-8)
  ○ Exceeding (9-10)			

Stage 2 – Sub-Stage: Ideate (Week 3 | 2 Periods)			
Purpose: The purpose of this stage is for students to **generate possible approaches** for collecting, estimating, and calculating the amount of paper to be recycled, and to **use mathematical reasoning** to make predictions before actual measurement. Students connect **estimation → conversion → division** to real environmental impact and begin planning how to represent their thinking clearly.			
Teacher Role and Key Actions	Period and Time	Student Role and Learning Tasks	Evidence in Students' Portfolio (Examples)
1. Encourage creative thinking and connect math to possible solutions. **Teacher Action:** Prompt students to brainstorm practical, realistic ideas to support the paper recycling plan in class and at school. Reinforce that ideas must involve **measurable elements** (weight, number of sheets, water/energy savings). **Instruction Prompt:** "Now that we understand the problem, let's think of possible ways our class could recycle or reuse paper. Your ideas should be things we can measure, calculate, or compare using math." **Guiding Questions:** • "How could we organize the collection of old books and papers?" • "What could help us estimate the total amount of paper before we measure it?" • "Which ideas help our school reduce waste every year?" **Differentiation**: • **Approaching Level:** Provide visual examples (collection box, paper sorting area). • **On Level:** Students suggest practical ideas that can be measured. • **Beyond Level:** Students expand ideas into awareness campaigns or yearly recycling routines.		**1. Brainstorm possible approaches to support the Paper Recycling Plan.** **Student Task:** Students discuss and write down different ways they can organize and carry out the paper collection and recycling process. They focus on **practical ideas** that can be carried out by their class. **Students may:** • Suggest locations for paper collection (class bin, hallway box, shared container). • Plan how to remind classmates and families to bring in old books. • Identify simple ways to separate reusable vs. recyclable paper.	• Brainstorm list (individual or group) • Highlighted idea selected to move forward

2. Guide estimation and prediction using mathematical reasoning. **Teacher Action:** Model how to **estimate total paper weight**, convert weight using **powers of 10**, and **divide** to estimate the number of sheets. **Instruction Prompt:** "Let's estimate the weight of the paper in **grams** first, then convert to **kilograms by dividing by 1,000**. Once we know the weight of one sheet in grams, we can estimate how many sheets we have by **dividing** the total grams by the weight of one sheet." **Guiding Questions:** • "If each notebook weighs about 700 g and you expect 5 notebooks, what is your estimated total weight in kg?" • "How do we convert this to kilograms?" • "How can dividing help us estimate the number of sheets?" **Differentiation**: • **Approaching Level:** Use whole-number rounding and base-ten block visuals. • **On Level:** Generate estimates and check reasonableness independently. • **Beyond Level:** Compare estimates to potential actual results and evaluate accuracy.		**2. Estimate and predict measurements using mathematical reasoning.** **Student Task:** Students use estimation strategies to make predictions **before** collecting data. They: • Estimate how much paper they expect to bring (in **grams**). • Convert that estimated weight to **kilograms by dividing by 1,000**, using place-value patterns to move the decimal point. • Estimate the number of sheets using: **Total Weight (g) ÷ Weight of One Sheet (g)**	• Estimation notes • Conversion steps (g → kg) • Estimated sheet calculation Students must show their **estimation steps**, not only the final answer.
3. Support clear representation of mathematical ideas **Teacher Action:** Encourage students to **represent** their calculations and predictions using tables, charts, or simple diagrams to communicate their thinking. **Instruction Prompt:** "Show your estimation steps in a way others can understand. Draw, label, or chart your thinking."		**3. Represent their thinking using tables, sketches, or diagrams** **Student Task:** Students represent their prediction process visually to make their reasoning clear to others. **They may:** • Draw or complete a table showing Estimated vs. Actual columns.	• Labeled estimation table • Diagram / sketch / simple chart • Short written explanation: "This is how we estimated our total paper and sheet count."

