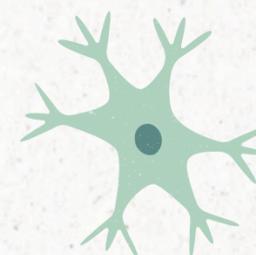
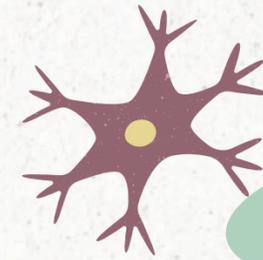


CHEMISTRY IN ACTION- REVIEW CLASS

THINKING LIKE A SCIENTIST





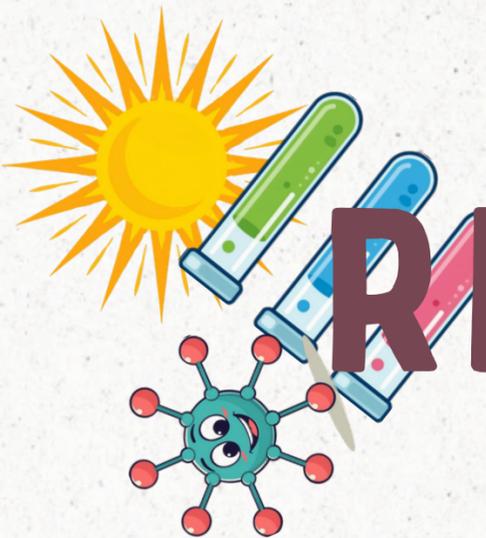
BIG QUESTION

What Do All Experiments Have in Common?
Think about the experiments we did together — they
all share something important!



**Turn to a partner and discuss: "What do you
think connects all our experiments?"**





RECALL OUR EXPERIMENTS



COLOR CHANGE

Watch liquids transform from one color to another when acids meet bases — like magic happening right before your eyes!

GEL WORMS GLOWING

Create squishy, glowing gel worms using special chemicals that capture and release light energy!

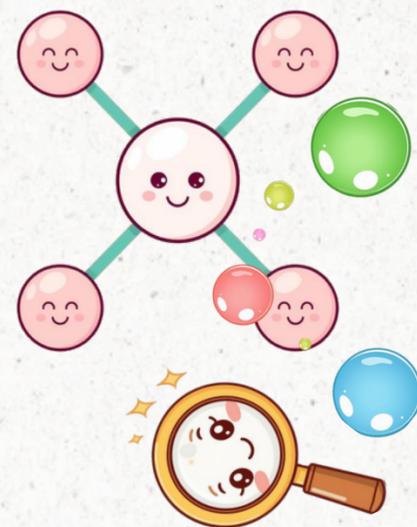
BUBBLES FORMING

See gases escape and create fizzy bubbles when chemicals react — proof that something new is forming!

GLOW EFFECTS

Watch materials light up in the dark using phosphorescent particles that store and emit energy!





WHAT DID WE OBSERVE?



COLOR CHANGES

We saw liquids change from one color to another when we mixed different chemicals together. This told us a chemical reaction was happening!

SHAPE & TEXTURE

Some materials changed their form - gel worms got their shape, and textures became different when chemicals combined.

GAS & BUBBLES

Fizzing and bubbling showed us that gas was being produced. Those tiny bubbles were actually new substances forming!

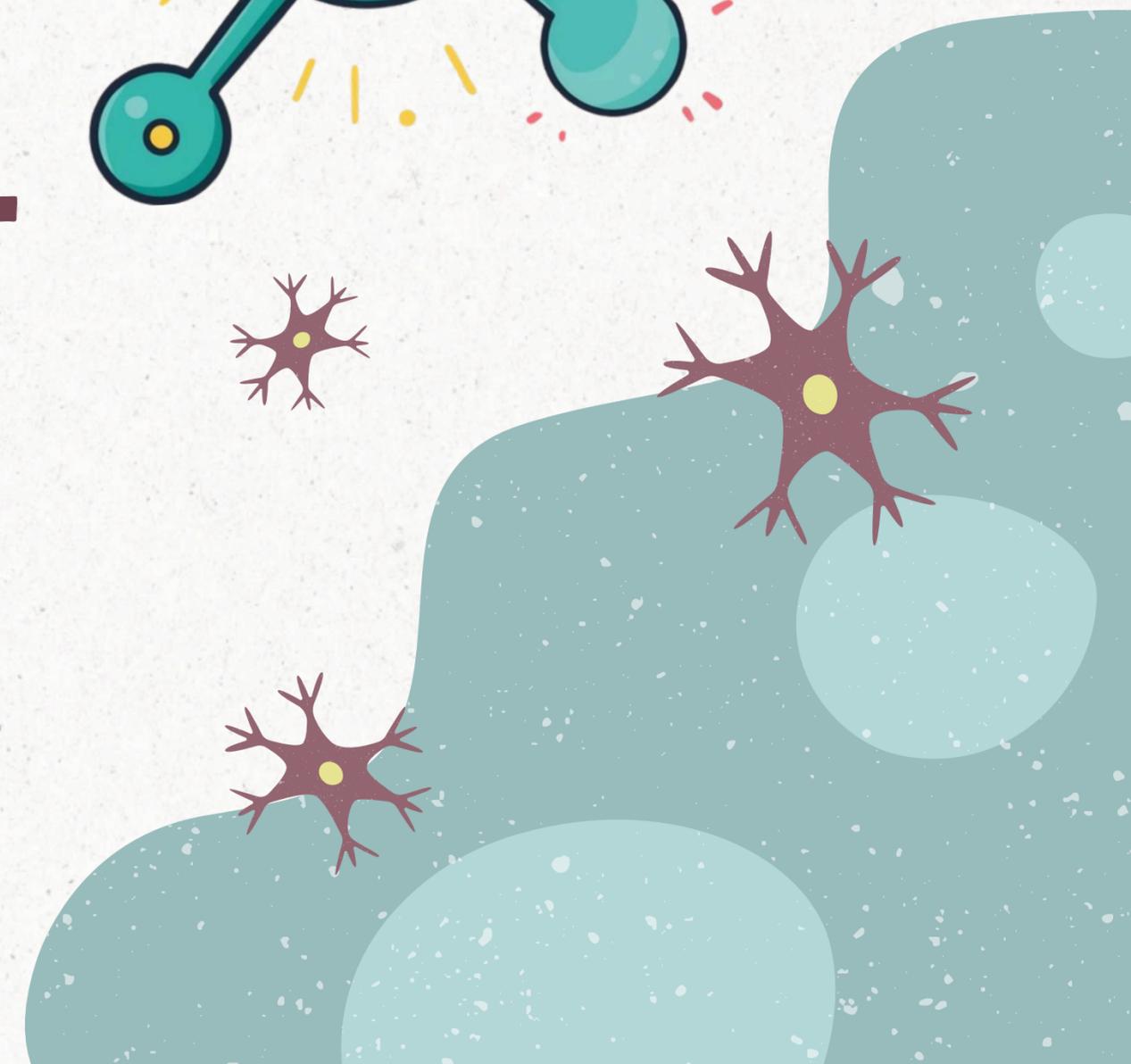
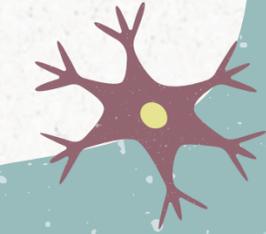
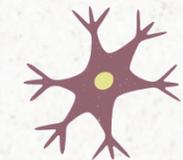
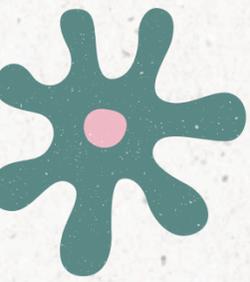
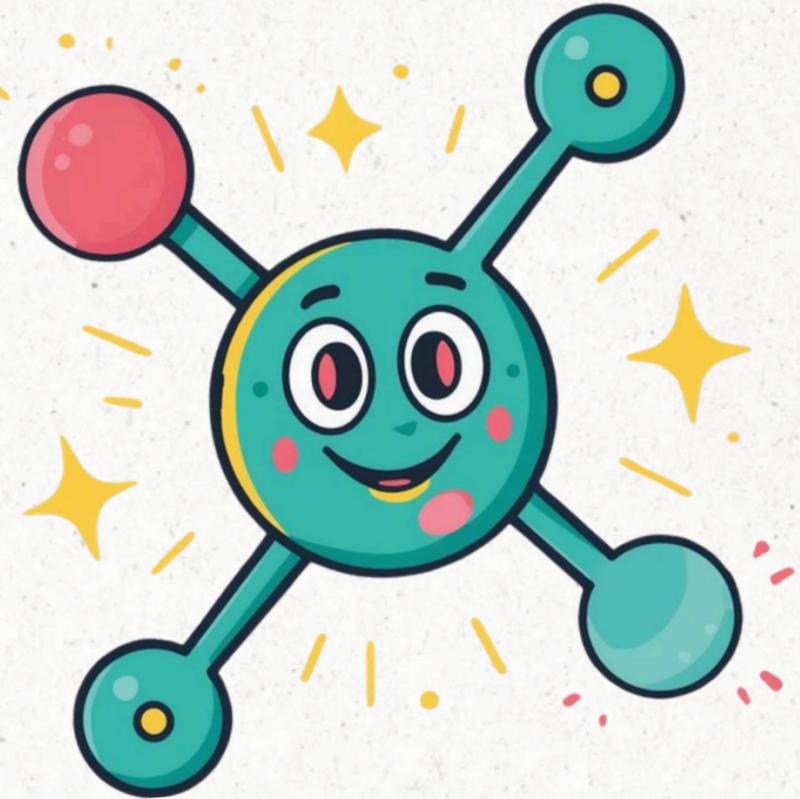
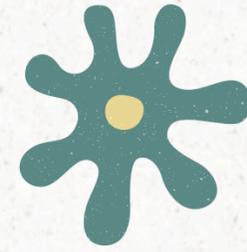
LIGHT OR GLOW

