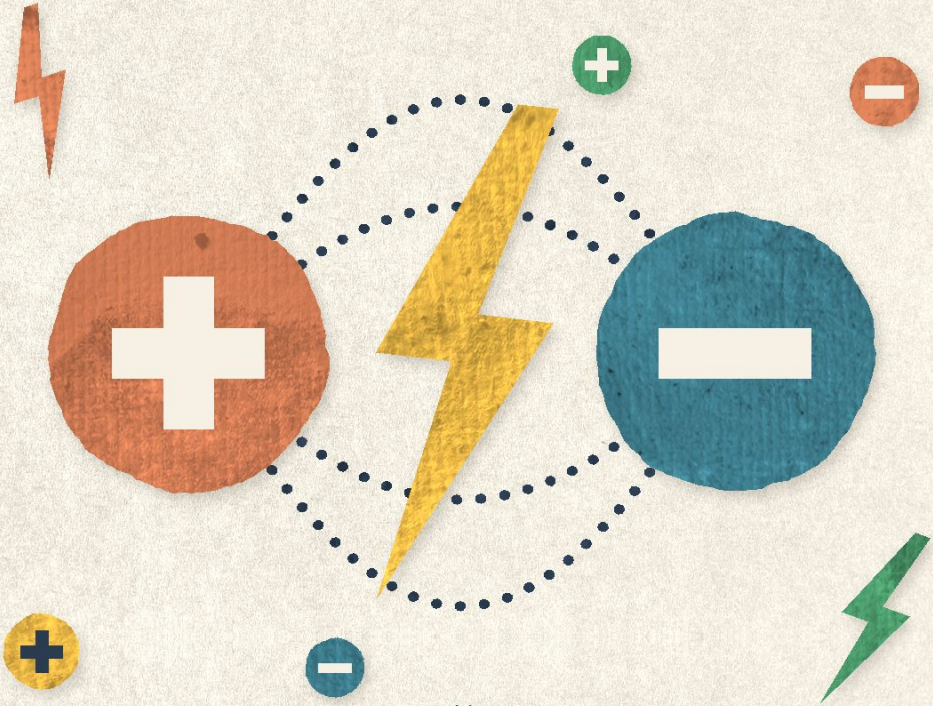


THE Roam

The Energy Guide

A read aloud companion to Energy Week

For Kids & Parents · Ages 2 to 17

©2026 The Brand Fam, LLC www.rachebrand.com

The Roam Learning Lab

Hi, Parents! Hi, Kids! Our collective future rocks.

My name is Rache, and this guide is for you and for your kids.

If you found us, you are probably a parent looking for new ways to educate and support your child, with the tools to help them come into their own light. Like me, you have probably started doing the inner work too.

On The Roam, you receive:

1. Free activities for you and your children, about 45 minutes each.
2. Free content on big questions and big ideas to get you thinking.
3. An invitation to a group chat for parents, so you can get to know the community.

Subscribe Now

Use what you want from it.

Meet the Brand Kids



Iza (13), Zai (11), Rache (45): igniting the dove in all of us, full release. Zai is proving physics by releasing SweetTarts from his mouth, with the dove flying above.

We live in the woods in Connecticut. I homeschool Iza, who is 13, and Zai, who is 11. Their dad, Kurtis Brand, is my co-pilot in life, and we raise the kids together. My bonus Soul Kid, Rishabh, and his wife, Himanshi, round out the family.

All of our kids make things. Iza has her own character and show called Shroomy. Zai builds in Blender and is chasing his Pokémon Master Set. Rishabh runs Peer Robotics, and Himanshi wrote a book.

Why We Do This

8 years ago, I took my life apart and rebuilt it on purpose. I was successful by everyone else's standards and empty by my own. I became a homeschooling mom, and we healed together from the inside out.

Our kids are our greatest teachers. My job is to help them think for themselves and trust themselves. The rest is memorization.

Many children learn early that they are not enough, and they spend years finding their way back to themselves. The Roam supports kids from day 1, so they can shape their lives around their own truth and mission, and then teach us what we are missing.

We live in nature, and we are all artists. We think of learning as a circle, with many ages learning together. It is how animals learn, so why not us?

Everything in The Roam comes home to 1 idea. We are all Rich by Nature: sovereign by nature. You arrived with everything you need. Our job as parents is to help our kids see what they already carry and learn to run it themselves.

Roaming together through life.

Why Energy?

Energy is every part of who we are. We move through life as atoms bouncing off other atoms, and every feeling we have is energy moving through a body.

The goal of this week is for kids to feel energy in their own bodies and in a room, and to know what to do with it.

Once kids understand how energy is stored, heats up, breaks, sparks, and lands, they can read the room. They can tell which energy to follow and which to move around, and when to merge with someone or hold a boundary, using physics instead of words.

This is what Rich by Nature looks like in a child. Your kids already carry all the energy they will ever need. This week teaches them how it moves, so they can run it themselves.

Each day teaches 1 piece

1. Day 1, Stored and Moving: choose where your energy lands.
2. Day 2, Heat: notice the heat rising, and settle.
3. Day 3, Breaking and Light: let a feeling out a little at a time.
4. Day 4, Electricity: read the room, and be the ground.
5. Day 5, Sound and the Big Drop: build soft landings for each other.

Your energy is yours to run.

How to Use This Guide

Best on a tablet
Read this guide on a tablet. The graphics are sized to be easy to see on a screen, with nothing extra in the way.

Energy Week runs 5 days, and each day follows the same path. It opens with what the day is about and why it matters, in nature and in you. Then come the science, the math, the experiment, and the pictures, and it closes with an unexpected learning.

Read the opening page aloud with everyone. Younger kids can stop there and go straight to the experiment. Older kids can work through the math, using the numbers from your own experiments.

The Lab Notebook at the back has a data table for every experiment, and the Answer Key after it has every practice answer.

Try it
Safety glasses go on for anything that snaps or flies, and a grown up does the dropping from high places.

The Week at a Glance

The Shape of the Week

1. Monday: stored and moving
2. Tuesday: heat
3. Wednesday: breaking and light
4. Thursday: electricity
5. Friday: sound and the big drop

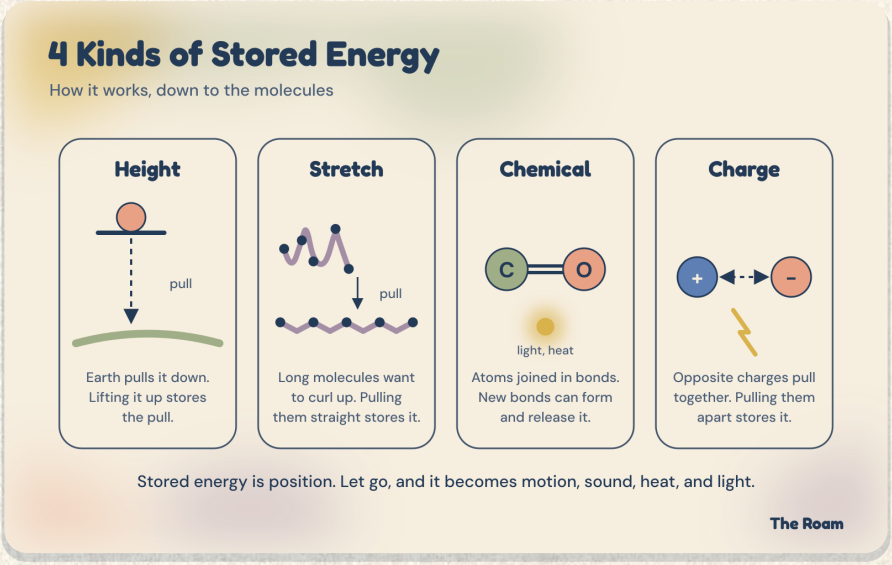
What to Gather (tap to shop)

- 12 eggs
- **10 water balloons**
- **1 bag of rubber bands**
- **1 bouncy ball about 2 inches across** and a **roll of painter's tape**
- **1 box of dry spaghetti**
- **3 glow sticks**
- 1 bowl of ice water and 1 bowl of warm tap water
- **1 balloon**
- **Tape measure** and **sidewalk chalk**
- Comfortable safety glasses for everyone: **Kids** and **Adults**
- Packing supplies: **straws**, paper, tape, **cotton balls**, and a few small boxes, any kind
- **1 notebook for the numbers**

Energy Basics

Energy is what makes things move, change, heat up, or light up. It changes form all the time, and it never disappears. When something stops, the energy has gone somewhere else, and finding where it went is the game of the week.