Examples of Representations: • Estimation table (predicted vs. actual) • Diagram showing sheet calculation • Bar chart showing expected water saved. **Differentiation**: • **Approaching Level:** Provide scaffolded chart templates. • **On Level:** Students independently create labeled tables and diagrams. • **Beyond Level:** Students compare group predictions and analyze which idea produces the greatest benefit. **4. Facilitate group discussion to select the best workable idea** **Teacher Action:** Guide students to review their generated ideas and **choose one** that is practical, measurable, and meaningful. **Guiding Questions:** • "Which idea can we apply easily as a class?" • "Which idea allows us to collect and calculate results clearly?" • "Which idea has the greatest positive environmental effect?"		• Create a simple diagram or labeled sketch showing how the sheet calculation works. • Prepare a quick chart showing predicted water/energy savings using the estimated sheet count. **4. Discuss ideas and select the most realistic class plan.** **Student Task:** • Students share ideas within their group and decide which approach is most practical and measurable. • Students explain why this approach is the best choice to use in the next stage (Model and Test)	**Group Output:** A short written group decision statement, for **example:** "We chose this plan because it is easy to apply in class and allows us to measure and calculate the amount of paper we are recycling accurately." • Group decision statement (copied into every student's portfolio)

Focus Skill: To guide and strengthen creative mathematical reasoning, the teacher asks: • "What different ways could we organize or carry out the recycling plan?" • "How can estimation help us compare these strategies before collecting data?" • "Which strategy is **most realistic** for our class to do successfully?" • "How does your plan clearly show the **environmental benefit** of recycling?" By prompting students to **generate, compare, and justify** strategies based on mathematical prediction, the teacher strengthens **Creative Thinking, Problem-Solving, and Mathematical Modeling**, directly supporting the **Ideate stage criteria** in the Math PBLA rubric.	**Skill Indicators:** - **Creative Thinking (Main Skill):** Students generate multiple possible solution strategies and then select the most practical and measurable one. Their ideas show initiative and flexibility, not repetition of a teacher-provided solution. - **Problem-Solving:** Students explain how their chosen approach can be carried out and what steps it requires. - **Linking to Real-World Sustainability:** Students make meaningful connections between their mathematical plan and actual environmental impact (saving water, energy, resources). - **Subject-Specific Skill – Mathematical Modeling & Comparative Reasoning:** Students use mathematical tools (estimation, conversion, division) to predict outcomes and compare strategies before acting. They do not just guess they model and reason.	• Brainstorm list of possible strategies for organizing and carrying out the paper recycling plan. • One **selected strategy** highlighted and justified. • **Estimation steps** clearly shown (weight → kg → sheet count). • A visual representation of reasoning (comparison table, bar chart, or simple diagram). • Group decision statement explaining *why* the selected approach is best.

- Assessment
  o Needs significant improvement (1-2)
  o Beginning (3-4)
  o Developing (5-6)
  o Proficient (7-8)
  o Exceeding (9-10)		

Stage 2– Sub-Stage Model and Test (Week 4 and 5 | 4 Periods)			
Purpose: In this stage, students **carry out their planned investigation**: They **collect, measure, convert, divide, and calculate** the total number of recycled sheets and then use credible sources to **estimate water and energy saved**. This stage focuses on **Accuracy, Calculation, and Representation,** applying the math skills from the chapter.			
Teacher Role and Key Actions	Period and Time	Student Role and Learning Tasks	Evidence in Students' Portfolio (Examples)
1. Guide Students to Collect and Measure Paper **Teacher Action:** Ensure each group follows the measurement plan fairly and consistently. **Instruction Prompt:** "Now is the time to test your estimates. Collect the books and papers your group planned for and weigh them carefully". **Teacher Checks For:** • Books and papers are **weighed accurately** • Units are recorded **consistently** (g) **Differentiation**: • **Approaching Level:** Provide a labeled scale & unit reminder chart. • **On Level:** Students measure independently and double-check results. • **Beyond Level:** Students compare group weights to class patterns (range/mean).		**1. Collect and Measure the Paper** **Student Task:** Students gather the notebooks, papers, and books they planned to recycle, then measure the total weight using a digital or manual scale **set to grams (g)**. • **Students Should:** ○ Record the weight in **grams (g)** in their table ○ Double-check the measurement at least once ○ Work together to ensure fair and consistent measuring.	• Recorded actual weight (g) in the data table.
2. Support Conversion and Calculation **Teacher Action:** Model or remind students how to convert **g → kg by dividing by 1,000** using powers of 10, then divide again to calculate the number of sheets.		**2. Convert the Weight Using Powers of 10** **Student Task:** Convert the measured weight from **grams (g) to kilograms (kg)** by **dividing by 1,000** to prepare for	• Conversion calculation (g → kg), including steps • Sheet count calculation + estimation check