Our glowing worms emitted light after being charged! This showed us how energy can be stored and released.



05

**SCIENCE IS ABOUT
UNDERSTANDING
CHANGE**

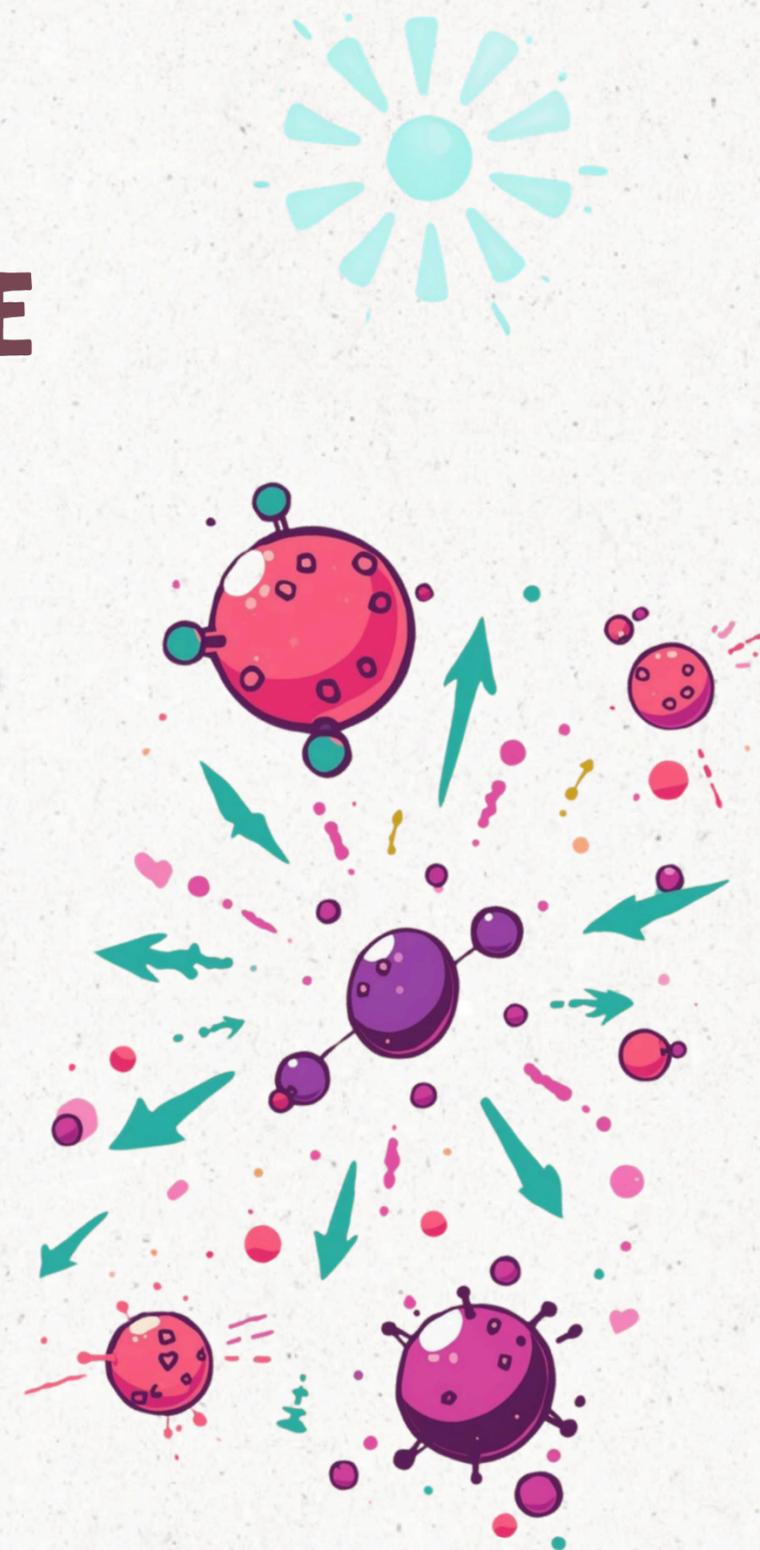
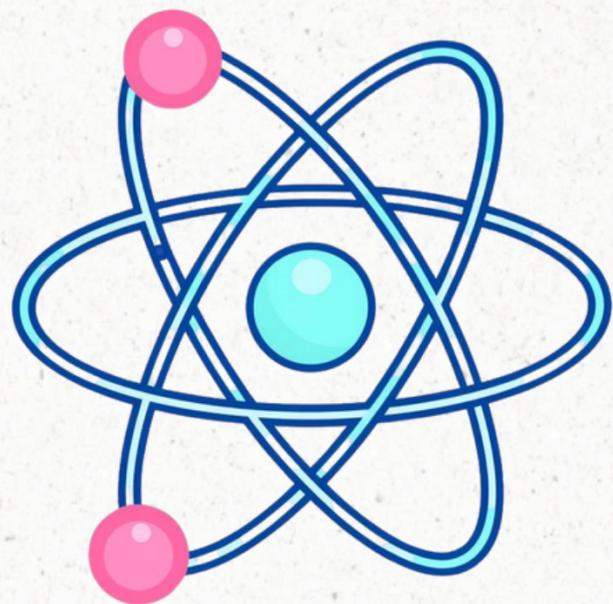


