THE STANDARD

Particles of Matter

Develop a model to describe that matter is made of particles too small to be seen.

ANCHORING PHENOMENON

The Flat Basketball That Comes Back to Life

A basketball is sitting flat and squishy on the floor. You push a pump needle in and start pumping. Nothing new goes in that you can see, but the ball gets firmer and rounder with every push. Then it bounces like new. 5th graders know you added air, but air looks like nothing. So what is actually filling that ball and making it hard?

> DRIVING QUESTION
> *"If you can't see anything going into the ball, what is making it firm enough to bounce?"*

INVESTIGATIVE 1

The Syringe You Can Barely Push

Seal the tip of a plastic syringe, pull the plunger back to fill it with air, then try to push it in. It moves a little, gets harder and harder, then stops. Nothing leaked out, yet the air took up less room. This sharpens the anchor: the air is made of pieces that can be squeezed closer together, which is exactly what's happening inside the basketball.

> DRIVING QUESTION
> *"If no air escaped, how did the same air fit into a smaller space when we pushed?"*

INVESTIGATIVE 2

The Sugar That Disappears but Stays

Stir a spoonful of food-grade sugar into a clear cup of warm water. Keep stirring and the sugar vanishes. The water looks plain again, but the sugar is still in there. Let the water dry up and the sugar is left behind. This sharpens the anchor a different way: matter can break into pieces too small to see and still be completely real, just like the air we couldn't see.

> DRIVING QUESTION
> *"If the sugar disappeared from sight, where did it actually go?"*

THE STANDARD

Conservation of Mass

Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

ANCHORING PHENOMENON

The Sealed Bag That Disappears but Weighs the Same

Drop an ice cube into a zip bag, seal it tight, and weigh the whole thing. Set it on the counter and watch the cube vanish into a puddle of water. The ice is gone, but put the bag back on the balance and the weight has not changed one gram. 5th graders will want to know how.

DRIVING QUESTION

"If the ice cube vanished, why does the bag weigh exactly the same as before?"

INVESTIGATIVE 1

Where Did the Sugar Go?

Weigh a cup of water with a spoonful of sugar sitting next to it. Stir the sugar in until it completely disappears. The water looks clear again, like the sugar was never there. Weigh the cup again. Same number. Dissolving makes stuff seem to vanish, but the weight proves it is still in there.

DRIVING QUESTION

"The sugar disappeared into the water, so why didn't the cup get any lighter?"

INVESTIGATIVE 2

Two Liquids, One New Color

Weigh two small cups of liquid that change color or get cloudy when poured together. Pour them into one zip-seal bag (not a rigid container), press out the extra air, and seal it. Weigh the new mixture. It looks like brand-new stuff, but the weight is just the two starting weights added up, because nothing escaped the sealed bag.

DRIVING QUESTION

"We made what looks like a new substance, so why does it weigh the same as the two we started with, as long as we keep it sealed so no gas escapes?"

THE STANDARD

Properties of Matter

Make observations and measurements to identify materials based on their properties.

ANCHORING PHENOMENON

Four White Powders That Look Exactly the Same

Four small cups sit on the table, each holding a white powder. By eye they look identical. But one is baking soda, one is salt, one is cornstarch, and one is granulated sugar (table sugar). A drop of vinegar makes one of them fizz like crazy. A drop of iodine turns one of them dark blue-black. Warm water dissolves some fast and one barely at all. Same color, totally different materials.

> DRIVING QUESTION
> *"If four powders look exactly alike, what tests can prove which one is which?"*

INVESTIGATIVE 1

Which Stuff Does the Magnet Grab?

Lay out a tray of samples: an iron nail, an aluminum tab, a copper penny, a plastic bead, a steel paperclip. Run a magnet over each. Some leap to it, others ignore it. This sharpens the anchor's big idea: response to a magnet is one property in the fingerprint.