Energy is either stored, waiting to move, or moving. Stored energy comes in 4 kinds you can find at home: height, stretch, chemical, and charge. Moving energy shows up as motion, heat, light, sound, and electricity.



Scientists measure energy in joules, named after James Prescott Joule, who proved that motion and heat are the same thing in 2 forms. 1 joule is about the energy it takes to lift an apple 1 meter.

Energy Basics

$$1\ \text{joule} = 1\ \text{kilogram} \times 1\ \text{meter}^2 \div 1\ \text{second}^2$$

This week we use metric units, because the equations work cleanly in them. 1 meter is about 3.3 feet, and 1 kilogram is about 2.2 pounds. Gravity on Earth speeds every falling thing up by 9.8 meters per second, every second, and we call that number g.

$$g = 9.8\ \text{m/s}^2$$

ENERGY WEEK

Day 1

Stored and Moving

Water balloons and rubber bands

THE Roam

Stored and Moving

What it is

Stored energy is energy waiting to move. Lifting, stretching, and building all store it, and letting go turns it into motion.

In nature

A pinecone hangs high on its branch all summer, full of the energy of its height. A breeze lets it go, and it thumps onto the path.

In you

You store energy too: the excitement before a birthday, the nerves before a game, a feeling you have not said out loud yet. Your body knows when it is full, and your intuition tells you before your words do.

Why it matters

A child who can feel energy building can choose where it lands. That is presence: knowing what you carry, and releasing it with intention, in a place that serves you.

Try it

Before a big moment, stand still and ask your body, how full am I? Then choose where that energy goes: a run, a song, a drawing, or a talk.

Choose where your energy lands.

DAY 1: STORED AND MOVING

The Science of Stored Energy

Understanding how energy is stored helps us feel what we carry.

When you lift something, you push up against gravity, and physicists call that push over a distance work. The work does not vanish. The object keeps it as gravitational potential energy, stored in its height above the ground.

When you let go, gravity pulls the object down and the stored energy turns into kinetic energy, the energy of motion. At the bottom of the fall, nearly all of the stored energy has become speed, minus a little lost to the air.

Stretching works the same way. A rubber band is made of polymers, long chain molecules that rest in a tangle. Pulling straightens the chains, and they pull back toward the tangle. The farther you stretch, the harder they pull, and the energy grows with the square of the stretch.

Robert Hooke described this in 1678: the force of a spring grows in step with how far you stretch it. A rubber band follows Hooke's law closely for small stretches.

The Math of Stored Energy

Numbers show how much energy is stored, and how fast it moves when it lets go.

Energy stored by height

$$PE = m \times g \times h$$

PE is potential energy in joules, m is mass in kilograms, g is 9.8, and h is height in meters.

Worked example

A 1 pound water balloon has a mass of 0.45 kg. The porch is 3.05 m high (10 feet).

PE = 0.45 × 9.8 × 3.05 = 13.5 joules

Speed when it lands

$$v = \sqrt{(2 \times g \times h)}$$

Worked example

v = √(2 × 9.8 × 3.05) = √59.8 = 7.7 meters per second

7.7 m/s × 2.24 = about 17 miles per hour

Energy stored by stretch

$$PE = \tfrac{1}{2} \times k \times x^2$$

The Math of Stored Energy

k is the band's stiffness in newtons per meter, and x is the stretch in meters.

Worked example

A band with k = 40 N/m:

Stretched 0.05 m (2 in): ½ × 40 × 0.05^2 = 0.05 J

Stretched 0.10 m (4 in): ½ × 40 × 0.10^2 = 0.20 J, 4 times as much

Stretched 0.15 m (6 in): ½ × 40 × 0.15^2 = 0.45 J, 9 times as much

Try these

1. What is the stored energy of the balloon at knee height, 0.46 m?
2. How fast does the shoulder balloon land, from 1.37 m?
3. If you double the drop height, what happens to the stored energy? What happens to the landing speed?
4. A 100 g bag (0.98 newtons) stretches your band 2.5 cm. What is k?

DAY 1: STORED AND MOVING

The Stored Energy Experiment

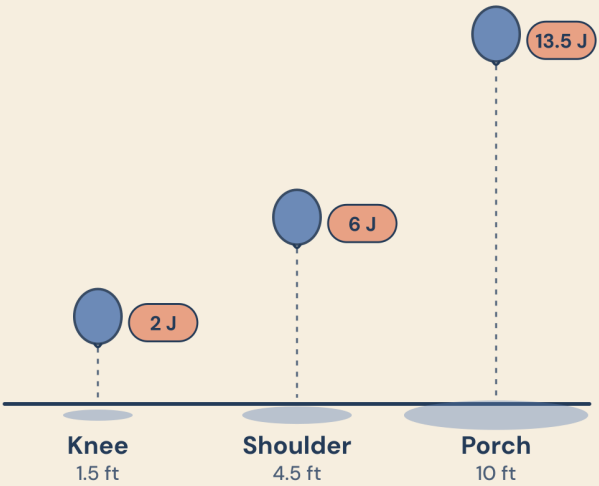
Measure it yourself, and an invisible energy becomes a number you can see.

1. Fill 3 water balloons to the same size, about 1 pound each.
2. Drop 1 from knee height, 1 from shoulder height, and 1 from the porch, with an adult close by.
3. Chalk a circle around each splash and measure it across.
4. Calculate the stored energy for each height, and record it next to the splash width in the Lab Notebook.
5. Measure your band's stiffness: hang a 100 g bag from it and measure the stretch.
6. Launch bands stretched 2, 4, and 6 inches from a chalk line and measure each distance.
7. Compare the distances to the 1 : 4 : 9 prediction. Air slows the bands, so expect the long launches to fall a little short.

Try it
Graph splash width against stored energy. Does the line go up?

HEIGHT

Higher stores more



A 1 pound balloon at 10 feet stores almost 7 times the energy it has at your knee.

The 3 balloons are identical. Only the height changes, and the stored energy changes with it: 2 joules at the knee, 6 at the shoulder, and 13.5 at the porch.

The splash grows with the energy. Measuring the splash is how you see a number you cannot see directly.

WHERE IT COMES FROM

You put it there



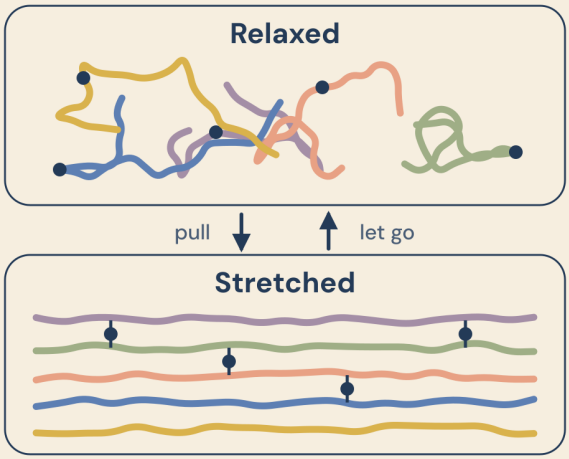
You carry the balloon up, and it keeps your work until it lets go.

Every joule in the porch balloon came from your arms. Your muscles burned food to lift it, the balloon kept the work as height, gravity turned the height into speed, and the ground turned the speed into a splash, a slap of sound, and a little heat.

Follow the energy backward and it reaches breakfast, then the plants, then the sun.

STRETCH

Inside a rubber band



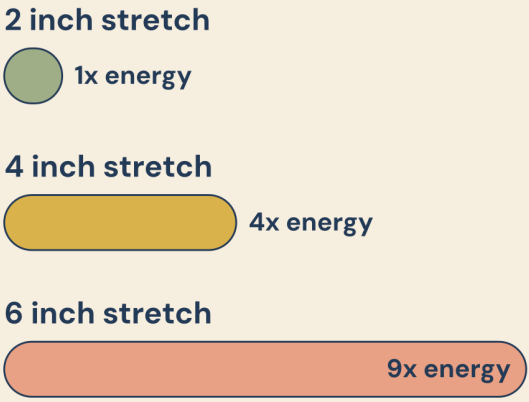
Long, tangled molecules called polymers. Pull them straight, and they pull back toward the tangle.

