

Matter

Anything that takes up space and has mass.

**Mass**

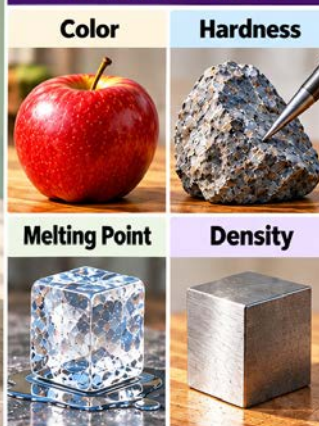
The amount of matter in an object.



More mass means more matter.

Physical Property

A trait you can measure or observe without changing the material.



Physical properties help us describe and identify materials without changing what they are.

Lesson Objective

You will explain how physical science splits into matter and energy, then compare a scientist's question to an engineer's design constraints across careers like HVAC and welding.

Standards: NGSS MS-ETS1-1: Define a design problem's criteria and constraints, accounting for science and real-world impact.

TEKS 6.4C: Investigate STEM careers using resources like professionals, organizations, and online platforms.

Essential Question: What does a house actually pay for when the energy bill arrives, and where does all of that energy end up?

Top 3 Concepts

- 1. Everything You Can Touch Is Matter**
The desk, the air, and your own body are all matter, because each one has mass and takes up space.
- 2. Energy Moves Through a House and Changes Form**
Energy enters your house through wires and pipes, then leaves again as heat once it has finished its job.
- 3. Scientists Ask Why, Engineers Must Meet Limits**
A scientist studies why heat escapes a wall; an engineer must stop it within a budget and a deadline.

Why This Matters

This Science Shows Up on Your Family's Bill Every Month

Every time you charge a phone overnight, you're using something a meter will measure by month's end. That same measurement helps families decide whether to fix a leaky window or replace an old heater.

**Prediction**

Based on the three concepts above, make a prediction about where most of the energy a house pays for ends up.

The Science Hiding in Your Power Bill

In 2024, the average American home used about 10,400 kilowatt-hours of electricity. One kilowatt-hour runs a 1,000-watt space heater for one hour. The average monthly bill came to about \$142. That paid for a refrigerator humming in the kitchen, a phone charging on a nightstand, and warm air pushing through a vent. None of it stayed. Every bit turned into motion, light, or heat, then spread out through the walls.

Everything in the Room Is Made of Matter

Start with the desk. *Matter* is anything that takes up space and has mass.

Mass is the amount of matter in an object, not how big it looks or feels.

The desk counts as matter. So does the water in your bottle and the air you cannot see.

A *physical property* is a trait you can measure or observe without changing the material. Color is one. So are hardness, melting point, and how heavy something feels for its size.

Many physical properties can be tested right in the room you're sitting in, using a scale, a ruler, or your own hands. Press your thumb into an eraser, then into the top of the desk. The eraser gives easily; the desk barely moves. You just tested hardness, without changing either material into something new.



STOP AND THINK

Look at Figure x.2. Name two of the objects, and name one physical property you could test for each.



Figure x.1 - A house glows with light while its energy bill quietly adds up.

Every lit window means energy has already traveled from a power line into that room.



Figure x.2 - Four ordinary objects show four different physical properties.

Look at the water level, the softness of the ball, and the stiffness of the paper.

Energy Moves Through the House and Leaves as Heat

The other half of physical science is *energy*. **Energy is what makes objects move**, heat up, glow, or make sound. It arrives through power lines or a gas pipe, then moves into a motor, a heating coil, a speaker, or a bulb.



Figure x.3 - **Energy enters a house through pipes and wires but escapes through walls, windows, and cracks.**
Notice how many small arrows point outward compared to the two arrows pointing in.

A house is a *system*, a set of parts that affect one another. **A house works as one system**, so a change in one part can cause a change somewhere else. Turn on a clothes dryer and the meter outside spins faster. Open a window in winter and the furnace runs longer. The bill really tracks how much energy came in.

Scientists Ask Why and Engineers Have to Choose

Physical science splits the work two ways. **A scientist asks why it happens**, then tests until the answer holds up. A scientist might ask why a wall loses heat faster on a windy night.

An engineer starts somewhere else. An *engineering problem* is a need with its limits already attached. Those limits are called *constraints*, covering money, space, time, and safety.

Engineers must design within every constraint, or the design isn't finished. Replacing a furnace means working within a budget the homeowner has already set. The wall opening is already a fixed size, and cold weather arrives in a week.

Both kinds of work show up on a power bill. Scientists measure how much heat a window lets through. Engineers use those measurements to choose a window a family can afford. Families then decide whether the upgrade is worth the cost.