> DRIVING QUESTION
> *"Why does the magnet pull some metals and skip others that look just as metallic?"*

INVESTIGATIVE 2

Race to Dissolve

Give each group equal scoops of salt, granulated sugar, baking soda, and sand, plus identical cups of warm water. Stir each one the same number of times. Salt and sugar disappear, baking soda dissolves slower, sand never does. Solubility becomes a measurable, repeatable property that helps separate look-alikes.

> DRIVING QUESTION
> *"If we stir each powder the same way, why do some vanish and one never dissolves at all?"*

THE STANDARD

Formation of New Substances

Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

ANCHORING PHENOMENON

The Cup That Bubbled, Got Cold, and Made Something New

Pour one clear liquid into another clear liquid and nothing happens. Pour a white powder into a different liquid and it foams up, overflows, and the cup turns cold to the touch. Both times you mixed two things, but one mixing made a brand new substance and the other didn't. 5th graders will want to know what's different about the second one.

> DRIVING QUESTION
> *"Why does mixing some substances make something totally new, while mixing others just gives you a blend?"*

INVESTIGATIVE 1

Baking Soda Meets Vinegar

Drop a spoon of baking soda into a cup of vinegar and it erupts with fizzing bubbles. Run it again with the same amounts and it fizzes the same way every time. This sharpens the anchor's big question: the bubbles are a gas that wasn't there before, so a new substance formed. The fizzing is the evidence.

> DRIVING QUESTION
> *"Where do the bubbles come from, and does that mean a new substance was made?"*

INVESTIGATIVE 2

Salt in Water: New Substance or Just a Blend?

Stir salt into a cup of warm water until it disappears. It looks like the salt is gone, but let the water dry out and white salt crystals come right back, so nothing new formed. Comparing this to the fizzing cup helps 5th graders see that dissolving is not the same as making a new substance.

> DRIVING QUESTION
> *"When the salt seems to disappear in the water, did it turn into something new or is it still salt?"*

THE STANDARD

Gravitational Force

Support an argument that the gravitational force exerted by Earth on objects is directed down.

ANCHORING PHENOMENON

Australia Is Upside Down, So Why Don't They Fall Off?

Show a globe and point to your town, then spin it to Australia on the bottom. To us, those people look upside down. Yet they walk and drop their pencils just like we do, and nothing floats off into space. Same planet, opposite side, and somehow "down" works for everyone. 5th graders will want to know how that's possible.

> DRIVING QUESTION
> *"If people on the bottom of the globe are upside down to us, why doesn't gravity make them fall off into space?"*

INVESTIGATIVE 1

The Drop Test That Always Goes One Way

Hand groups a tray of safe objects: a cotton ball, an eraser, a crumpled paper, a marble, a feather. Drop each one, again and again, from different spots in the room. Every single object falls straight down toward the floor, never up, never sideways. Use this to sharpen the anchor: "down" is one steady direction, and Earth is doing the pulling.

> DRIVING QUESTION
> *"No matter what object we drop or where we stand, which direction does it always go?"*

INVESTIGATIVE 2

Gravity Arrows Around the Globe

Give each group a printed picture of the globe. At the top, the bottom, and both sides, 5th graders draw an arrow showing which way gravity pulls a person standing there. Every arrow points inward, toward the center of the globe, even the one on the bottom that points "up" relative to your room. These are drawn arrows, a model of how real Earth pulls everything toward its center.

> DRIVING QUESTION
> *"When we draw a gravity arrow at different spots on the globe, where does every arrow point?"*

THE STANDARD

The Sun's Energy

Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.

ANCHORING PHENOMENON

The Hamburger That Started in a Field of Grass

Hold up a hamburger and ask a 5th grader where the energy in it came from. Most will say 'the cow.' Push back. Where did the cow get its energy? From eating grass. Where did the grass get its energy? Now they're stuck. Keep tracing it back and the trail leads somewhere surprising: the sun. A burger, a bun, the whole meal, all of it can be traced back to sunlight that fell on a field months ago. 5th graders will want to figure out how the sun ended up on their plate.

DRIVING QUESTION

"How can the energy in a hamburger have started out as sunlight?"