The colored strands are polymer chains, and the navy dots are cross links that tie them together, so the band springs back instead of pulling apart.

Relaxed, the chains are tangled every which way. Stretched, they line up, and they pull back toward the tangle the moment you let go.

STRETCH

More stretch, more launch



Double the stretch and the band stores 4 times the energy. Launch at 2, 4, and 6 inches and measure.

Because the energy grows with the square of the stretch, 2 times the stretch stores 4 times the energy, and 3 times the stretch stores 9 times the energy.

That is why a slingshot pulled a little farther flies so much farther.

Unexpected Learning

Did you know?
A raindrop falling from a cloud a mile up would hit the ground at hundreds of miles per hour if there were no air. Air pushes back on it, and it lands at about 20 miles per hour.

Did you know?
Every rubber band started as sap. Rubber trees bleed a milky latex when their bark is cut, and that latex is the polymer you stretched this week.

Did you know?
Hydroelectric dams run on stored height. The sun lifts water into clouds, rain fills the lake behind the dam, and the falling water spins turbines that light homes.

ENERGY WEEK

Day 2

Heat

Rubber bands, bouncy balls, and 10 jumps

THE Roam

DAY 2: HEAT

Heat

What it is

Heat is the energy of molecules moving. The faster they move, the warmer something feels.

In nature

On a cold morning, bumblebees shiver their flight muscles until their bodies are warm enough to fly. A stone in the sun keeps its warmth long into the evening.

In you

Your body heats when you run, when you feel embarrassed, and when you chase something you want. That warmth is your energy speeding up, and it is information. When you feel it rising, you can breathe it out, cool down, and come back to yourself.

Why it matters

A child who notices the heat before it boils over can stay present with what they feel. That is how we show up: awake to the energy moving in us, and calm enough to let it pass through.

Try it

Before your next big moment, put a hand on your chest and feel its warmth. Breathe out slowly 3 times, and feel it settle.

Notice the heat, and let it move through you.

DAY 2: HEAT

The Science of Heat

Heat is the most common way energy spreads, in a bouncing ball and in a body.

Every object is made of molecules that never stop moving. In a solid they jiggle in place, in a liquid they slide past each other, and in a gas they fly around and collide. Temperature measures how fast they move on average.

Heat is energy moving from something warmer to something cooler. When you rub your hands, the tiny bumps of your skin catch and drag, and that work speeds up the molecules in your palms.

Rubber does something special. Stretching it fast lines up its polymer chains, and the ordered chains release heat into your skin. Letting it shrink lets the chains tangle again, and they pull heat back in. Scientists call this the Gough Joule effect, first noticed by John Gough in 1805.

Every time energy changes form, some of it spreads out as heat and sound. This is the second law of thermodynamics: spread out energy is hard to gather back up. It is why a bouncing ball settles, a swing slows down, and no machine runs forever.

Your body follows the same law. Muscles turn only about a quarter of their food energy into motion, and the rest becomes heat, which is why you warm up when you run.

The Math of Heat

Counting the bounces shows exactly how much energy spreads out with each landing.

How bouncy is the ball?

$$e = \sqrt{(h_2 \div h_1)}$$

e is the bounce ratio, h_1 is the drop height, and h_2 is the height of the next bounce. Each bounce keeps e^2 of the energy.

Worked example

A ball dropped from 1.00 m bounces to 0.64 m.

$e = \sqrt{(0.64 \div 1.00)} = 0.8$

Energy kept each bounce = $0.8^2 = 0.64$, so 64%

After 3 bounces: $1.00 \times 0.64 \times 0.64 \times 0.64 = 0.26$ m

Where the lost energy goes

$$\text{Heat and sound} = m \times g \times (h_1 - h_2)$$

Worked example

A 50 g ball (0.05 kg) on its first bounce:

$0.05 \times 9.8 \times (1.00 - 0.64) = 0.18$ joules into the floor and air

The heat in your jumps

1 food Calorie = 4,184 joules

DAY 2: HEAT

The Math of Heat

Worked example

A 30 kg kid jumps 0.3 m high, 10 times:
Motion energy = 10 × 30 × 9.8 × 0.3 = 882 joules
Muscles are about 25% efficient, so the body burns 882 ÷ 0.25 = 3,528 joules
Heat made = 3,528 − 882 = 2,646 joules, and the whole set uses less than 1 food Calorie

Try these

1. A ball dropped from 1.5 m bounces to 1.08 m. What is its bounce ratio?
2. A ball keeps 64% of its energy each bounce. Dropped from 1 m, after how many bounces is it below 10 cm?
3. A banana has 105 Calories. How many joules is that?
4. How many sets of 10 jumps could 1 banana power?

DAY 2: HEAT

The Heat Experiment

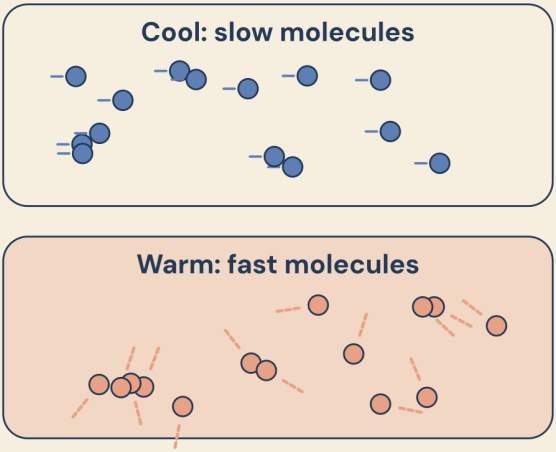
Feel heat with your own skin, then measure where it goes.

1. Rub your hands together fast for 10 seconds and press them to your cheeks.
2. Press a thick rubber band to your forehead and stretch it fast. Note the warmth. Let it shrink slowly against your skin and note the cool.
3. Hold a meter stick against a wall and drop a bouncy ball from 1 meter onto a hard floor.
4. Film it on a phone in slow motion, and mark the top of each bounce with painter's tape.
5. Record each bounce height in the Lab Notebook and calculate the bounce ratio for each pair.
6. Count your heartbeats for 15 seconds, do 10 jumps, and count again.

Try it
Try the drop on carpet and on tile. Which floor takes more energy on each landing?

TUESDAY

Heat is molecules moving



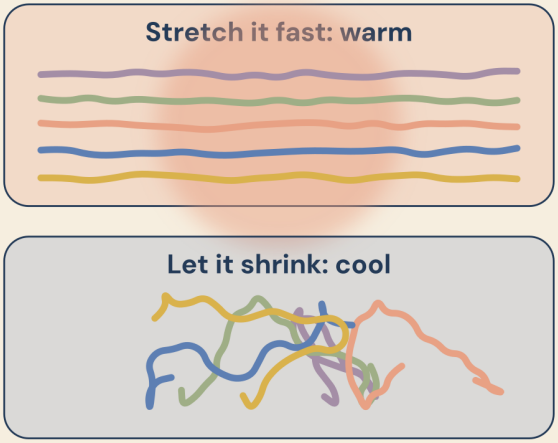
Rub your hands together for 10 seconds. You are speeding up their molecules, and you feel it as warmth.

Cool molecules drift slowly. Warm molecules race and collide. A thermometer measures their average speed.

When your hands rub together, you are speeding up the molecules in your skin.

INSIDE A RUBBER BAND

Stretch it, feel it warm



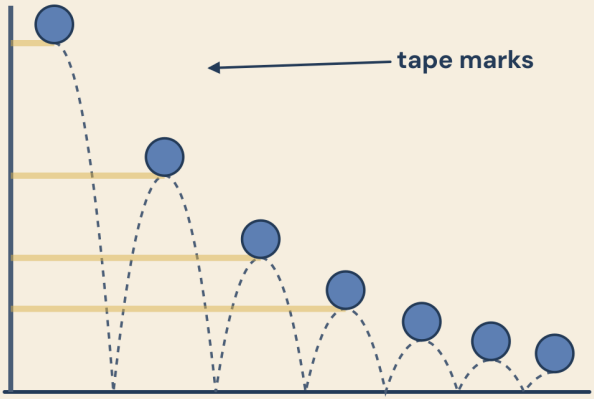
Press a thick band to your forehead and stretch it fast. Lining the molecules up gives off heat.