$$\text{Weight in Kg} = \text{Weight in g} \div 1000$$ $$\text{Estimated Sheets} = \text{Total Weight (g)} \div \text{Weight of One Sheet (g)}$$ **Guiding Questions:** • "Where does the decimal move when we **divide** by 1,000?" • "How does dividing by 10, 100, and 1,000 change the value of a decimal?" • "What strategy will you use to divide? Standard algorithm? Area model? Repeated subtraction?" • "Does your answer make sense compared to your estimate from Stage 2?" **Differentiation**: • **Approaching Level:** Use place-value charts and teacher-modeled examples. • **On Level:** Students calculate and check reasonableness independently. • **Beyond Level:** Students perform error analysis and refine accuracy (e.g., measure the weight of a sheet sample).		sheet calculation and to connect with division patterns. $$\text{Weight in Kilograms} = \text{Weight in g} \div 1000$$ ○ **Students Should:** • Show the conversion step clearly • Use place-value knowledge to move the decimal point **three places to the left**. **3. Calculate the Number of Sheets Using Division** **Student Task:** Estimate the total number of sheets by dividing the total weight in grams by the weight of one paper sheet. $$\text{Estimated Sheets} = \text{Total Weight (g)} \div \text{Weight of One Sheet (g)}$$ **Students Should:** • Apply decimal division or whole-number division, depending on the weight per sheet. • Use estimation to check whether the result is reasonable. • Show their division steps clearly (not only the final answer).	
3. Facilitate Calculation of Water & Energy Savings **Teacher Action:** Provide **approved, reliable data** (e.g., 1 kg of recycled paper saves ~100 L of water).		**4. Calculate Water and Energy Savings** **Student Task:** Use the provided sustainability conversion values to	• Water saved (L) • Energy saved (kWh)

Allow students to choose one reliable conversion factor and apply it consistently. **Instruction Prompt:** "Use your total **weight of recycled paper** to estimate how much water and energy your group helped save." **Example Conversion:** • 1 kg of recycled paper saves **100 liters of water** • 1 kg of recycled paper saves **1.5 kWh of energy** (example benchmark; can be adjusted to UAE data). **Differentiation**: • **Approaching Level:** Provide the formula already written. • **On Level:** Students substitute and calculate independently. • **Beyond Level:** Students compare savings across groups and represent results graphically.		calculate how much water and energy the recycling has saved. **Example Conversion Factors (class-agreed):** • 1 kg of recycled paper saves 100 liters of water • 1 kg of recycled paper saves 1.5 kWh of energy **Students Should:** • Substitute the weight collected into these Conversions. • Show multiplication steps. • Label final answers with units (L, kWh).	
4. Guide Students to Compare Estimated vs. Actual Results **Teacher Action:** Help students evaluate whether their earlier **estimation** was accurate. **Discussion Questions:** • "Was your estimate close to the actual result?" • "Why was it more or less than expected?" • "What did you learn about making estimations?" **Differentiation**: • **Approaching Level:** Teacher provides a comparison sentence frame. • **On Level:** Students write comparisons independently.		**5. Compare Estimated and Actual Results** **Student Task:** Students compare the estimated sheet count from Stage 2 with the actual calculated sheet count. **Students Should:** • Note whether their estimation was higher or lower. • Explain why the result might differ (book thickness, binding weight, mixed paper types, etc.).	• A short comparison sentence or paragraph explaining the difference