INVESTIGATIVE 1

Sun, Then Sprout

Grow two sets of bean seeds, one on a sunny windowsill and one shut in a dark cabinet. After a couple of weeks, the sunny sprouts are green and healthy and the dark ones are pale and yellow with no green color. Same seeds, same water, only the sunlight changed. Use this to sharpen the anchor: without sunlight a plant can't make its own food, so it stays yellow and eventually runs out of stored energy. The sun is the first link in the chain. No sun, no food energy to pass on.

DRIVING QUESTION

"Why does the plant in the dark turn pale and yellow while the plant in the sunlight stays green?"

INVESTIGATIVE 2

Follow the Energy Back

Give groups a stack of food cards, like an apple, a chicken nugget, a glass of milk, a fish stick, and have them lay out the chain behind each one, working backward until every chain lands on the sun. The apple traces to an apple tree to the sun. The chicken nugget traces to a chicken to the corn it ate to the sun. Every single card ends in the same place. This is the anchor turned into a hands-on sorting task.

DRIVING QUESTION

"No matter what food we pick, why does the trail always end at the sun?"

THE STANDARD

Plant Growth

Support an argument that plants get the materials they need for growth chiefly from air and water.

ANCHORING PHENOMENON

The Giant Tree and the Tiny Pile of Soil

Show 5th graders a photo of a massive oak tree, then a small bucket of soil. Tell them the tree started as an acorn in a pot with just a few pounds of soil. Now it weighs thousands of pounds. If you dug it up, the soil in the ground would barely have changed. So where did all that wood, all those leaves, all that mass come from? It clearly did not come out of the dirt. 5th graders will want to solve this.

> DRIVING QUESTION
> *"If the soil barely changed, where did all the tree's mass actually come from?"*

INVESTIGATIVE 1

Sprout a Seed With No Soil At All

Place bean seeds on a wet paper towel inside a clear plastic bag, tape it to the window, and add no soil whatsoever. Over a week the seeds sprout roots, a stem, and green leaves. The seed itself stores food that powers the first sprout, but once the leaves open and it keeps growing with no soil, the new material has to come from air and water. Use this to sharpen the anchor: if a plant can keep growing with zero soil, just water and air and light, then the soil was never the source of the plant's material in the first place.

> DRIVING QUESTION
> *"How can these seeds grow roots and leaves when there is no soil for them to eat?"*

INVESTIGATIVE 2

Weigh the Soil Before and After

Plant a fast-growing seed in a measured amount of dried soil. Weigh the dry soil at the start and tag it. Water the plant and give it light for several weeks, then carefully dry and re-weigh the soil while weighing the grown plant. The soil drops only a tiny bit, but the plant gained a lot. The numbers do not add up unless the new mass came from somewhere else: air and water. This is the cleanest, strongest evidence on the page, so lean on it as the main proof.

> DRIVING QUESTION
> *"Where did the plant's new weight come from if the soil only lost a little?"*

THE STANDARD

Cycling of Matter

Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

ANCHORING PHENOMENON

The Pumpkin That Turned Back Into Dirt

Set a whole pumpkin outside in early fall and watch it for a few weeks. It softens, caves in, grows fuzzy mold, and collapses into a dark mushy spot. By the end the pumpkin is mostly gone, and the soil under it looks richer. Where did all that matter go?

DRIVING QUESTION

"Where did the matter from the pumpkin go when the pumpkin disappeared into the ground?"

INVESTIGATIVE 1

The Plant That Grew From Almost Nothing

Plant a bean seed in a clear cup of soil and give it only water and sunlight. Over two weeks it grows tall leaves and a stem, far bigger than the seed. You never added solid food. The plant is building its own food matter out of air, water, and soil.

DRIVING QUESTION

"The seed was tiny and we only added water. Where did all the new plant matter come from?"

INVESTIGATIVE 2

The Worm Bin Eats the Scraps

Put apple cores, leaves, and veggie scraps into a bin with worms. Over a week or two, the scraps shrink and turn into dark, crumbly material that looks like rich soil. The worms and tiny decomposers did the work. This zooms in on the decomposer step of the anchor loop, showing matter going from dead food back toward the soil.