Lining the chains up gives off heat, and you feel it on your forehead. Letting them tangle again pulls heat back in, and the band feels cool.

A fast stretch of a thick band can warm it by several degrees, enough for your forehead to notice.

SPREADING OUT

Every bounce is lower



Drop a bouncy ball beside a wall, mark the top of each bounce with tape, and count until it rests.

Each tape mark sits lower than the last by about the same fraction. That steady fraction is the bounce ratio, and it is a fingerprint of the ball and the floor together.

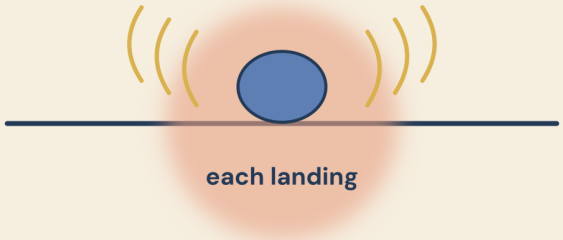
A super ball on tile keeps about 80% of its energy per bounce. A tennis ball on carpet keeps far less.

WHERE IT GOES

Each landing gives some away

Sound
into the air

Heat
into the floor



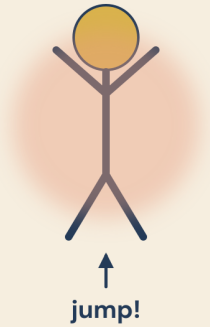
The energy stays. It spreads out, so thin you can barely find it.

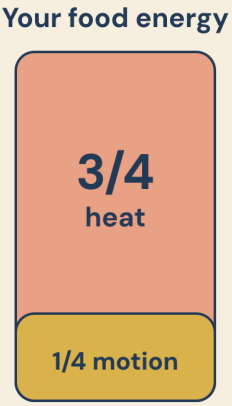
The energy a bounce loses does not disappear. It becomes a click of sound and a little warmth in the floor and the ball.

Add up every landing, and the heat and sound equal the energy the ball started with.

IN YOUR BODY

You run warm





About a quarter of your food energy moves you. The rest becomes heat. Do 10 jumps and feel it.

About 1 quarter of your food energy moves you, and about 3 quarters becomes heat. Your body sweats and flushes to send that heat away.

This is why 10 jumps warm you up long before they tire you out.

Unexpected Learning

Did you know?
Rattlesnakes see heat. 2 small pits on their faces sense the warmth of a mouse in total darkness.

Did you know?
A resting person gives off about 100 watts of heat, about the same as an old fashioned light bulb. A room full of people warms itself.

Did you know?
Bumblebees shiver before they fly. They buzz their flight muscles without moving their wings until their chest warms enough to take off on a cold morning.

ENERGY WEEK

Day 3

Breaking and Light

Spaghetti and glow sticks

THE Roam

Breaking and Light

What it is

Breaking is stored energy let go in an instant. Light is energy carried in tiny packets called photons, and chemistry can turn stored energy into light.

In nature

When ice on a pond cracks in winter, you hear its stored strain let go across the whole surface. On summer nights, fireflies turn the energy in their bodies into light.

In you

A feeling bent too far for too long lets go all at once, and the snap travels through the whole house. When you name a feeling early and let it out a little at a time, it releases gently, and the same energy can come out as light: a laugh, a song, an idea.

Why it matters

Kids who know they can release energy gently learn they can be heard and stay whole. That is surrender at its best: letting go on purpose, and watching what you carried turn into light.

Try it

When a feeling starts to bend you, say 1 true sentence about it out loud, right then.

Let it out slowly, and it can become light.

The Science of Breaking and Light

Breaking and glowing both release stored energy. The difference is how fast it comes out.

Dry spaghetti is starch, made of sugar rings linked into long chains. Bending it stretches the chains on the outside of the curve and squeezes them on the inside, storing elastic energy. When the stretch passes what the links can take, a crack opens at the most curved point.

The crack releases the stored energy all at once. Each half snaps back toward straight so fast that a bending wave races along it and briefly bends it even harder than before. That extra bend cracks it again. Basile Audoly and Sébastien Neukirch explained this in 2005, after Richard Feynman had puzzled over it for years.

In 2018, a team at MIT found the fix. Twisting the spaghetti about 270° before bending stores energy in the twist too. When it cracks, a twist wave travels faster than the bending wave and carries energy away first, so the halves never bend hard enough to break again.

A glow stick makes light from a chemical reaction, called chemiluminescence. Hydrogen peroxide in the glass vial meets an oxalate ester in the tube. Together they form a tiny, strained ring of atoms called 1,2 dioxetanedione, packed with energy. The ring splits into 2 molecules of carbon dioxide and hands its energy to a dye. The dye's electrons jump up, then fall back and release the energy as light.

The Science of Breaking and Light

Heat makes molecules move faster and collide harder, so reactions run faster when warm. A warm glow stick is brighter and burns out sooner. A cold one is dimmer and lasts longer.

The Math of Breaking and Light

Averages, light, and temperature each show how energy is released.

Finding the average

Average = total ÷ number of trials

Worked example

10 bends gave 3, 3, 4, 3, 2, 3, 4, 3, 3, and 5 pieces.

Total = 33, so the average = 33 ÷ 10 = 3.3 pieces

The energy in 1 bit of light

$$E = h \times c \div \lambda$$

Light comes in tiny packets called photons. h is Planck's constant, 6.63×10^{-34}, c is the speed of light, 3.00×10^{8} m/s, and λ is the wavelength of the color.

Worked example

Green light has a wavelength of 520 nanometers, or 5.2×10^{-7} m.

$E = 6.63 \times 10^{-34} \times 3.00 \times 10^{8} \div 5.2 \times 10^{-7} = 3.8 \times 10^{-19}$ joules per photon

How heat speeds a reaction

Rate × 2 for every 10°C warmer

The Math of Breaking and Light

This rule of thumb from chemistry gives an estimate for many reactions.

Worked example

Ice water is 0°C and warm water is 40°C, 4 steps of 10°C apart.

2 × 2 × 2 × 2 = 16, so the warm stick reacts about 16 times faster

Try these

1. 5 twisted pieces broke into 2, 2, 2, 3, and 2. What is the average?
2. Red light has a wavelength of 650 nm. Does each red photon carry more or less energy than green? How much?
3. How many green photons add up to 1 joule?
4. How much faster is the reaction at 40°C than at a 20°C room?

The Breaking and Light Experiment

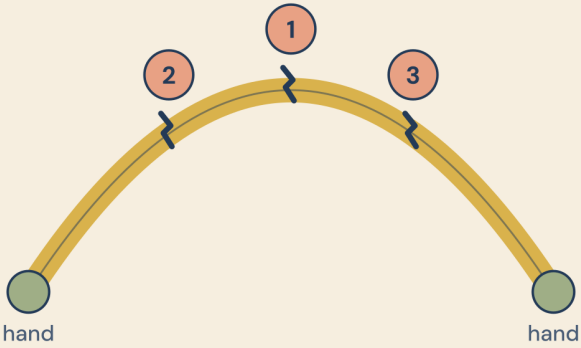
Break it fast, release it slow, and compare what happens.

1. Hold a piece of dry spaghetti at both ends and bend it slowly until it breaks.
2. Count the pieces. Repeat 10 times and record each count in the Lab Notebook.
3. Twist a fresh piece about 270°, then bend it slowly. Repeat 5 times and record.
4. Calculate both averages and compare.
5. Snap 3 glow sticks. Set 1 in ice water, 1 in a room temperature cup, and 1 in warm tap water.
6. After 2 minutes, turn off the lights and rank them from brightest to dimmest.
7. Check them every hour and record which one fades first.

Try it
Slow motion video shows the second crack happening a few thousandths of a second after the first.

WEDNESDAY

Why spaghetti breaks in 3



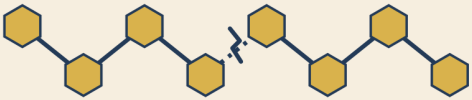
Hold dry spaghetti at both ends and bend it until it snaps. Count the pieces.