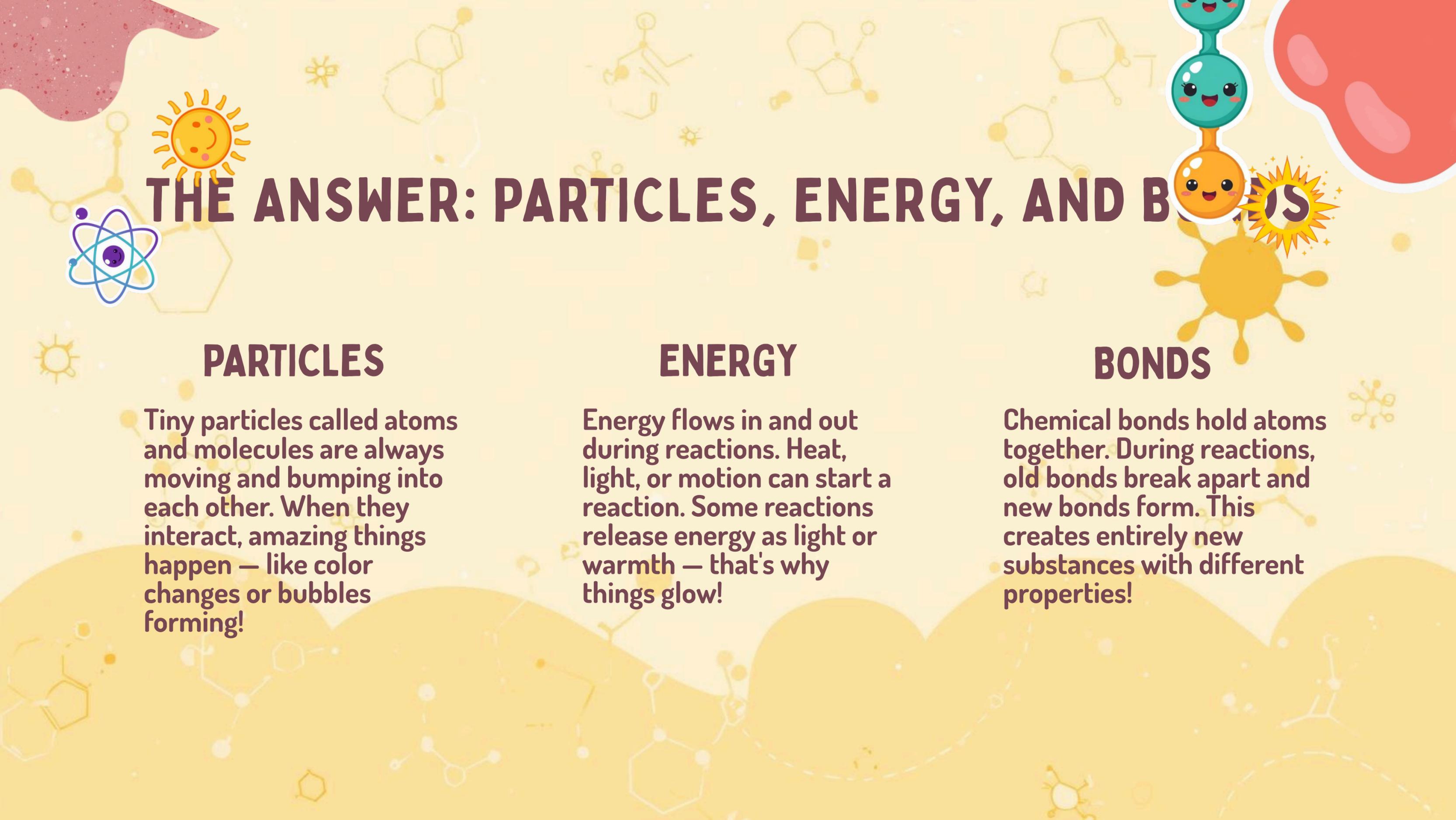


DEEP QUESTION: WHAT CAUSES THESE CHANGES?

Changes happen because of particles and energy working together. When particles move and interact, they can create new substances, release light, or change color. Energy is the driving force behind all these transformations!

Discuss with a partner: What do you think causes changes in experiments?





THE ANSWER: PARTICLES, ENERGY, AND BONDS

PARTICLES

Tiny particles called atoms and molecules are always moving and bumping into each other. When they interact, amazing things happen — like color changes or bubbles forming!

ENERGY

Energy flows in and out during reactions. Heat, light, or motion can start a reaction. Some reactions release energy as light or warmth — that's why things glow!

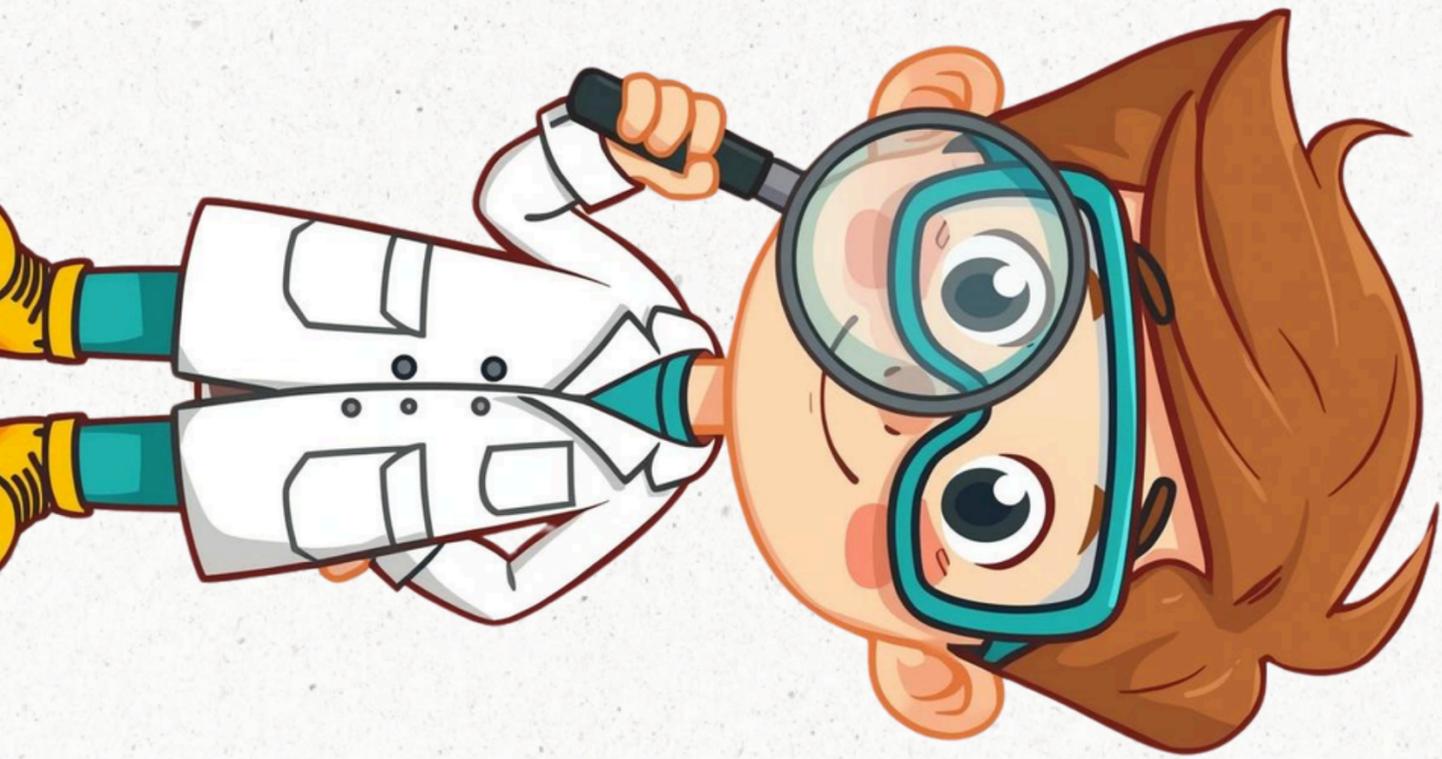
BONDS

Chemical bonds hold atoms together. During reactions, old bonds break apart and new bonds form. This creates entirely new substances with different properties!

A cartoon illustration of a young man with brown hair, wearing a white lab coat over a teal shirt. He is in a thinking pose, with his right hand to his chin. A glowing yellow lightbulb is positioned near his chin, with small orange lines radiating from it. The background is a gradient of teal and blue, featuring several other glowing yellow lightbulbs and blue question marks floating around. On the left side, there is a large yellow question mark with a teal circle below it.

SCIENTIFIC THINKING

How do you think scientists figure out answers?