DRIVING QUESTION

"How do the worms turn old food scraps into something that looks like fresh soil?"

THE STANDARD

Brightness of the Sun and Stars

Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.

ANCHORING PHENOMENON

The Flashlight That Disappears Down the Hallway

A bright flashlight sits a few feet away and it is almost too bright to look at. A classmate carries the same flashlight slowly down a long hallway. With every step it gets dimmer, until at the far end it looks like a tiny, weak dot. The bulb never changed. Only the distance did. 5th graders will wonder if the night sky works the same way.

> DRIVING QUESTION
> *"If the flashlight bulb never changed, why did it look so dim once it was far away?"*

INVESTIGATIVE 1

The Sun Is a Star, Just the Closest One

At night the sky fills with tiny points of light. Each one is a star, a giant ball of hot gas like our sun, and some are far bigger. Yet they look like faint specks. Our sun is a star too. The only reason it blazes so much brighter is that it sits far closer to Earth than any other star.

> DRIVING QUESTION
> *"If the other stars are giant suns too, why do they look like dim specks while our sun lights up the whole day?"*

INVESTIGATIVE 2

Two Bright Dots, One Box

Two identical small bulbs are placed inside a long cardboard box, one near a peephole and one at the far end. Looking through the hole, the near bulb glows bright and the far one looks faint, even though the bulbs are exactly the same. Same setup as the anchor, but now both lights are visible at once so 5th graders can compare them directly.

> DRIVING QUESTION
> *"The two bulbs are identical, so why does one look so much brighter than the other?"*

THE STANDARD

Observable Patterns of the Sky

Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

ANCHORING PHENOMENON

The Shadow That Won't Hold Still

Tape a stick upright in the schoolyard and trace its shadow every hour. By the end of the day the chalk marks fan out like spokes on a wheel. The shadow was long and pointing one way in the morning, tiny at midday, then long again pointing the other way by afternoon. The stick never moved. So what made the shadow swing all the way around and shrink in the middle?

> DRIVING QUESTION
>
> *"The stick never moved all day, so why did its shadow keep changing length and direction?"*

INVESTIGATIVE 1

The Daylight Is Sneaking Longer

Hand 5th graders the sunrise and sunset times for the first of every month from a calendar or weather site. They subtract to find the hours of daylight and build a bar graph, month by month. The bars are short in winter, tall in summer, then short again. Same swing as the shadow, but stretched across a whole year. The sky changes on a schedule you can chart.

> DRIVING QUESTION
>
> *"Why does the number of daylight hours keep changing month to month instead of staying the same?"*

INVESTIGATIVE 2

The Stars That Disappear for the Season

Show 5th graders a simple star chart for the same place in January, then in July. Some bright stars and constellations are missing from one and back in the other. Orion blazes in winter and is gone by summer. Have them tally which months each star shows up and graph it. Same idea as the shadow and the daylight: a repeat you can see once it is on paper.

> DRIVING QUESTION
>
> *"Why can we see certain stars only during certain months and not others?"*

THE STANDARD

Earth's Spheres

Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

ANCHORING PHENOMENON

The Disappearing Beach

Show 5th graders two photos of the same beach, one from years ago and one from today. In the old photo there's a wide sandy beach in front of a house. In the new photo the sand is gone and the waves are reaching the porch. Nobody moved the sand with trucks. The ocean did it, a little at a time, wave after wave. 5th graders will want to know how water could erase a whole beach.

> DRIVING QUESTION
>
> *"How can the ocean move a whole beach when no people and no machines were involved?"*

INVESTIGATIVE 1

The Cliff That Crumbles

Pack wet sand or soil into a clear bin to make a small cliff, then pour or splash water against the base over and over. The bottom wears away first, and chunks of the "cliff" slump down. This sharpens the anchor: 5th graders see the hydrosphere (water) directly reshaping the geosphere (land), the same thing happening to the beach, but up close and on purpose.