The first crack opens at the top of the curve, where the stretch is greatest. The next 2 cracks open where the snap back wave bends each half too far.

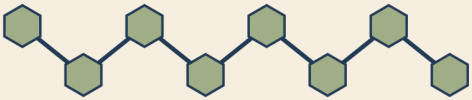
Your hands held the stored energy. The cracks let it go.

INSIDE THE SPAGHETTI

Starch stores the bend



sugar rings, linked in a chain



bending stretches every link

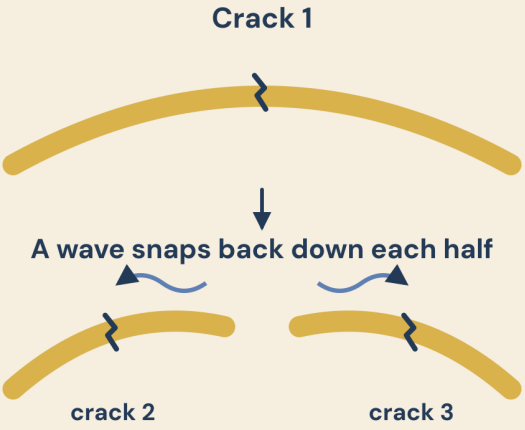
Dry spaghetti is starch: sugar rings linked in long chains. Bending stores energy in the links until one cracks.

Each hexagon is a sugar ring, and the lines between them are the bonds that link them into a chain. Bending stretches every link a little.

One link failing starts the crack, and the crack runs across the whole strand in an instant.

THE SNAP BACK WAVE

1 crack makes another



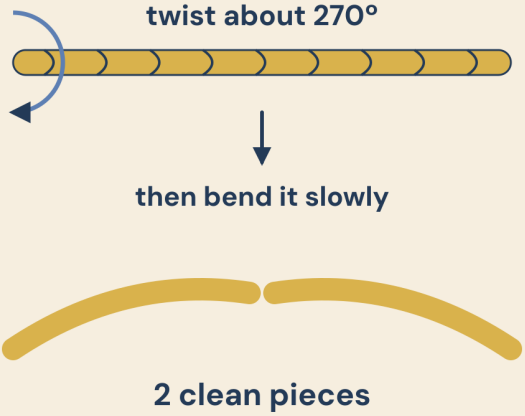
The first crack sends a wave down each half, and the wave cracks it again. Feynman puzzled over this for years.

When the strand breaks, each half whips back toward straight. The whip travels as a wave, and where it bends the strand past its limit, the spaghetti cracks again.

This is why the pieces fly. Some of the stored energy becomes motion.

TRY IT

Twist it 270° first



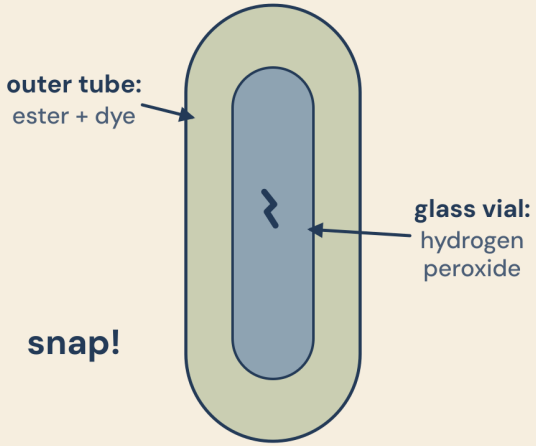
It breaks cleanly in 2, because the twist lets the stored energy out more gently. MIT, 2018.

The twist stores some of the energy as torsion. After the first crack, the twist unwinds as a fast wave and drains energy away before the bending wave can do damage.

2 clean pieces, every time.

LIGHT

Inside a glow stick



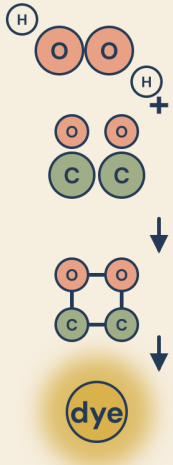
Snapping the stick cracks the glass vial inside, and 2 liquids mix.

The plastic tube bends, and the thin glass vial inside cracks. Shaking mixes the hydrogen peroxide with the ester and the dye.

The dye decides the color. Different dyes give green, blue, red, or orange.

CHEMICAL ENERGY

It turns into light



peroxide

ester

a tight ring
full of energy

light!

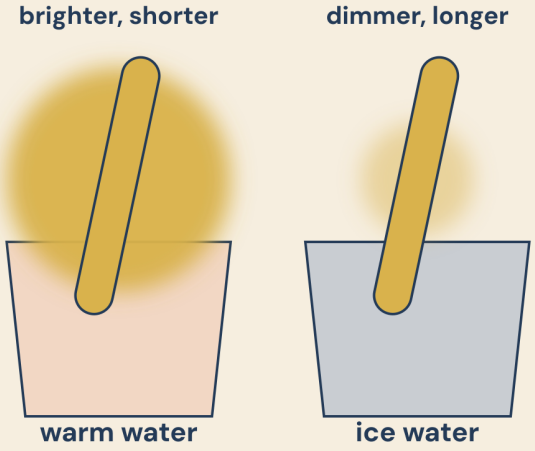
The ring breaks into carbon dioxide and hands its energy to the dye, which glows.

The 2 chemicals build a strained ring of atoms. When it splits into carbon dioxide, it hands its energy to the dye, and the dye gives the energy off as photons.

Almost none of the energy becomes heat, which is why a glow stick feels cool in your hand.

TRY IT

Heat speeds it up



Set 1 glow stick in warm water and 1 in ice water for 2 minutes, then compare them in the dark.

In warm water the molecules collide faster and harder, so the reaction races, the glow is bright, and the chemicals run out sooner.

In ice water the reaction crawls. Put a glowing stick in the freezer overnight and it will glow again the next day.

Unexpected Learning

Did you know?
Fireflies make light the same way a glow stick does, with a chemical reaction, and their light feels cool for the same reason. Almost none of the energy becomes heat.

Did you know?
Crush a wintergreen mint in a dark room with a mirror, and you will see a blue green spark. Breaking sugar crystals pulls charges apart, and the wintergreen oil turns the flash visible.

Did you know?
The deepest parts of the ocean are full of light. Most creatures living there glow, using light to hunt, hide, and find each other.

ENERGY WEEK

Day 4

Electricity

Balloons, doorknob spark

THE Roam

DAY 4: ELECTRICITY

Electricity

What it is

Electricity is electrons on the move. Charge builds when electrons gather in 1 place, and it flows when it finds a path.

In nature

A thunderstorm separates charge inside its clouds until the sky and the earth pull hard enough on each other, and lightning carries the charge home to the ground.

In you

Moods move through a room the way charge moves off a balloon. You can feel a room before anyone speaks, and that feeling is your intuition reading the charge. A grumpy breakfast spreads around the table, and so does a good laugh.

Why it matters

A child who can read the charge in a room knows which energy to follow, when to merge with someone, and when to hold a boundary. They can step out of a bad mood's path, give it space, or offer it ground, using physics instead of words.

Try it

When you walk into a room, pause for 3 breaths and notice what you feel before anyone talks.

You can be the ground.

The Science of Electricity

Charge is the energy you can feel in a room before anyone speaks.

Every atom has a center called the nucleus, holding positive protons, and a cloud of negative electrons around it. Most things carry equal amounts of each, so they are neutral.

When 2 materials rub, electrons hop from one to the other. Scientists rank materials in the triboelectric series by how tightly they hold electrons. Hair lets go easily and rubber grabs them, so a rubbed balloon ends up negative and your hair ends up positive.

A charged balloon can pull on things that are neutral. Near the balloon, the electrons inside a bit of paper shift away, leaving the near side slightly positive, and opposites pull. Water molecules have a positive end and a negative end, and they turn to face the balloon, which is why the stream bends.

Metals have electrons that move freely, so they conduct. Rubber, plastic, and dry air hold their electrons tight, so they insulate. Grounding gives extra charge a conducting path into the earth, which is big enough to take any amount.

When enough charge builds up, it can tear through air. Air breaks down at about 3,000 volts for every millimeter of gap, and the electrons rush across, heating the air until it glows and cracks. A doorknob spark and a lightning bolt are the same event at different sizes.