? STOP AND THINK

In Figure x.3, where does the energy end up after it has finished the job it was sent to do?

Energy leaves your house as heat in nearly every case, no matter the job it did first. A bulb lights the room and warms it. A motor turns a fan and warms it too.

DID YOU KNOW?

- A refrigerator rated at 400 kilowatt-hours a year costs about \$64 a year to run where electricity sells for 16 cents per kilowatt-hour.
- One cubic meter (35 cubic feet) of water has a mass of about 1,000 kilograms (2,200 pounds). The same space filled with air holds only about 1.2 kilograms (2.6 pounds), so the water has more than 800 times the mass.

Case Study — Regina, Saskatchewan, 1977

Researchers in Saskatchewan built a two-story demonstration house on the edge of Regina, treating it as one energy system. The walls held about 30 centimeters (12 inches) of insulation, far more than a typical wall at the time. The house was sealed so tightly that little warm air could escape.

A heat exchanger pulled warmth from the stale air leaving the house. It used that warmth to heat the fresh air coming in, so the house needed no furnace. Heat from the sun, the appliances, and the people inside kept it warm. Nights fell as cold as minus 24 degrees Celsius (minus 11 degrees Fahrenheit). Engineers made this possible using measurements scientists had already gathered.

STOP AND THINK

? Figure x.6 shows two walls. Which one costs the family more each winter, and how can you tell by looking?

THINK LIKE A SCIENTIST

Your school wants to cut its power bill by 10 percent. Name one thing a scientist would measure first, one worker you would hire to make the change, and one limit that worker must respect.

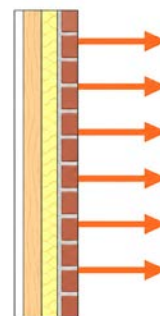


Figure x.4 - A technician checks a furnace before winter demand begins. This kind of job turns the constraints from Concept 3 into a daily checklist.



Figure x.5 - Regina's 1977 conservation house needed no furnace at all. Thick walls and a sealed shell kept the cold prairie air from getting inside.

Thin Wall



Thick Wall

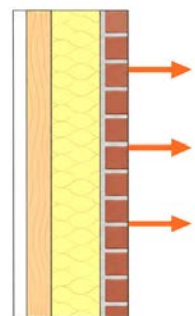


Figure x.6 - One wall loses far more heat than the other every winter. Which wall do you think belongs to the house with the lower energy bill?

GUIDED NOTES



Complete the guided notes as you read, using key ideas and evidence from the article to organize and strengthen your understanding.

Three Most Important Concepts

Based on the article, identify and explain the three most important topics you learned:

Concept 1: _____

Concept 2: _____

Concept 3: _____

Main Concept Overview

Fill in each blank using one word from the box. Each sentence restates a big idea from the article.

Word Bank: energy | constraint | properties | mass | system

1. _____ is the amount of matter in an object.
2. Many physical _____ can be tested using a scale, a ruler, or your own hands.
3. _____ is what makes objects move, heat up, glow, or make sound.
4. A house works as one _____, so a change in one part can cause a change somewhere else.
5. Engineers must design within every _____.

Matching Section

Match each term to its description.

- | | |
|------------------------------|---|
| _____ 1. Matter | A. A limit, like money, time, or space, that a design must respect |
| _____ 2. Energy | B. Anything that takes up space and has mass |
| _____ 3. System | C. A need that comes with limits already attached |
| _____ 4. Engineering Problem | D. A set of parts that affect one another |
| _____ 5. Constraint | E. What makes objects move, heat up, glow, or make sound |

True or False

Write T or F for each statement.

1. ____ Air has no mass.
2. ____ A physical property can often be tested without changing the material.
3. ____ Energy disappears completely once a light bulb turns off.
4. ____ An engineer must work within limits called constraints.
5. ____ The Saskatchewan house needed a large furnace to stay warm in winter.

Fill in the Table

Fill in what happens next for each action inside the house system.

If this happens...	Then this happens...
You turn on a clothes dryer	
You open a window in winter	
A bulb lights a room	
A motor turns a fan	

Critical Thinking

A family wants to lower their power bill by fixing one part of their house. Using what you learned about energy leaving as heat and about engineers working within constraints, explain one upgrade they could make and one limit that upgrade would have to work around.

REFLECTION & TRANSFER



Use evidence from the article and examples from your own life to explain your thinking.

01

CONNECT



How might energy moving through your own house show up in something you did this morning?

THINK ABOUT



Step 1: Name three things you used this morning that need power.

Step 2: Name where each gets its energy.

Step 3: Circle which used the most and explain why.