> DRIVING QUESTION
>
> *"Why does the water wear away the bottom of the cliff first instead of the top?"*

INVESTIGATIVE 2

Mountains Make Their Own Weather

Show a simple map or cross-section of air blowing toward a mountain range, rising, cooling, and dropping rain on one side, leaving the other side dry. Use a fan and a damp paper "mountain" if you want it hands-on. This sharpens the anchor from the air side: now the geosphere (the mountain) is changing the atmosphere (winds and clouds), proving the push works both directions between systems.

> DRIVING QUESTION
>
> *"How can a mountain, which can't move, change where the rain falls?"*

THE STANDARD

Distribution of Water on Earth

Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

ANCHORING PHENOMENON

100 Cups of Earth's Water

Fill 100 small clear cups with water to stand for all the water on Earth. Then a guide sorts them. Ninety-seven cups get a pinch of salt and slide to the "ocean" side. Only 3 cups stay fresh, and 2 of those get a tiny ice cube for "glaciers," leaving almost nothing for the lakes and rivers we drink from. 5th graders stare at that lonely splash and start asking how the planet can be called a water world.

DRIVING QUESTION

"If Earth is covered in water, why is almost none of it water we can actually drink?"

INVESTIGATIVE 1

Salt Water You Can't Drink

First, each group stirs salt into a cup of plain water until no more will dissolve, which shows the salt really is in there even when you can't see it. Do not taste that over-salted cup. For the taste comparison, use a separate cup with just a small pinch of salt (about a teaspoon per cup) so it tastes more like real seawater. Groups take a tiny taste of fresh water versus that lightly salted cup. The point: the ocean is 97 out of 100 cups, but the salt makes it useless for drinking, so the "tiny splash" of fresh water suddenly matters a lot more.

DRIVING QUESTION

"The ocean is enormous, so why can't we just drink from it?"

INVESTIGATIVE 2

The Frozen Fresh Water

Groups measure how much liquid water a handful of ice cubes makes when it melts, recording the amount before and after. The cubes stand for glaciers and polar ice caps, where most of Earth's fresh water is locked up. This sharpens the anchor by showing that even the small fresh-water share is mostly frozen solid, so the part we can actually reach is tinier still.

DRIVING QUESTION

"If most fresh water is frozen, how much is left for us to use right now?"

THE STANDARD

Protect Earth's Resources

Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

ANCHORING PHENOMENON

The Stream Behind the School Used to Be Brown

Show 5th graders two photos of the same neighborhood stream, years apart. In the old photo the water is brown and choked with trash. In the new photo the water runs clear, grasses and young trees line the banks, and an Adopt-A-Stream sign stands by it. Nothing changed on its own. People did something.

> DRIVING QUESTION
> *"What did the people in this community actually do to turn a brown, trashy stream into a clean one?"*

INVESTIGATIVE 1

Where Does Our School's Trash Go?

Have 5th graders weigh one day's lunchroom trash, then sort it into landfill, recycling, and compost piles. Most of the pile turns out to be food scraps and recyclable bottles that never needed a landfill. It zooms in on one resource problem the 5th graders make themselves, plus a sorting fix a community could copy.

> DRIVING QUESTION
> *"How much of our trash is actually trash, and what could a school do to send less of it to the landfill?"*

INVESTIGATIVE 2

The Water We Pour Down the Drain

Have 5th graders catch and compare the water from two handwashing methods: tap running the whole time, and tap off while scrubbing. The off-while-scrubbing test wastes far less. This connects the anchor to a resource, fresh water, that 5th graders can measure and protect with one small change a whole community could copy.

> DRIVING QUESTION
> *"How much water does one small habit save, and what could a community do to save water on a bigger scale?"*

THE STANDARD

Defining Design Problems

"Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost."

ANCHORING PHENOMENON

The Backpack That's Breaking Your Back

Every elementary student knows the struggle: a backpack so stuffed it pulls your shoulders down and digs into your straps. It is a real, daily, annoying need. But "my backpack stinks" is not a problem you can solve yet. The challenge is to take that complaint and sharpen it into a design problem with clear rules. 3rd to 5th graders will argue about what "better" even means, and that argument IS the work.