The Math of Electricity

Equations show how charge builds, how far it pulls, and how a spark jumps.

Counting electrons

$$\text{electrons} = \text{charge} \div 1.6 \times 10^{-19}$$

Charge is measured in coulombs, and 1 electron carries 1.6×10^{-19} coulombs.

Worked example

A rubbed balloon carries about 1×10^{-7} coulombs.

$1 \times 10^{-7} \div 1.6 \times 10^{-19} = 6.25 \times 10^{11}$, about 625 billion extra electrons

How the pull changes with distance

$$F = k \times q_1 \times q_2 \div r^2$$

This is Coulomb's law, from 1785. The pull F weakens with the square of the distance r.

Worked example

Move the balloon twice as far away: the pull drops to $1 \div 2^2 = 1/4$.

3 times as far: $1 \div 3^2 = 1/9$.

The Math of Electricity

How many volts in a spark?

Volts ≈ 3,000 × gap in millimeters

Worked example

A doorknob spark jumps a 4 mm gap.
3,000 × 4 = about 12,000 volts. The current is tiny and lasts a millionth of a second, so it stings and nothing more.

Try these

1. The stream bends 2 cm with the balloon 4 cm away. Predict the bend at 8 cm.
2. About how many volts make a 2 mm spark?
3. A balloon carries 3×10^{-7} coulombs. How many extra electrons is that?
4. Is your body a conductor or an insulator?

DAY 4: ELECTRICITY

The Electricity Experiment

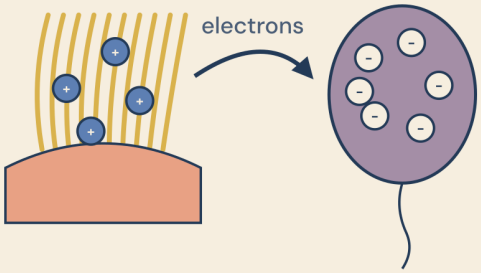
Build a charge, watch it pull, and give it a path to ground.

1. Rub the balloon on dry hair for 10 seconds.
2. Hold it 5 cm above torn bits of paper and record how many jump up.
3. Turn the faucet to a thin, steady stream. Hold the balloon 2, 4, 6, and 8 cm away and measure how far the stream bends each time.
4. Compare your bends to the Coulomb's law prediction.
5. Touch the balloon to the metal faucet, then test the paper again. Record what changed.
6. After dark, shuffle across a rug in socks, slowly bring a finger toward a doorknob, and estimate the spark gap.

Try it
Dry winter air makes the best sparks. Humid air carries charge away before it builds.

THURSDAY

Rubbing moves electrons



hair: missing electrons (+)

balloon: extra electrons (–)

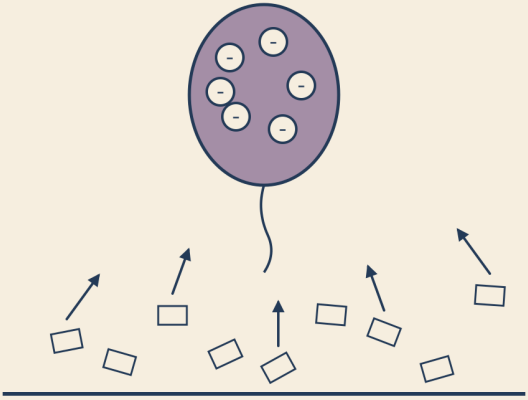
Every atom has tiny particles called electrons on its outside. Hair gives them up, and the balloon takes them.

Rubbing pulls electrons off your hair and onto the balloon. The balloon is now negative and your hair is positive.

Opposite charges pull, which is why your hair rises to follow the balloon.

OPPOSITES PULL

Paper jumps up



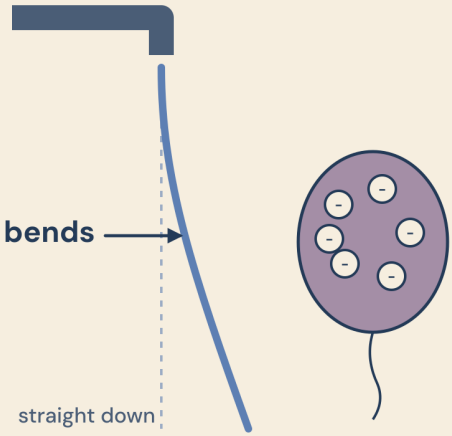
Hold the charged balloon over torn bits of paper. The extra electrons pull them up to meet it.

The paper starts neutral. Near the balloon, its electrons shift to the far side, the near side turns slightly positive, and the balloon pulls it up.

Scientists call this induction: charge rearranging without touching.

TRY IT

It bends water



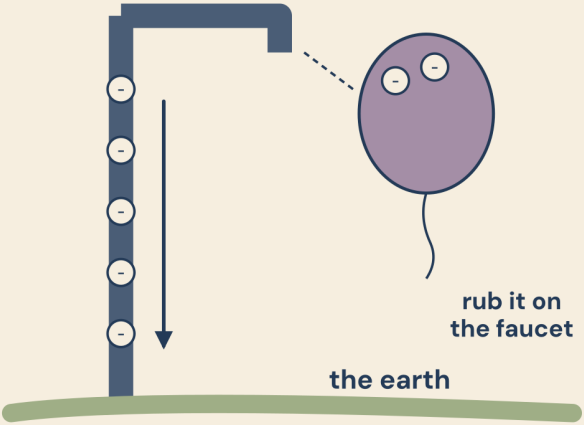
Turn the faucet to a thin, steady stream. Hold the charged balloon close without touching.

Each water molecule has a slightly positive end and a slightly negative end. They turn to face the balloon, and the whole stream leans toward it.

Try it with a stream of cooking oil, whose molecules lack those ends. It barely bends.

GROUNDING

Charge goes to ground



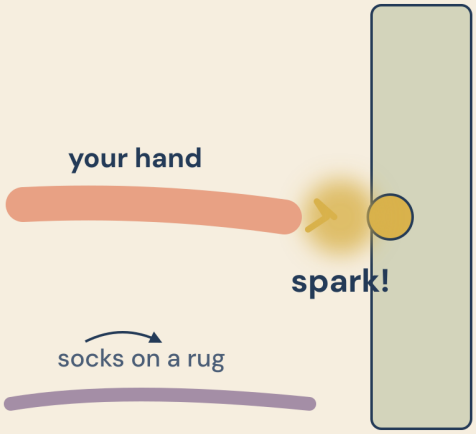
Metal gives extra electrons a road into the earth, which is big enough to take every one.

Metal pipes give the extra electrons a road. They spread through the plumbing and into the earth, and the balloon goes back to neutral.

Lightning rods on rooftops work the same way, giving a strike a safe path down.

TRY IT AFTER DARK

The doorknob spark



Shuffle across a rug in socks and touch a doorknob. Your stored charge finds its way to ground.

Shuffling in socks charges your whole body. When your finger nears the metal, the charge rips across the air gap in a flash of light and a snap of sound.

Every spark shows 3 forms of energy at once: electricity, light, and sound.

Unexpected Learning

Did you know?
Lightning strikes the Earth about 45 times every second.

Did you know?
Your heart runs on electricity. Every beat starts as an electrical signal from a small knot of cells called your natural pacemaker.

Did you know?
Electric eels can make more than 600 volts, enough to stun a fish, from cells stacked like batteries along their bodies.

ENERGY WEEK

Day 5

Sound and the Big Drop

A soft landing

THE Roam

Sound and the Big Drop

What it is

Sound is energy traveling through the air as a wave of tiny pushes. A landing is the moment moving energy has to go somewhere.

In nature

A deer lands from a leap with its legs bent, stretching the stop so its body stays whole. In winter, deep snow softens every fall.

In you

Everyone lands hard sometimes: a long day, a loss, a big disappointment. A sharp voice or a slammed door is the crack of a hard landing, and it tells you where someone needs padding.

Why it matters

Kids who know how to build soft landings can carry each other through hard days. That is harmony in a family: every person part of the padding, and every landing heard.

Try it
Tonight, listen to the voices in your house. When you hear a crack, offer padding: time, a hug, or a slower moment.

Listen to how it lands.

The Science of Sound and Landings

Every landing sends energy somewhere, and sound tells you where it went.