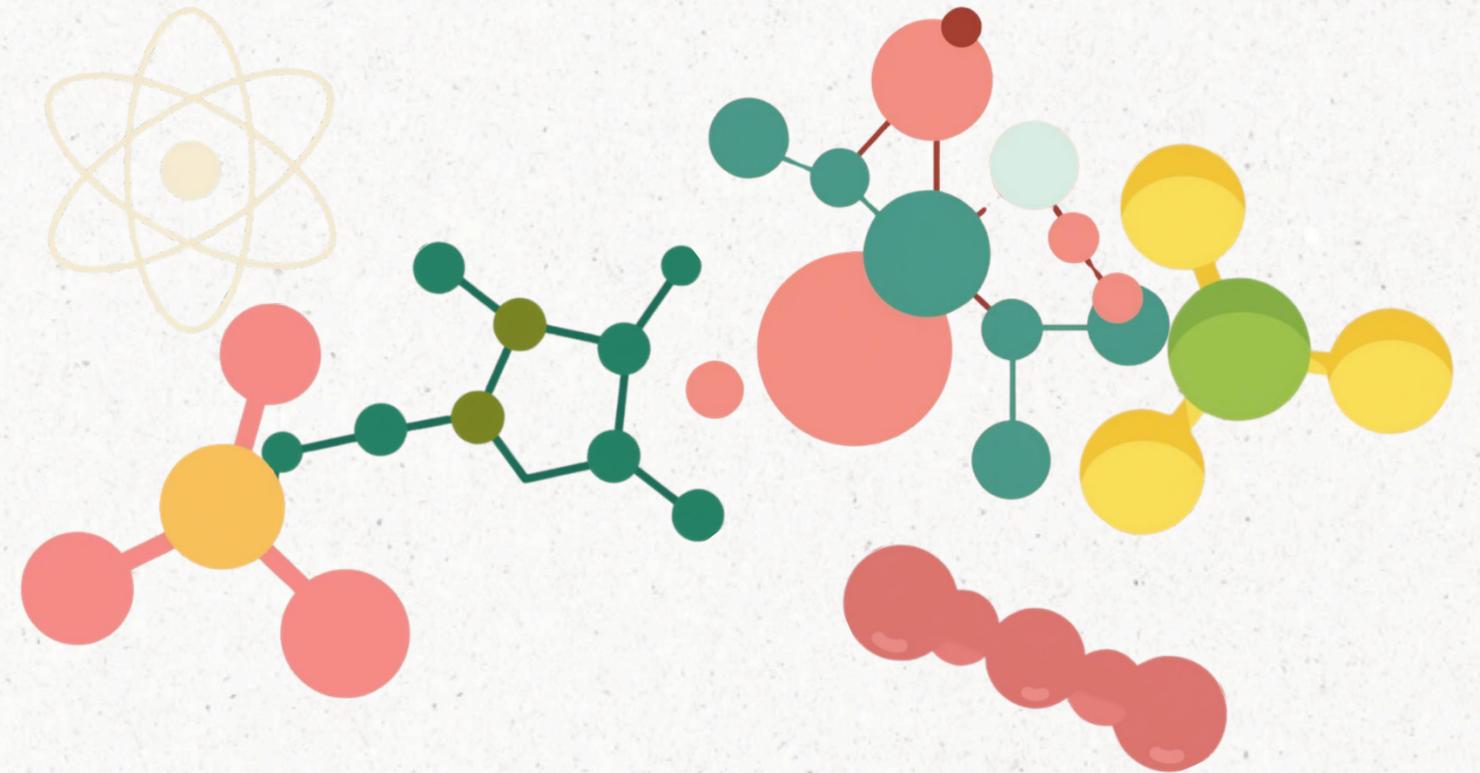


OBSERVE & ASK

Scientists follow a clear process to discover answers. They start by observing carefully, then ask questions about what they see. Next, they predict what might happen and test their ideas through experiments. Finally, they explain their results to others.

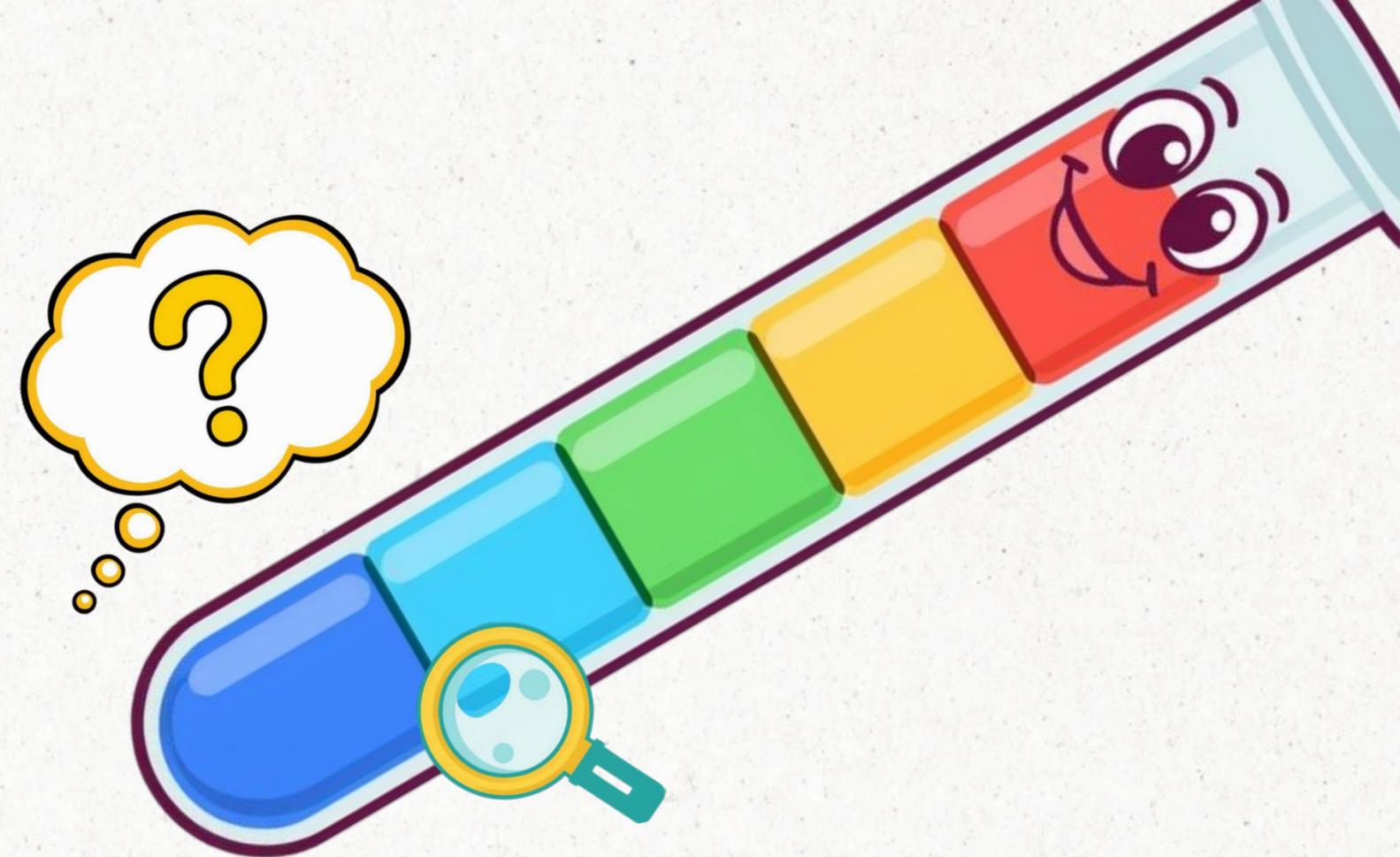
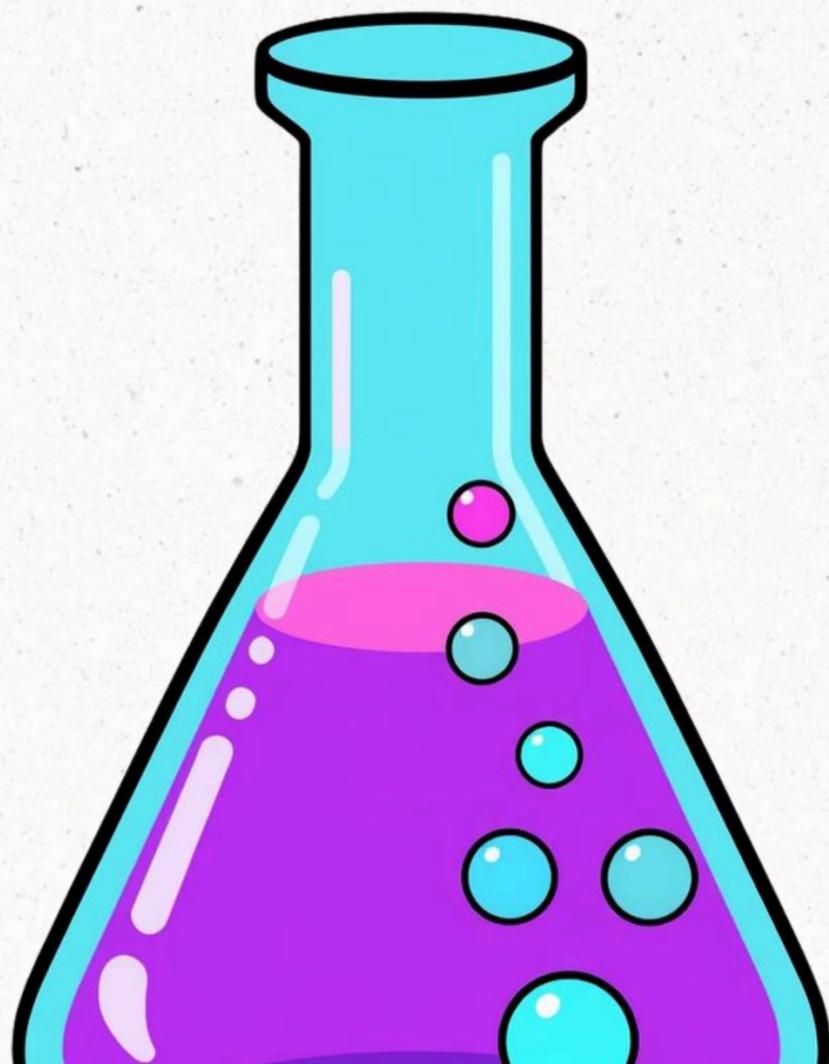
PREDICT & TEST

Before testing, scientists predict what will happen based on their observations. Then they design and run experiments to test their predictions. This hands-on testing reveals whether their ideas are correct!