• **Beyond Level:** Students interpret patterns across multiple groups (e.g., "class average error").			
5. Support Clear Recording of Final Calculations **Teacher Action:** Ensure students show the calculation steps, not just final answers, so mathematical reasoning is visible. **Teacher Checks For:** • Conversion steps are shown. • Division steps are shown. • Final totals are labeled correctly (grams, sheets, liters, kWh).		**6. Organize Results in a Mathematical Display** **Student Task:** Students create a **working table or simple diagram** to organize their numerical results (weight, sheets, water, energy) so they can check and compare their calculations. **Examples:** • A table summarizing: total weight (g → kg), total sheets, water saved (L), energy saved (kWh). • A comparison row or mini-table showing estimated vs. actual sheet count. • A simple flow diagram showing the calculation steps (weight → sheets → water/energy).	• A clearly labeled visual representation of results
Focus Skill: **To support reasoning, precision, and justification, the teacher asks:** • "Which method did you choose to calculate your sheet total? Why is it appropriate?" • "Show me how you converted your units - what place value patterns did you use?" • "How can you verify if your results are reasonable compared to your estimate?" • "What adjustments or corrections did you make after checking your work?" By prompting students to explain and validate their mathematical decisions, the teacher strengthens Mathematical Reasoning, Precision, and Communication - directly aligned with the Model & Test criteria in the Math PBLA rubric.		**Skill Indicators:** - **Mathematical Reasoning (Main Skill):** Students apply the chosen mathematical method (unit conversion, division, multiplication) and justify why the method is appropriate for the problem. - **Communication:** Students clearly explain their calculation steps, label units correctly, and use mathematical vocabulary to describe their reasoning. - **Applying Tools & Attending to Precision:** **Students:** o Use measurement tools carefully. o Convert units accurately. o Record data consistently. o Check for reasonableness by comparing estimated and actual results.	• Measured weight of paper recorded in **g**, and converted to k**g** with working steps. • **Division steps** shown to calculate the **number of sheets** (not just final answers). • Water and/or energy savings calculated with correct unit labeling (L, kWh). • A comparison statement between **estimated** and **actual** results. • A final visual representation (table,

	- **Constructing Arguments:** **Students justify their results by explaining:** ○ Why the method works. ○ How they verified their answers. ○ What might have caused any differences?	chart, or diagram) clearly labeled.
- Assessment ○ Needs significant improvement (1-2) ○ Beginning (3-4) ○ Developing (5-6) ○ Proficient (7-8) ○ Exceeding (9-10)		

Stage 3 – Sub-Stage: present (Week 6 | 2 Periods)			
Purpose: In this stage, students **communicate their mathematical findings and environmental message** to others. The purpose is to **share results clearly**, **use evidence to support claims**, and **recommend sustainable actions** the school/community can adopt.			
Teacher Role and Key Actions	Period and Time	Student Role and Learning Tasks	Evidence in Students' Portfolio (Examples)
1. Support students in organizing their findings into a clear and logical presentation **Teacher Action:** Guide students to summarize their key results and select the most important numbers and visuals to include. **Instruction Prompt:** "Choose the most important results that show your impact. Your presentation should be clear, simple, and evidence-based." **Guiding Questions:** • "Which numbers best show the difference you made?" • "How can we show these results visually so others understand quickly?" • "Which final actions will you recommend to help reduce paper waste?" **Differentiation**: • **Approaching Level:** Provide a video idea, a poster template, or a presentation template (title + measurements + savings + recommendation). • **On Level:** Students organize and present using their own layout and visual choices. • **Beyond Level:** Students connect findings to wider sustainability goals (e.g., UAE Vision 2030, school policy proposals).		**1. Organize Key Results into a Clear Summary** **Student Task:** Students review their results from the Model & Test stage and select the **most important findings** to include in their presentation. **Students Should:** • Identify the **total paper weight collected.** • Identify the **total estimated number of sheets.** • Identify the **water and energy savings** calculated. • Write a brief summary statement explaining what their data shows.	• Short written result summary (2-4 sentences)