Sound is energy traveling as a pressure wave. A cracking shell pushes the air molecules next to it, they push the next ones, and the push travels outward at about 343 meters per second. When it reaches your ear, it shakes your eardrum, and your brain hears a crack.

Loudness is measured in decibels. The scale climbs by multiplying: every 10 decibels louder carries 10 times the energy. A whisper is about 30 decibels and a shout is about 80.

A falling egg carries momentum, its mass times its speed. To stop it, something must push back, and the push it takes depends on how quickly the stop happens. Stop it fast and the push is huge. Stop it slowly and the push is gentle. This is called the impulse momentum theorem.

An eggshell is a dome of calcium carbonate. It holds up well to an even squeeze and breaks easily under a sharp, quick push, at around 30 to 50 newtons. Padding works by crushing, which stretches the stop over more time and spreads the push across more shell.

Car crumple zones, airbags, bike helmets, and bent knees on a landing all use the same idea: make the stop take longer.

The Math of Sound and Landings

The math of a landing shows why a slower stop keeps things whole.

The push it takes to stop

$$F = m \times v \div t$$

F is the force in newtons, m is the mass, v is the landing speed, and t is how long the stop takes in seconds.

Worked example

A 60 g egg (0.06 kg) dropped from the porch lands at 7.7 m/s.
Bare deck, stopping in 0.002 s: F = 0.06 × 7.7 ÷ 0.002 = 231 newtons. Cracked.
Padded box, stopping in 0.02 s: F = 0.06 × 7.7 ÷ 0.02 = 23 newtons. Whole.

How far sound travels

$$\text{distance} = 343 \times \text{seconds}$$

Worked example

Thunder arrives 3 seconds after the lightning flash.
343 × 3 = 1,029 meters, so the strike was about 1 kilometer away.

The Math of Sound and Landings

Decibels

Every +10 dB = 10 × the energy

Worked example

A crack at 80 dB and a thud at 60 dB are 20 dB apart.

10 × 10 = 100, so the crack carries 100 times the sound energy.

Try these

1. How fast does an egg land when dropped from 1.5 m?
2. That egg stops in 0.01 s. What is the force? Will it crack?
3. How long must the porch egg's stop last to keep the force under 20 newtons?
4. A sound is 30 dB louder than another. How many times the energy does it carry?

The Sound and Landings Experiment

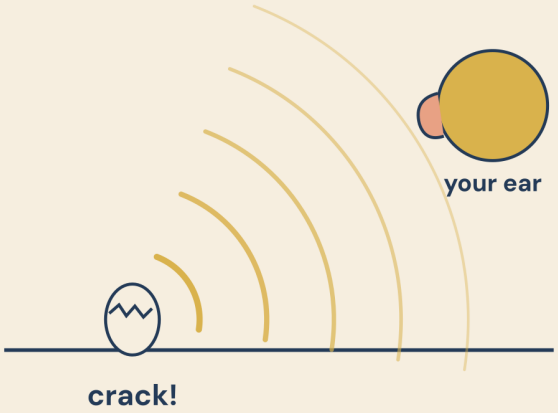
Design a soft landing, and listen for the proof.

1. Give each designer 1 egg, a pile of packing supplies, and 45 minutes.
2. Before building, calculate the landing speed from your drop height.
3. Build a landing that stretches the stop: crushable straws, soft cotton, a box with room to give.
4. Have an adult drop every egg from the same height.
5. Close your eyes and listen to each landing, and rate it loud, medium, or soft.
6. Unwrap, record each result in the Lab Notebook, and compare the sound ratings to the survivors.

Try it
Count the seconds between a lightning flash and the thunder on the next stormy night, and calculate how far away it struck.

FRIDAY

Sound is energy moving



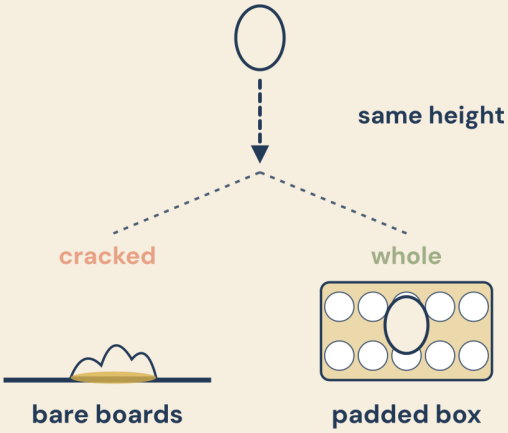
Every crash, crack, and splat sends energy through the air as a wave of tiny pushes.

The crack pushes the air, and the push spreads out in rings, losing strength as it spreads. Your ear catches a tiny slice of it.

Light travels almost a million times faster than sound, which is why you see the egg break a split second before you hear it from across a field.

THE BIG DROP

Same egg, same energy



Every egg arrives with the same energy. The landing decides what happens to the shell.

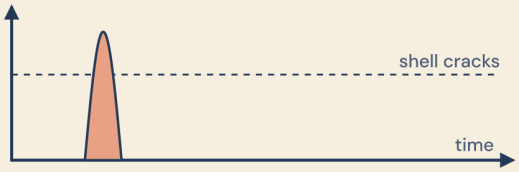
Both eggs fall from the same height and land at the same speed. The difference is the landing.

The bare deck stops the egg in about 2 thousandths of a second. The padded box takes 10 times longer.

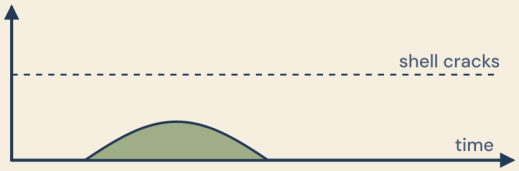
SLOW THE STOP

A longer stop, a gentler push

Bare egg on the deck



Egg in a padded box



Padding stretches the stop over a longer moment, so the push on the shell stays under the cracking line.

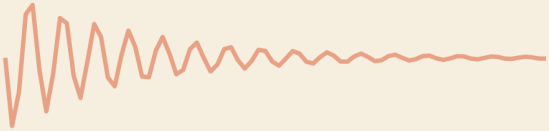
The area under each curve is the same, because both eggs had the same momentum to lose. The bare landing packs it into a tall, thin spike that crosses the cracking line.

The padded landing spreads it into a low, wide hill that stays below it.

CLOSE YOUR EYES

Listen to each landing

Loud crack
energy went into the shell



Soft thud
energy went into the padding



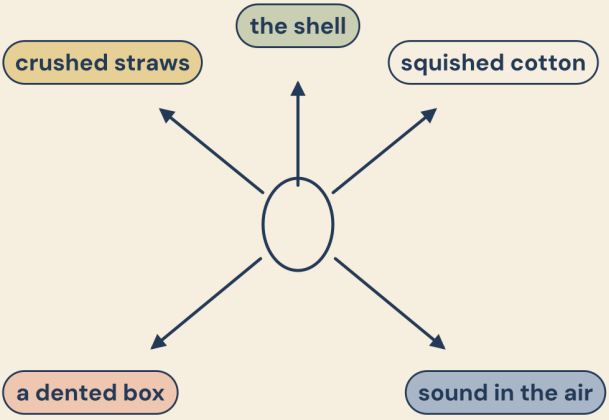
Before you unwrap the eggs, listen. A loud crack usually means a broken egg.

A loud crack means much of the energy went into breaking the shell and shoving the air. A soft thud means the padding soaked it up by crushing.

Your ears are measuring energy.

WHERE DID IT GO?

Into everything it touched



Ask each designer where their egg's energy went. Everything that falls ends up grounded.

Into crushed straws, squished cotton, a dented box, a little heat, and a burst of sound. Add it all up and it equals the energy the egg had at the top.

Everything that falls ends up grounded.

Unexpected Learning

Did you know?
Sound travels about 4 times faster through water than through air, and more than 15 times faster through steel. Put your ear to a long metal railing while someone taps the far end, and you will hear the tap twice.

Did you know?
Sound needs molecules to push, so in space, explosions make no sound at all.

Did you know?
An egg is strongest end to end. Over a bowl, wrap your whole hand around a raw egg and squeeze evenly. The dome spreads your push, and most eggs hold.

In the Woods

The woods follow the same rules. A pinecone on a high branch stores energy from height, and it lets go with a thump on the path.