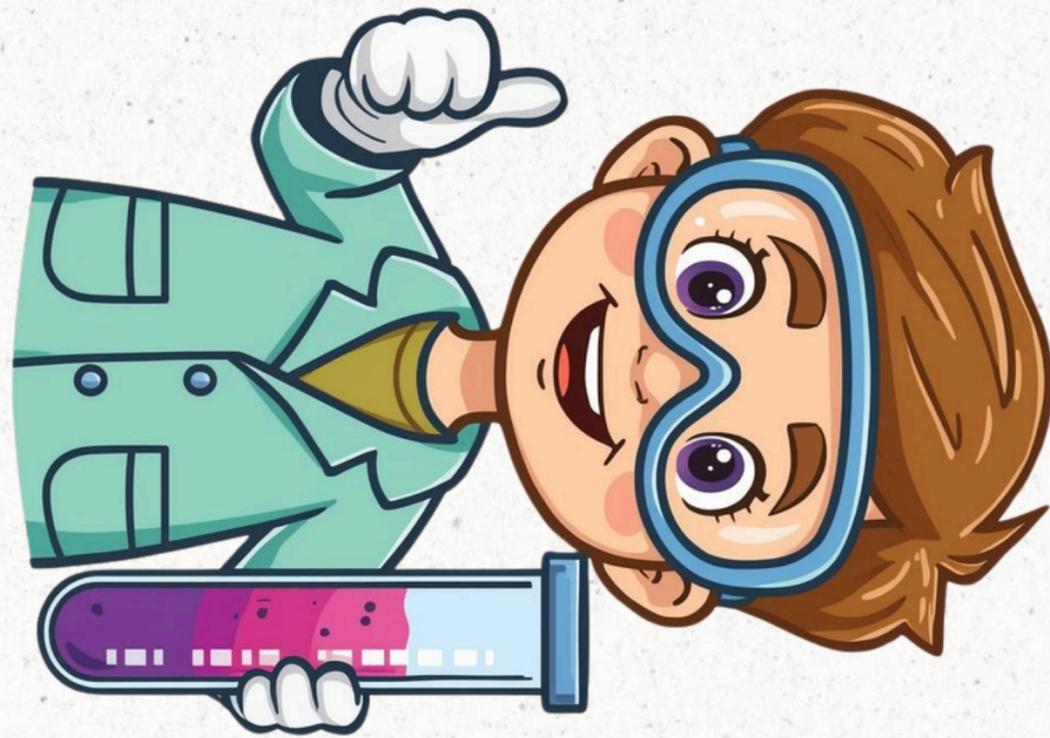
WHAT DID YOU OBSERVE?

Think back to the acid-base experiment. What color changes did you see? Write or draw your observations in your notebook!



WHAT QUESTIONS DID YOU ASK?

What made you curious during the experiment? What did you want to know more about? Share your questions with me.



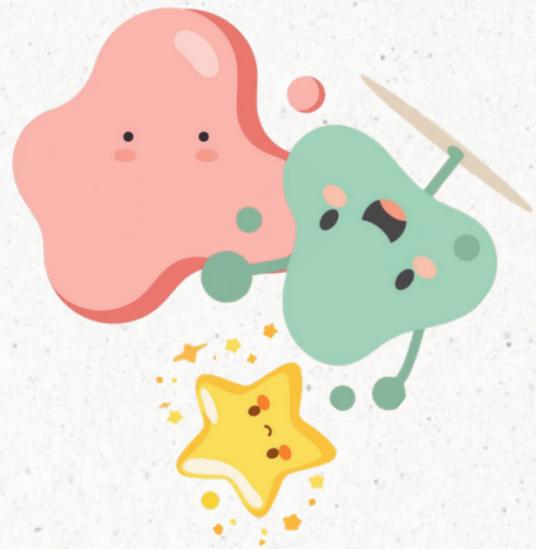
SCIENTIFIC THINKING STEPS

This is how scientists think through experiments! Each step builds on the last. You observed something interesting, asked why it happened, made a prediction, tested it, and explained your results using science!

✓ EXAMPLE ANSWER

Observed: The solution changed color when mixed.
Asked: What causes the color change?
Predicted: Mixing acid and base will change color.
Tested: Combined the solutions carefully.
Explained: Particles reacted and released energy!





MATCHING ACTIVITY



ACID-BASE

→ Color change?

When acids and bases mix, special indicator chemicals change color to show the reaction happening!

WORMS

→ Glow?

Zinc sulfide absorbs light energy and slowly releases it back as a beautiful glow in the dark!

FIZZ

→ Gas bubbles?

Chemical reactions can produce gases that escape as fizzy bubbles you can see and hear!

GLOW

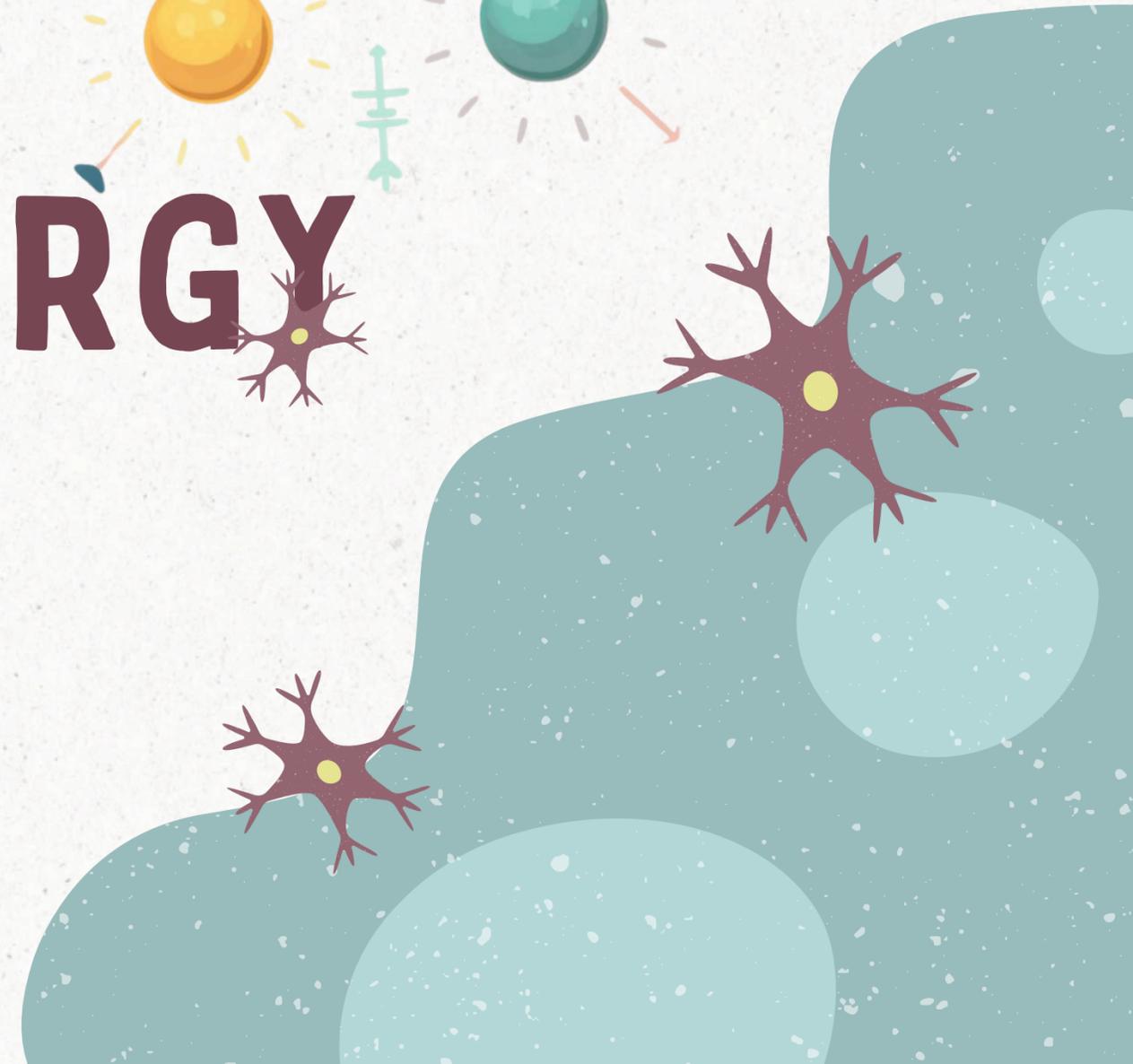
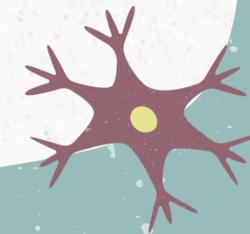
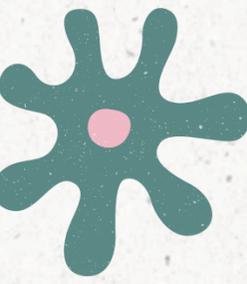
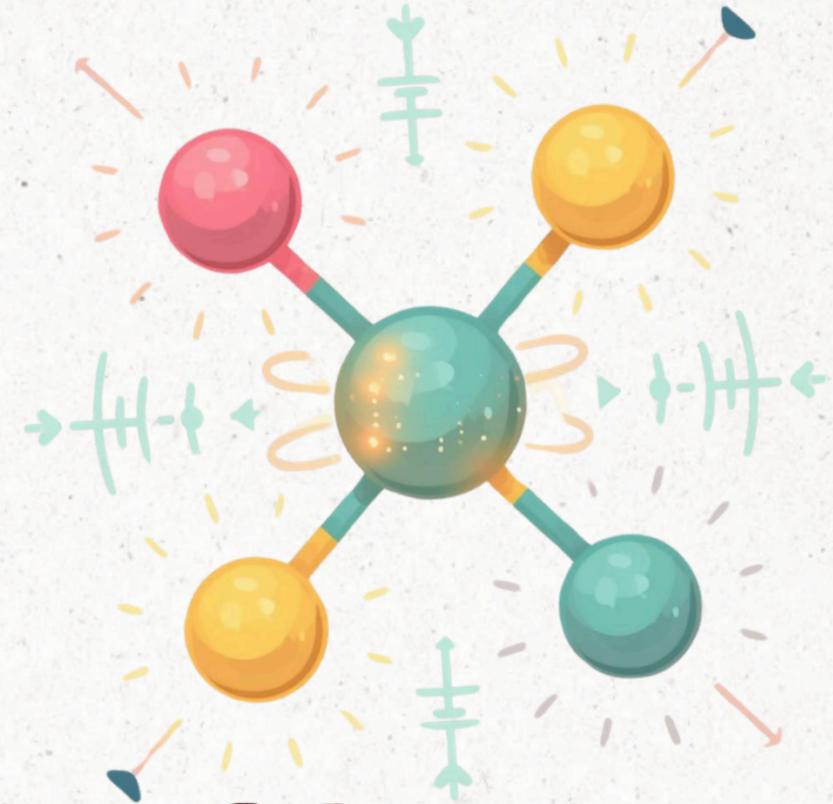
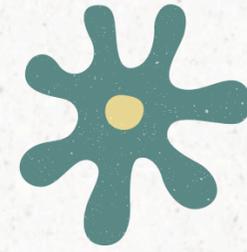
→ Light emission?