02

APPLY



What would you do if you had to cut your family's power bill by 10 percent this month without buying anything new?

THINK ABOUT



Step 1: list three things in your home that use energy daily.

Step 2: decide which ones you could use less or turn off sooner.

Step 3: pick the change that saves the most for the least sacrifice.

03

DECIDE



Which would you choose, and why: sealing air leaks around your own windows and doors, or adding more insulation to your own attic?

THINK ABOUT



Step 1: Think about drafts or summer heat in your home.

Step 2: Match the problem to one choice.

Step 3: Name one cost or piece of equipment needed.

DATA ANALYSIS



Use the data table below to answer the questions that follow.

STEM Careers Behind the House and Its Energy Bill			
Job Title	What They Measure or Build	Median Annual Pay (2024)	Projected Change in Jobs, 2024–2034
Mechanical Engineer	Designs, builds, and tests mechanical and thermal devices	\$102,320	9% growth
Industrial Engineer	Designs and tests systems that manage how factories and processes run	\$101,140	11% growth
Electrical Power-Line Installer and Repairer	Installs and repairs the power lines that carry electricity to houses	\$92,560	7% growth
HVAC Mechanic and Installer	Installs and repairs the heating and cooling systems inside houses	\$59,810	8% growth
Welder, Cutter, Solderer, or Brazier	Joins or cuts metal parts used in machines and buildings	\$51,000	2% growth
Source: U.S. Bureau of Labor Statistics, Occupational Outlook Handbook, 2024–2034 employment projections.			

Every job on this page connects back to a house and its energy bill. Some measure how heat moves through walls, others build the equipment that controls it, and all of them show up in a real, published data set. Use the table above to compare how these jobs pay and how fast each one is expected to grow.

Question 1 — Read It

Which job on the table has the highest median annual pay, and what is that pay?

Question 2 — Find the Pattern

Find the difference in projected job growth between the Industrial Engineer and the Welder, Cutter, Solderer, or Brazier. Fill in the blanks to solve it:

_____ % – _____ % = _____ percentage points

Question 3 — Explain It

Does the job with the highest pay always have the fastest projected growth? Make a claim, back it up with evidence from the table, and explain your reasoning.

Claim: _____

Evidence from the table: _____

Reasoning: _____

HYPOTHETICAL SCENARIOS

Read each hypothetical scenario carefully. Use evidence from the article and what you have learned to analyze the situation, solve the problem, and explain your reasoning.

Scenario 1: The Blackout Bet

A summer blackout hits your block right before movie night with friends. Your family's backup generator can power only 3 things for the next 2 hours: the fridge, a fan, or the TV and game console together.

A. Which physical property tells you how fast the fridge will warm up if you skip it?

B. Using the idea of a house as a system, predict what happens to the rest of the house if you run the TV and console together.

C. Evaluate which 3 things you'd choose to power, and defend your choice.

Scenario 2: The Ultimate Treehouse Build

You and 3 friends have a \$40 budget and one weekend to build a treehouse strong enough to hold all of you at once. The wood you can afford bends more than the wood you wanted.

A. Which physical property should you test before trusting that wood with your weight?

B. Name one constraint you're working under besides the budget.

C. Predict what might happen if you ignore the wood's flexibility and build anyway.

KEY TERMS



Write the definition of each term in your own words.