> DRIVING QUESTION
>
> *"How do we turn "my backpack is too heavy and uncomfortable" into a clear problem an engineer could actually solve?"*

INVESTIGATIVE 1

The Lunchbox That Won't Keep Anything Cold

A student opens their lunch at noon and the yogurt is warm and the juice is room temperature. Gross. This sharpens the anchor's big idea around CRITERIA: before anyone designs a better lunchbox, the class has to agree on what "success" actually means. Cold by lunchtime? For how long? Fits in a backpack? Students discover that a need is useless until you decide what would count as solving it.

> DRIVING QUESTION
>
> *"What would a lunchbox have to DO for us to say the cold-food problem is solved?"*

INVESTIGATIVE 2

The Class Pet Cage on a Tiny Budget

The class wants a better hideout for the class hamster, but there is a catch: you can only use the bin of recycled cardboard, three pieces of tape, and one class period. This sharpens the anchor's big idea around CONSTRAINTS. Suddenly the dream design crashes into real limits on materials, time, and cost. Students learn that a good problem statement names the limits up front, so nobody designs something they could never actually build.

> DRIVING QUESTION
>
> *"How do the limits on our materials, time, and cost change what problem we should even try to solve?"*

THE STANDARD

Comparing Solutions

"Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem."

ANCHORING PHENOMENON

Two Bridges, One Backpack to Hold

Two groups each build a paper bridge that has to span a gap and hold a stack of pennies. Both bridges look totally different. One is folded into a deep V, the other is flat with rolled paper columns. They both get pennies stacked on top until one sags. The class wants to know which design is actually better, and that turns out to be a trickier question than it sounds.

> DRIVING QUESTION
> *"When two designs solve the same problem in different ways, how do we decide in a fair way which one is better?"*

INVESTIGATIVE 1

Same Rules for Both: The Criteria List

Before testing anything, the class writes down what a good bridge has to do (span the gap, hold pennies, stay under a paper limit). Those are the criteria and constraints. Now both bridges get judged by the exact same list. This sharpens the anchor's big question: a comparison is only fair when both designs face the same rules.

> DRIVING QUESTION
> *"What rules does every design have to follow so the contest between them is actually fair?"*

INVESTIGATIVE 2

Borrow the Best Parts

After comparing, groups talk to each other about what worked. The V-fold group sees that columns added height, the column group sees that folding added strength. They each build a second bridge that borrows the other team's best idea. This sharpens the anchor: comparing isn't just to crown a winner, it's to make the next design better.

> DRIVING QUESTION
> *"After we compare two designs, how do the best parts of each one help us build an even better third design?"*

THE STANDARD

Improving Designs

"Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved."

ANCHORING PHENOMENON

The Tower That Keeps Falling on the Third Floor

Each group builds a paper-and-tape tower as tall as they can, then a fan or a gentle table shake tests it. Almost every tower fails the same way: it folds right where the second section meets the third. Same materials, same wobble, same weak spot. Elementary students will want to know why it always breaks in that one place, and how to stop it.

> DRIVING QUESTION
>
> *"Why does the tower keep failing in the same spot, and what one change would fix it?"*

INVESTIGATIVE 1

One Change at a Time: The Fair-Test Showdown

Two groups both want a stronger tower base, but one widens the base AND adds tape while the other only widens the base. When the wide-and-taped tower wins, nobody can say why. Use this challenge to sharpen the anchor's question: if you change two things at once, you never learn which one actually helped.

> DRIVING QUESTION
>
> *"If we want to know what really made the tower stronger, how do we set up a test that gives us a clear answer?"*

INVESTIGATIVE 2

Find the Failure Point Before You Fix It

Before changing anything, groups run the same wind test three times and watch closely for exactly where and when the tower gives out. They mark the weak spot with a sticky dot. This challenge zooms in on the anchor: you can't improve a design until you've found the precise place it fails.

> DRIVING QUESTION
>
> *"Where exactly does our prototype fail, and how do we pinpoint it before we start changing things?"*