Some materials store energy and release it as light - that's what makes things glow!



13

**PARTICLES + ENERGY
= CHANGE**





ENGINEERING THINKING

How do engineers solve problems? Engineers are creative problem-solvers who design and test solutions to make things work better. They look at challenges, imagine possibilities, and build things to help people. Think about it: "How do you think engineers solve problems?" Share your ideas with a partner!





THE ENGINEERING CYCLE



IDENTIFY THE PROBLEM

Look around and notice what needs fixing. Ask yourself: What's the challenge? What do people need? This is where every great invention starts!

IMPROVE THE DESIGN

Make it even better! Learn from what worked and what didn't. Engineers never stop improving — each version gets closer to perfect!

DESIGN A SOLUTION

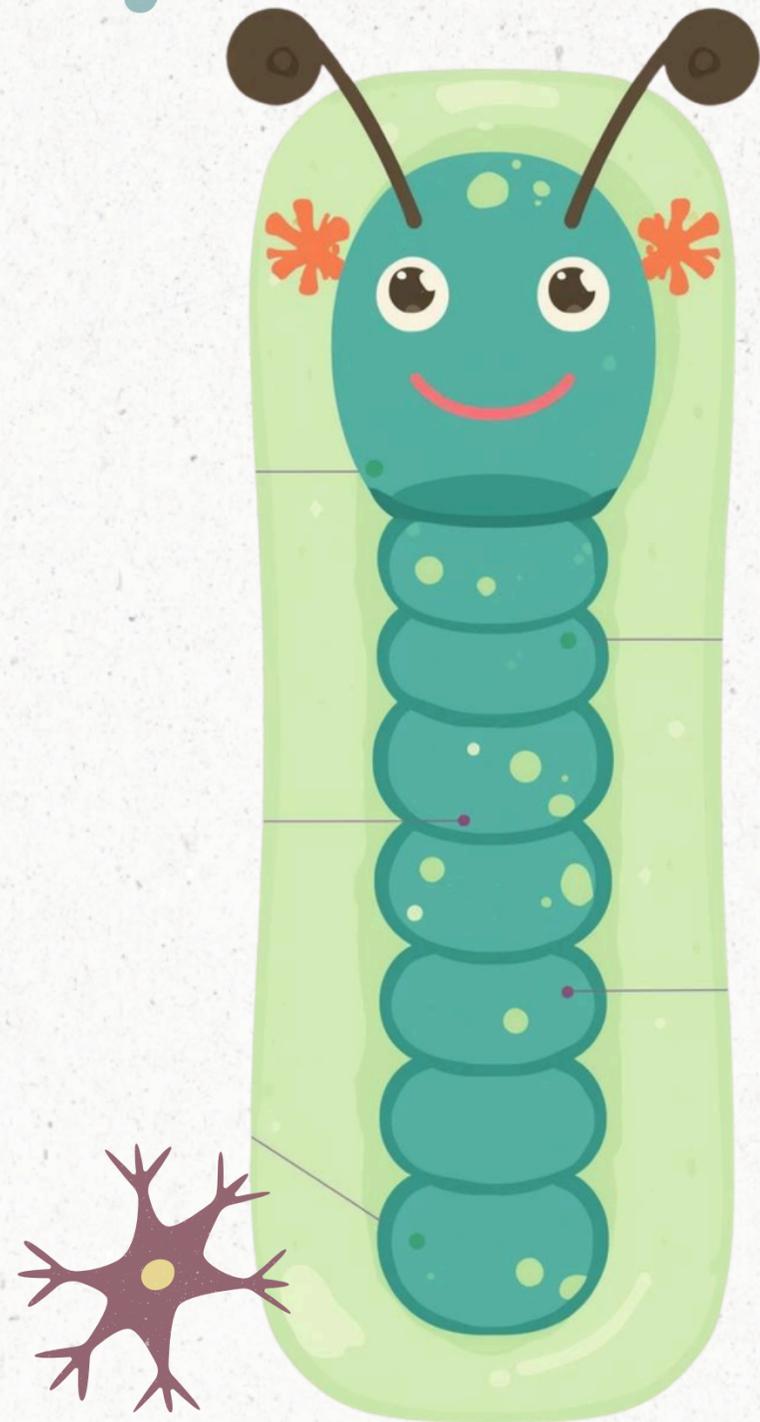
Get creative and brainstorm ideas! Sketch, plan, and choose the best approach. Think about materials, steps, and how it will work.

TEST IT OUT

Try your design and see what happens! Does it work? What goes wrong? Testing helps you learn and find ways to make it better.



* APPLY ENGINEERING THINKING



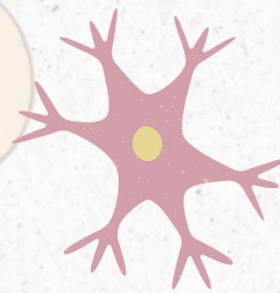
How did we design the glowing worms experiment? Think about the materials we used and the steps we followed to create our glow-in-the-dark worms.

Discussion Prompt: "What materials did we need? What order did we do things in? Why do you think each step mattered?"

EVALUATE OUR DESIGN

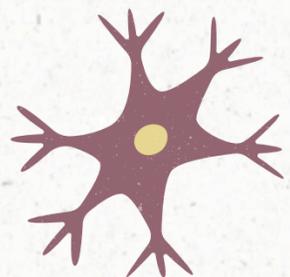


?