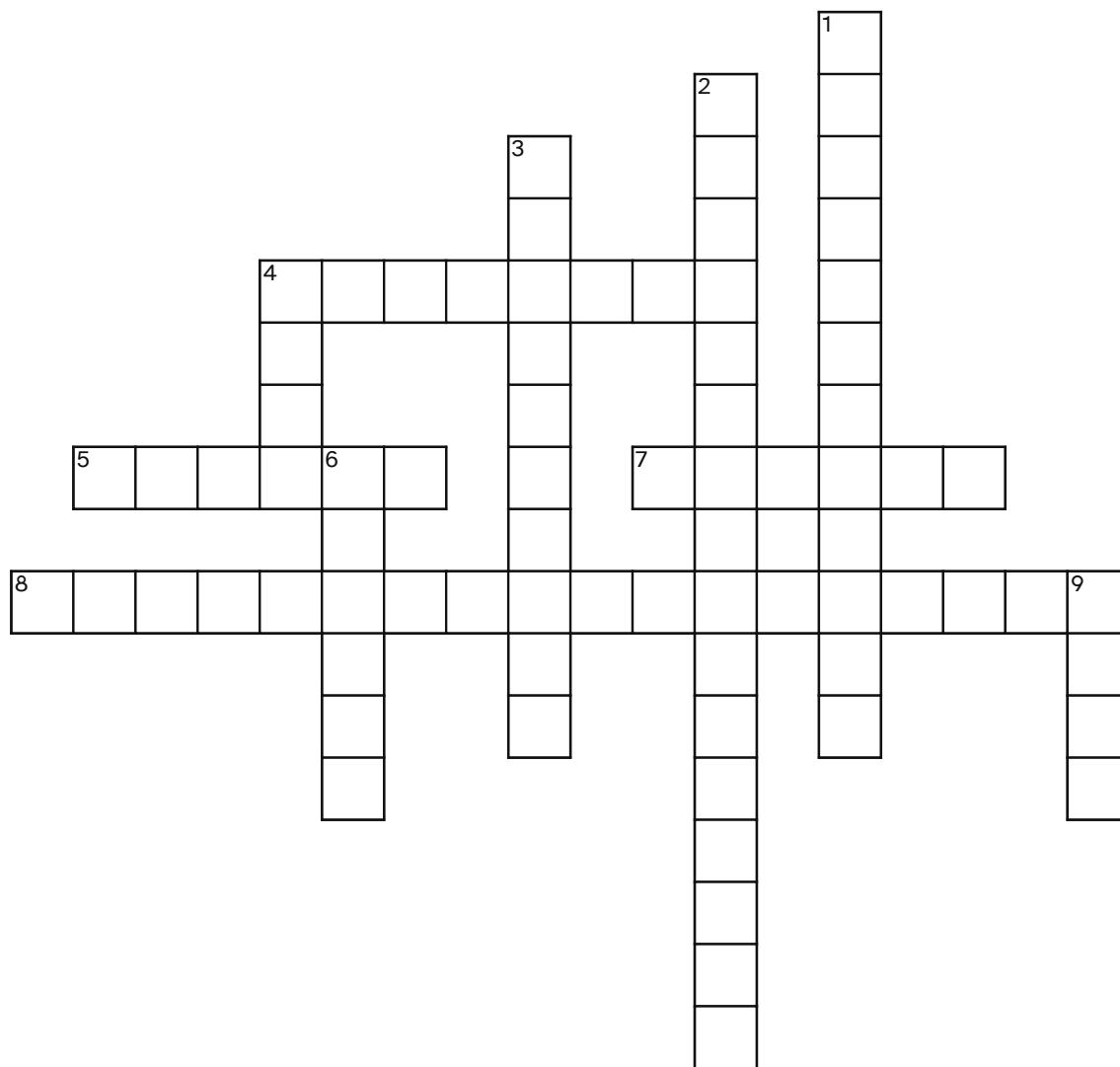
TERM	DEFINITION
Constraint	
Energy	
Engineering Problem	
Hardness	
Heat	
Kilowatt-Hour	
Mass	
Matter	
Physical Property	
System	

What Is Physical Science?

I D T M E E U S E E W I N H U D R O E N
M X I T O K T R P E E N V Y G E L L T R
L A A N N A I Y D R M N X E E H S L R I
L T T A C I H L N T U A N T A G P O E O
P X Y S E K T E O A O T T A T R H N R R
S A Y O R S T N T W T R N T H K Y T R A
T B T T Y H C C A H A R D N E S S T A A
Z S T T N T N W C M P T P N A R I N S T
U S E E M T U B G L E H T S T Y C H K E
S T Q I O I A U I A A X A H M M A S S O
L A T M I H N S M M L Y C I O N L T B H
S T T R T P S E C R N E O D H U P H L O
O E A T T Y Y G A I N E N N N M R T L T
E L L C G R S H A I F T S S O E O A A E
S E L E E O T M E E C S T P M C P I L I
E N G I N E E R I N G P R O B L E M T N
I U D G E E M P S S P S A E P O R G S C
A M E S O S R D O A E S I I R D T E T H
O G E G T R H G N T S S N A O L Y L E A
O A U T G N R E Y D R A T R I R K O E I

CONSTRAINT ENERGY ENGINEERING PROBLEM HARDNESS
HEAT KILOWATT-HOUR MASS MATTER PHYSICAL PROPERTY
SYSTEM

What Is Physical Science?



ACROSS

- 4 How well a material stands up to pressing or scratching
- 5 Group of parts that affect one another
- 7 Anything that takes up space and has mass
- 8 Need that comes with limits already attached (2 words)

DOWN

- 1 Unit for electrical use measured over time
- 2 Observable trait, such as color or scratch resistance, that leaves a material unchanged (2 words)
- 3 Limit a design must work within, such as budget or size
- 4 Warmth that moves from something hotter to something cooler
- 6 What can cause motion, warmth, light, or sound
- 9 Amount of matter in an object