2. Encourage students to represent results visually **Teacher Action:** Model or provide examples of clear, simple visual formats (e.g., bar graph, pie chart, before/after comparison). **Instruction Prompt:** "Visuals help others understand your message quickly. Choose a chart or diagram that highlights your results clearly." **Differentiation**: • **Approaching Level:** Provide graph axes or templates. • **On Level:** Students independently create labeled visuals. • **Beyond Level:** Students analyze trends or compare group data to generate insights.		**2. Create a Visual Representation of Findings** **Student Task:** Students convert their numerical results into a visual format to clearly communicate the impact of recycling. **Students May Create:** • A table comparing estimated vs. actual results. • A bar chart showing total sheets or water saved. • A simple diagram showing the paper recycling cycle. **Students Should:** • Label all visuals clearly. • Include correct **units** (kg, g, sheets, L, kWh). • Ensure visuals support their message, not just decorate it.	• One labeled visual (table, chart, or diagram).
3. Facilitate oral or written presentation to an audience **Teacher Action:** Prepare students to **explain their reasoning**, not just show numbers. **Teacher Prompts:** • "What steps did you follow to calculate your results?" • "How did you convert and divide to find the number of sheets?" • "What change do you want people to make after seeing your results?" **Differentiation**: • **Approaching Level:** Provide speaking frames or sentence starters. • **On Level:** Students present using complete explanations and labeled evidence. • **Beyond Level:** Students respond to audience questions and justify decisions confidently.		**3. Prepare a Short Presentation (Poster / Slide / Talk)** **Student Task:** Students present their investigation and final message to classmates or a small audience. **Students Should Explain:** • What problems they studied and why they matter. • How they collected and calculated the data. • How much paper was recycled, and what resources were saved?. • What actions do they recommend for sustainability? **Example Student Statement:** "Our class recycled 8.2 kg of paper, which equals about 1,640 sheets. This saved around 820 liters of water and 12 kWh of energy.	• Final written speaking notes or presentation card / slide outline

		We recommend placing permanent paper collection boxes in every classroom."	
4. Guide reflection on impact and next steps **Teacher Action:** Encourage students to evaluate the **effectiveness** and **scalability** of their recycling plan. **Reflection Questions:** • "How did your math help prove your message?" • "How could this project continue next year?" • "What changes do you think the school should adopt permanently?"		**4. Reflect on the Impact of Their Work** **Student Task:** Students write a short reflection about the importance of their actions and how they might continue the practice. **Students Should Reflect On:** • What they learned about recycling and sustainability. • How math helped them prove the impact. • A next-step action they believe the school should adopt.	• **3-5 sentence reflection**
Focus Skill: **To strengthen mathematical communication, the teacher asks:** • "How can you explain your calculation process so your audience understands each step?" • "Which visual best shows your results clearly and accurately?" • "How does your final finding support the message you want others to hear?" • "What action are you encouraging others to take - and why does your math support this recommendation?" By prompting students to explain, show, and justify their mathematical results, the teacher directly supports Communication, Creative Thinking, and Mathematical Clarity, in line with the Present Stage criteria in the Math PBLA rubric.		**Skill Indicators:** - **Communication (Main Skill):** Students clearly explain the **mathematical concepts, procedures, and results** they used (conversion, division, estimation, savings calculation). Their explanation is **accurate, ordered, and easy to follow**. - **Creative Thinking:** Students choose a **visual format** that best communicates their results and message (e.g., before/after table, bar chart, recycling cycle diagram). - **Engagement:** Students present their findings with **purpose** - encouraging others to act sustainably. - **Subject-Specific Skill – Communicating Mathematical Processes and Results:** Students: o Show calculation steps clearly o Label units correctly (kg, g, sheets, L, kWh) o Present results visually *and* verbally	• A clear written summary of key results (paper weight → sheet count → water/energy saved). • One **visual representation** (table, bar graph, or cycle diagram) with correct labels and units. • A short **presentation script or speaking notes** showing how the student will explain the process. • A reflection paragraph expressing what was learned and why it matters.

	○ Justify how their results support their final recommendation	
- Assessment ○ Needs significant improvement (1-2) ○ Beginning (3-4) ○ Developing (5-6) ○ Proficient (7-8) ○ Exceeding (9-10)		