What If Zinc Sulfide Is Wrong?
What happens if zinc sulfide isn't placed correctly in our glowing worms? Think about how the glow works - the zinc sulfide absorbs light and releases it slowly.

Discussion Question:
"How would incorrect placement affect the glow?" Consider: Would the worm glow evenly? Would it glow at all? Share your troubleshooting ideas!





CHALLENGE: HOW CAN WE MAKE WORMS GLOW LONGER?

Ideas: More light? Longer charging? Better mixing? Discuss in small groups!





SHARE IDEAS FOR IMPROVEMENT

MORE LIGHT

Provide more light to charge the glow worms! Brighter light sources like sunlight or UV lamps can energize the zinc sulfide particles more effectively.

LONGER CHARGE

Charge the worms for a longer time before turning off the lights. The longer they absorb light energy, the brighter and longer they will glow in the dark!

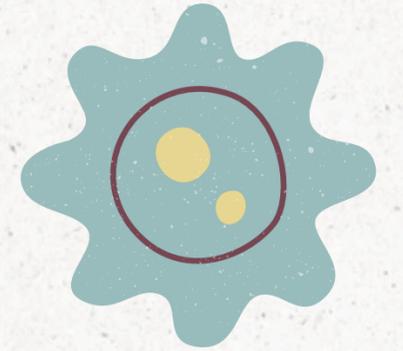
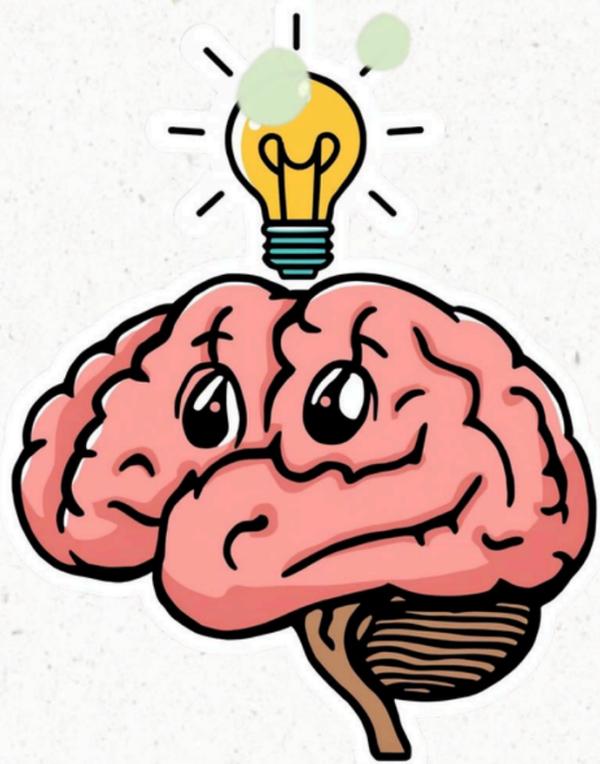
BETTER MIXING

Mix the chemicals more thoroughly and evenly. Better mixing ensures the zinc sulfide is distributed throughout the worm for a consistent, bright glow.

EXAM MINDSET

This Is Not a Memorization Test!

Don't worry about remembering every single fact. Focus on thinking and problem-solving instead. Use what you understand to figure out answers. Science is about exploring ideas, not just reciting information!





WHAT ARE WE TESTING?

What skills or ideas are we practicing in experiments? Share your thoughts aloud!





ANSWER: THINKING, EXPLAINING, PROBLEM-SOLVING

SCIENTIFIC THINKING

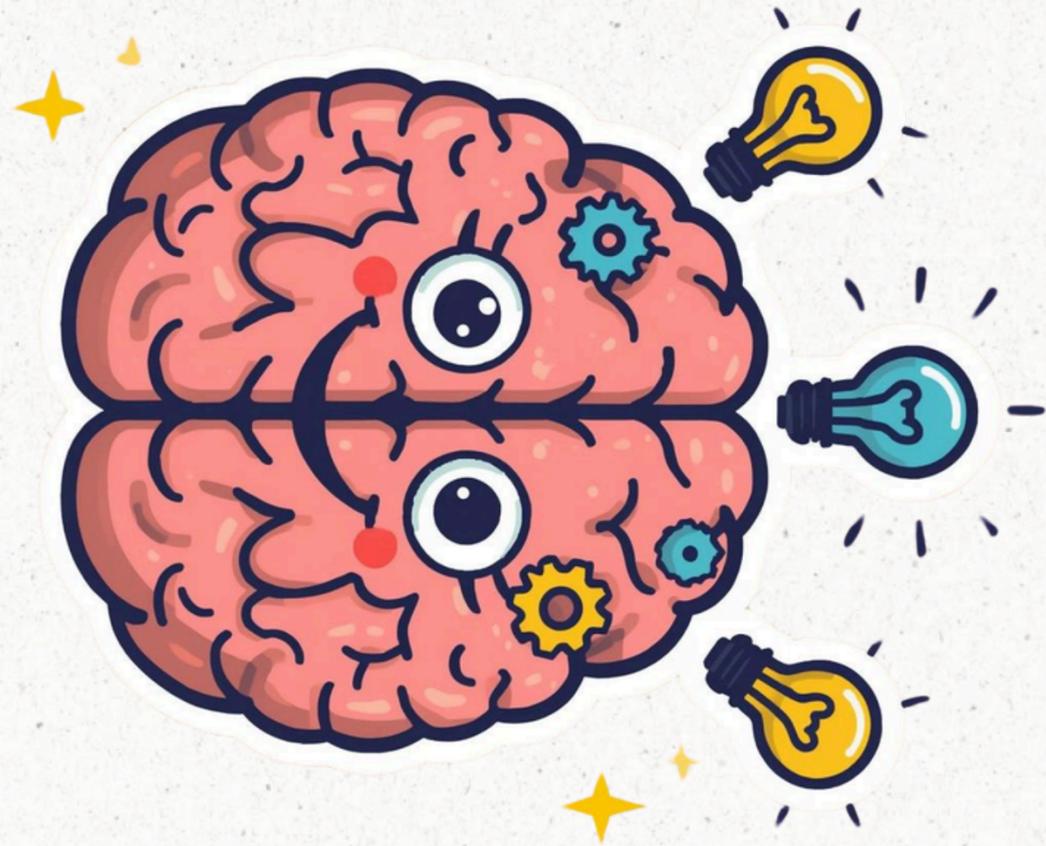
Use the scientific method to observe, question, predict, test, and explain. Think like a real scientist by following logical steps to understand how and why changes happen in experiments.

CLEAR EXPLAINING

Communicate your findings clearly using scientific vocabulary. Describe what you observed, what happened, and connect your results to particles, energy, and chemical changes.

PROBLEM-SOLVING

Apply creative thinking to design solutions and improve experiments. Use engineering skills to identify problems, test ideas, and make designs better through iteration.