A creek runs downhill because rain fell on higher ground. The sun lifted that water into the sky first, by warming it into vapor.

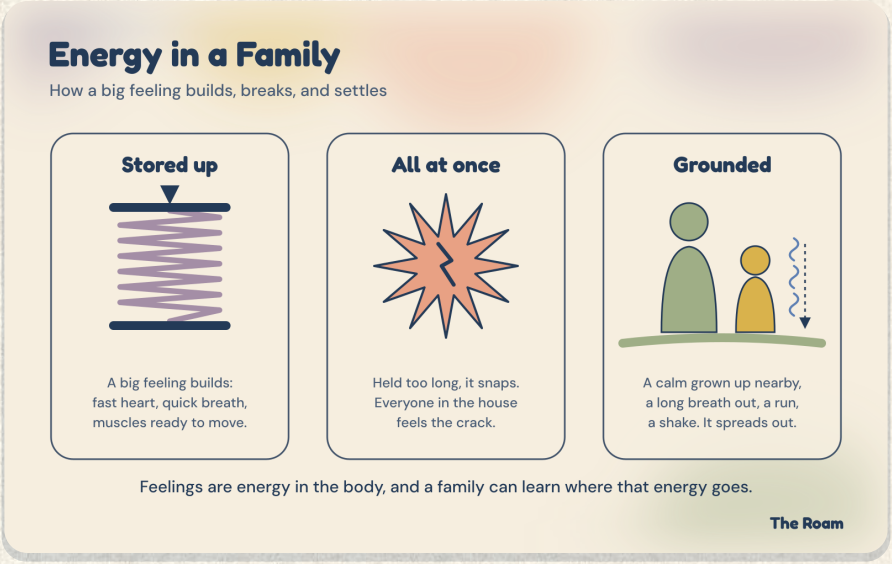
A tree catches sunlight in its leaves and stores it as wood. When you burn a log in the woodstove, the heat on your face is sunlight the tree caught years ago.

Try it
On your next walk, find 3 things in the woods with stored energy, and name the kind each one has.

Energy in a Family

Feelings are energy in the body. When you get mad or scared, your heart beats faster, your breath speeds up, and your muscles get ready to move. Your body is storing energy for action, the way a stretched rubber band stores it.

A big feeling held in for a long time is like a band stretched further and further. When it lets go all at once, it snaps, and everyone in the house feels the crack.



Moods spread like charge. A grumpy breakfast can spread around the whole table, the way a charged balloon makes the paper jump. A good laugh spreads the same way.

Energy in a Family

A calm grown up works like the metal faucet. When a child's feeling is big, a steady, quiet person nearby gives that energy a path to settle. Grown ups store up charge too, so ground yourself first, and then you can ground them.

For older kids

A big feeling releases adrenaline and sugar into your blood so your muscles can act. Moving uses that energy up, and a long, slow breath out slows your heart. Scientists call a calm person helping another person settle co-regulation.

Try it

Family reset: when someone's energy is high, everyone stands up, shakes out their arms and legs for 10 seconds, and takes 3 slow breaths out together.

Putting It Together

Energy never disappears. It changes form, and it spreads. The feelings in a family do the same.

From the science to your home

1. Stored and moving: choose where a building feeling lands.
2. Heat: notice the flush, and give it room to spread.
3. Breaking and light: let a feeling out early, and it can become light.
4. Electricity: step aside, give space, or be the ground.
5. Sound and the big drop: build soft landings for each other.

The family practice

1. Notice it: feel where the energy is in your body.
2. Name it: say what it is, out loud.
3. Move it: run, stomp, shake, or breathe it out.
4. Ground it: find a calm person, the floor, or the earth, and let it settle.

A child who can read and move their own energy is Rich by Nature. They run their life from the inside, and they help the people around them settle too.

Everything that falls ends up grounded.

Questions for the Dinner Table

1. What on this table has stored energy right now?
2. Where did the energy in your dinner come from before it reached your plate?
3. What was the loudest energy release you saw this week?
4. If energy never disappears, where did the energy from the egg drop go?
5. What helps you settle when your energy is high?

Every bit of energy in your house started somewhere else. Most of it started with the sun.

Lab Notebook

Day 1: Stored and Moving

Drop	Height (m)	Energy (J)	Splash (cm)

Stretch (in)	Predicted	Distance (m)

Band stiffness test: weight _____ N, stretch _____ m, k = _____ N/m

Day 2: Heat

Bounce	Height (cm)	Ratio to last

Lab Notebook

Heartbeats in 15 s	Before	After 10 jumps

Day 3: Breaking and Light

Trial	Bent pieces	Twisted pieces

Average bent: _____ Average twisted: _____

Glow stick	Brightness rank	Hours until dim

Lab Notebook

Day 4: Electricity

Balloon distance (cm)	Stream bend (cm)	Predicted

Paper bits lifted: _____ Spark gap: _____ mm Estimated volts: _____

Day 5: Sound and the Big Drop

Designer	Padding	Sound	Survived?

Drop height: _____ m Landing speed: _____ m/s

Answer Key

Day 1

1. 0.45 × 9.8 × 0.46 = 2.0 joules
2. √(2 × 9.8 × 1.37) = 5.2 m/s, about 12 mph
3. The stored energy doubles. The landing speed grows by √2, about 1.4 times.
4. k = 0.98 ÷ 0.025 = 39 N/m

Day 2

1. √(1.08 ÷ 1.5) = 0.85
2. 6 bounces. After 5 the ball reaches 10.7 cm, and after 6 it reaches 6.9 cm.
3. 105 × 4,184 = 439,320 joules, about 440,000
4. 440,000 ÷ 3,528 = about 125 sets of 10 jumps

Day 3

1. 11 ÷ 5 = 2.2 pieces
2. Less. $6.63 \times 10^{-34} \times 3.00 \times 10^{8} \div 6.5 \times 10^{-7} = 3.1 \times 10^{-19}$ joules
3. $1 \div 3.8 \times 10^{-19}$ = about 2.6×10^{18} photons
4. 2 steps of 10°C, so 2 × 2 = 4 times faster

Answer Key

Day 4

1. Twice the distance gives 1/4 the pull, so about 0.5 cm
2. 3,000 × 2 = about 6,000 volts
3. $3 \times 10^{-7} \div 1.6 \times 10^{-19}$ = about 1.9×10^{12}, or 1.9 trillion electrons
4. A conductor. Your body is mostly salty water, which carries charge.

Day 5

1. $\sqrt{(2 \times 9.8 \times 1.5)} = 5.4$ m/s
2. 0.06 × 5.4 ÷ 0.01 = 32 newtons, right at the cracking point. It may crack.
3. t = 0.06 × 7.7 ÷ 20 = 0.023 seconds or longer
4. 10 × 10 × 10 = 1,000 times the energy

More Like This

Energy Week is 1 of many. A new teaching arrives every week.

Subscribe for more like this

If you have a need or an idea, reach out. I love conversation and connection, and I want to do this with you.

Sponsor a Teaching

What does your child want to learn? Name it, and I will build it.

Sponsor a teaching, and I will develop a full curriculum around the topic your family is curious about: daily experiments, a read-aloud guide, and step-by-step pictures, the same way I built Energy Week.

Every sponsored teaching is shared with all the families in The Roam, so your child's question becomes a gift to every kid who reads it.

Sponsor a Teaching

If money is tight, come anyway. I will always keep The Roam open and available for parents.

Sources

1. Audoly, B. and Neukirch, S. (2005). Fragmentation of Rods by Cascading Cracks: Why Spaghetti Does Not Break in Half. Physical Review Letters.
2. Heisser, R. H., et al. (2018). Controlling Fracture Cascades Through Twisting and Quenching. Proceedings of the National Academy of Sciences.
3. OpenStax. College Physics 2e: Chapter 7, Work, Energy, and Energy Resources; Chapter 8, Linear Momentum; Chapter 15, Thermodynamics; Chapter 17, Physics of Hearing; Chapter 18, Electric Charge and Electric Field; Chapter 29, Introduction to Quantum Physics.
4. OpenStax. Chemistry 2e: Chapter 12, Kinetics.
5. OpenStax. Biology 2e: Chapter 8, Photosynthesis.

©2026 The Brand Fam, LLC www.rachebrand.com