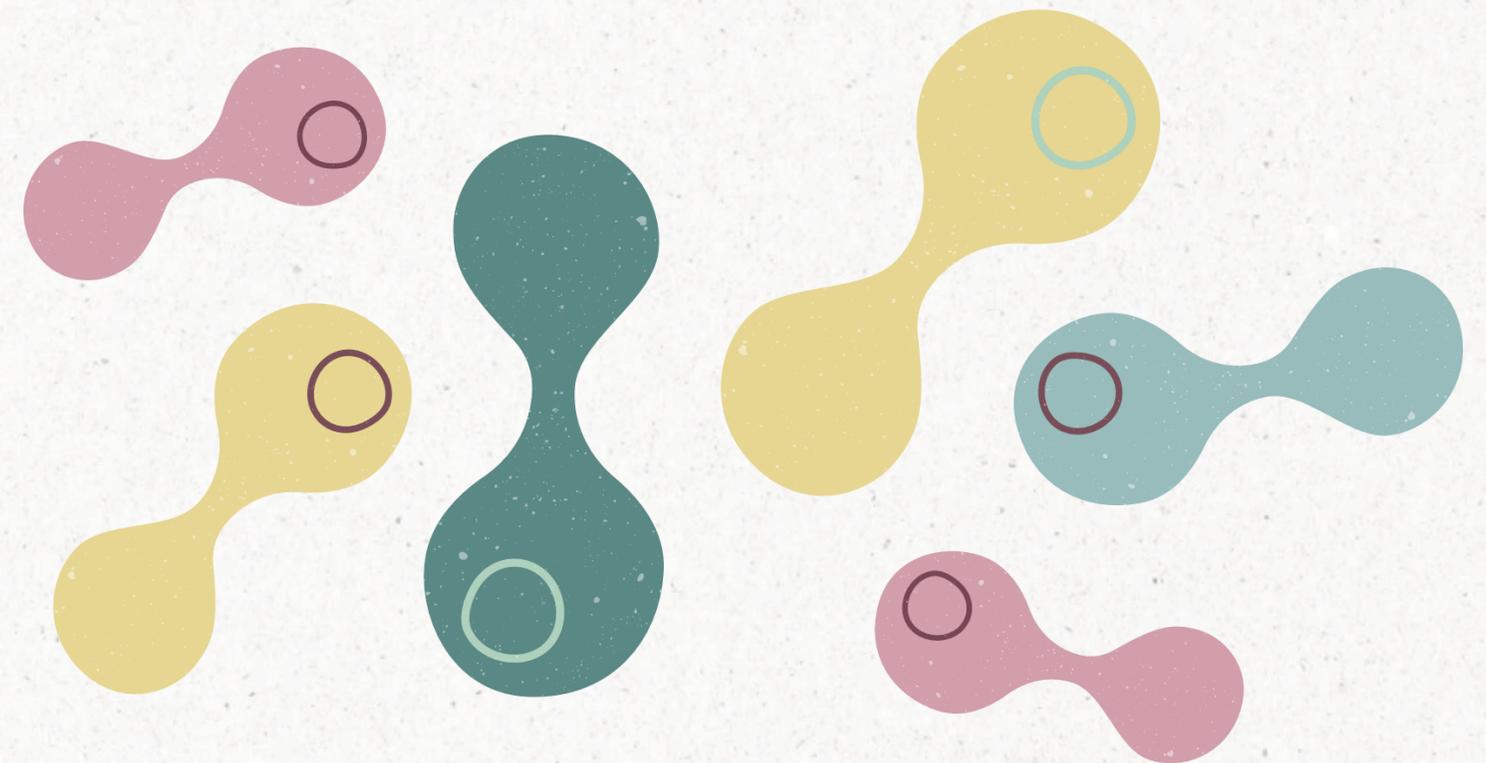


01 THE FRAMEWORK

This framework helps you approach any science or engineering challenge. Start by carefully observing what happens, then analyze the patterns you notice. Design a solution or experiment, explain your results clearly, and always look for ways to improve.

02 YOUR STEPS

Observe → Analyze → Design → Explain → Improve. These five steps guide scientists and engineers through any problem. Use them every time you experiment or create something new!





MINI PRACTICE: DESIGN A NEW EXPERIMENT



Use two ideas from this course to design your own experiment! Think about what you want to observe and how you would test it. Consider: What materials would you need? What changes would you look for?

Remember the scientific method: Observe carefully, ask questions, predict what will happen, test with experiments, and explain your results. Now it's your turn to be the scientist!

26 SHARE IDEAS

Present your experiment ideas to the class or your group. Explain what you observed, what you tested, and what you learned. Speaking about science helps you understand it better!

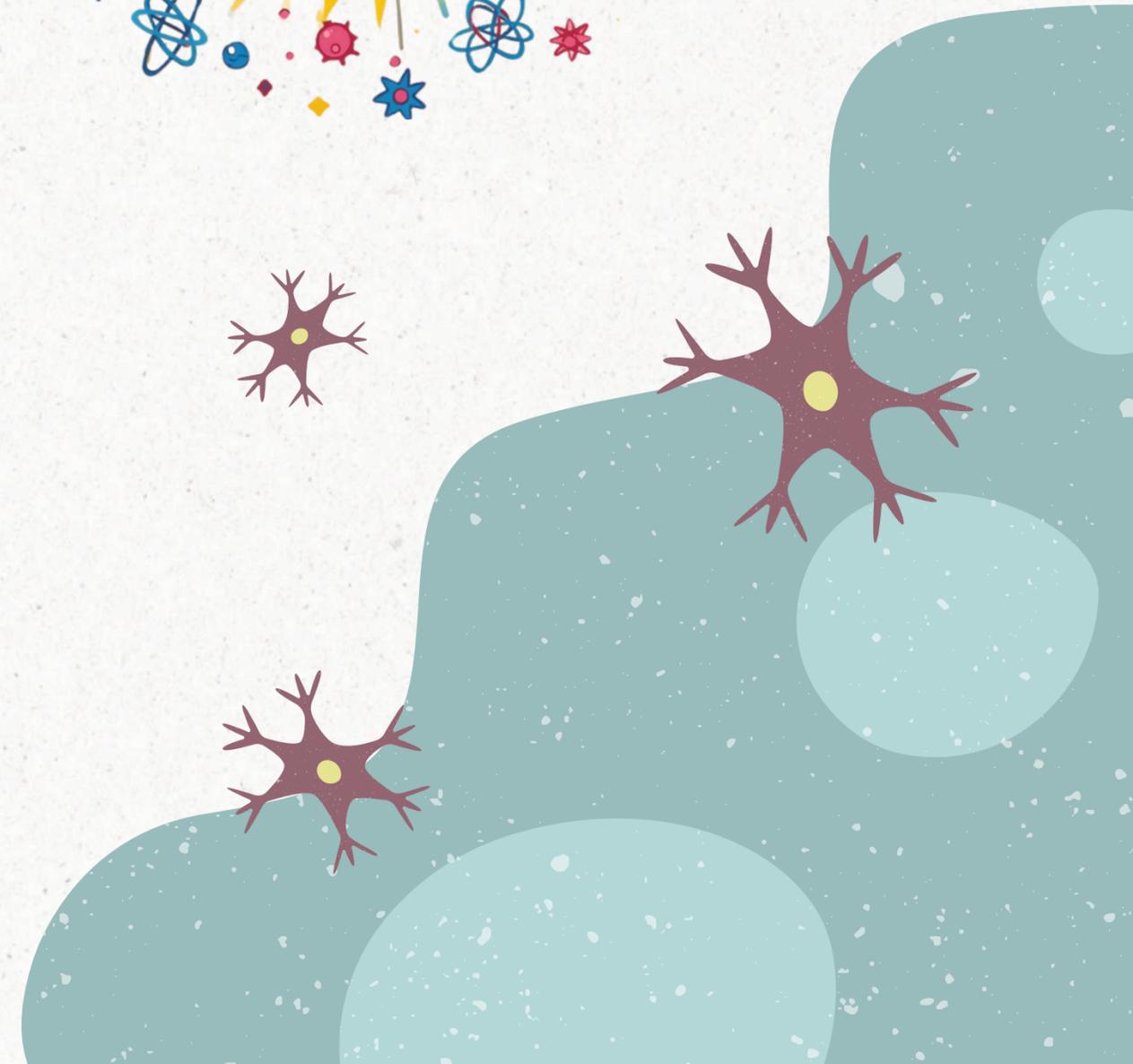
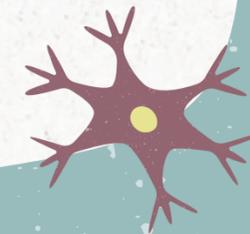
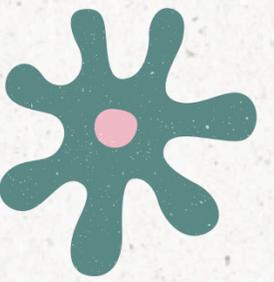
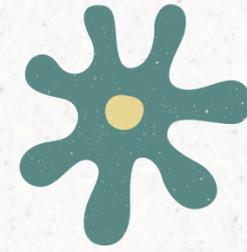


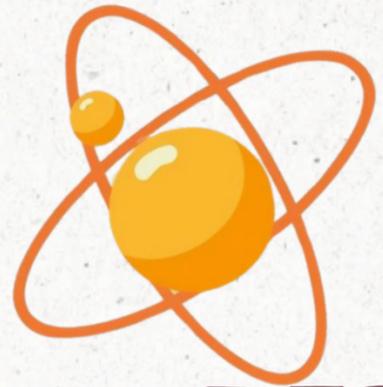
26 GIVE FEEDBACK

Listen carefully to your classmates' ideas. Give helpful feedback that is kind and constructive. Ask questions to learn more about their experiments and designs!

27

**FINAL
MESSAGE**





REFLECTION: WHAT DO YOU UNDERSTAND



What is one thing you understand now that you didn't before? Take a moment to think about all the experiments, scientific thinking, and engineering design we explored together.

Share your reflection with a partner or write it down in your notebook. Remember: every scientist started by asking questions and wondering about the world around them!

