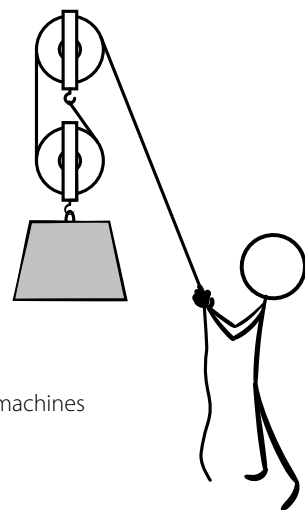


Simple Machines



compound machines



pulley



wheel and axle



lever

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Simple Machines



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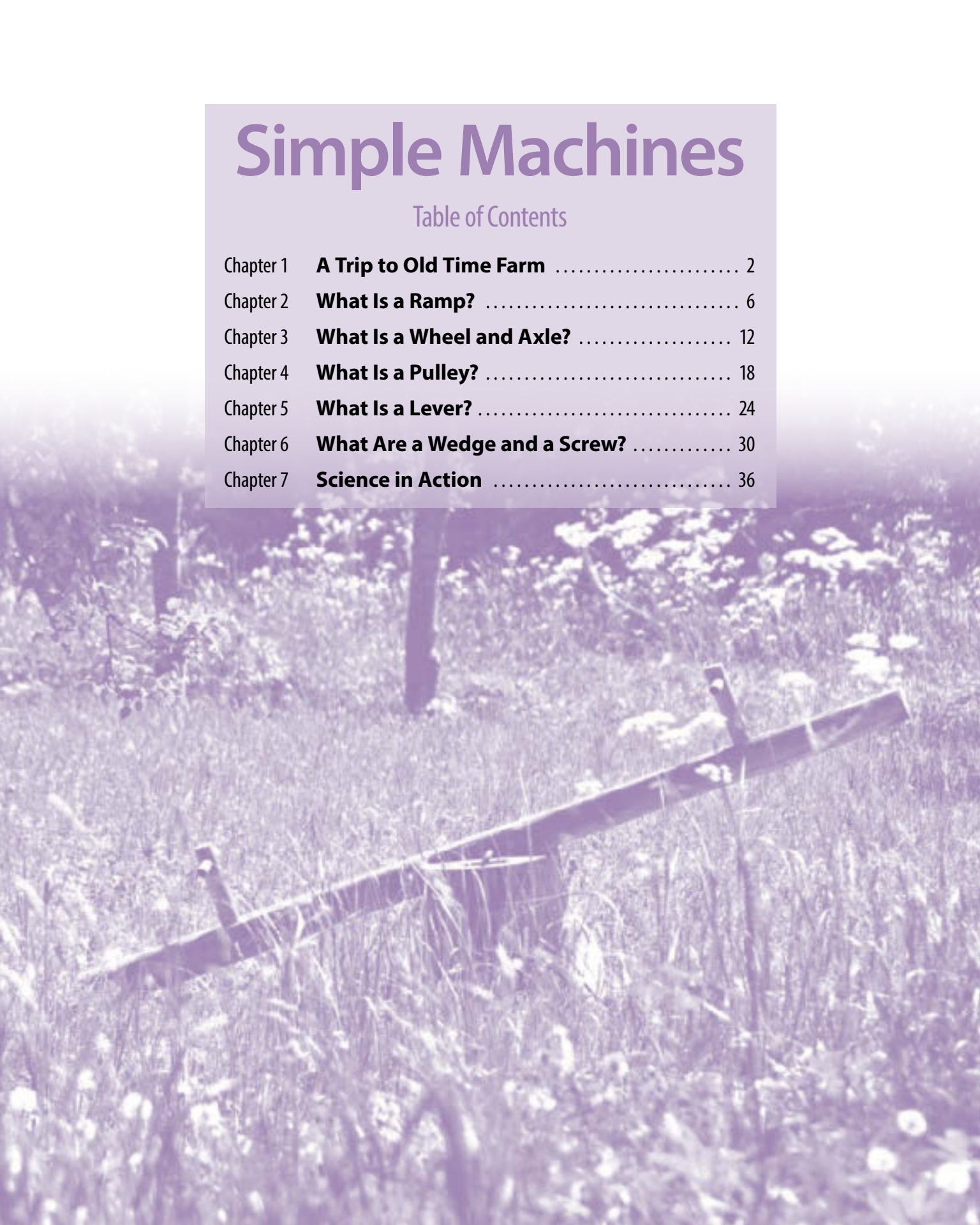
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Simple Machines

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A Trip to Old Time Farm

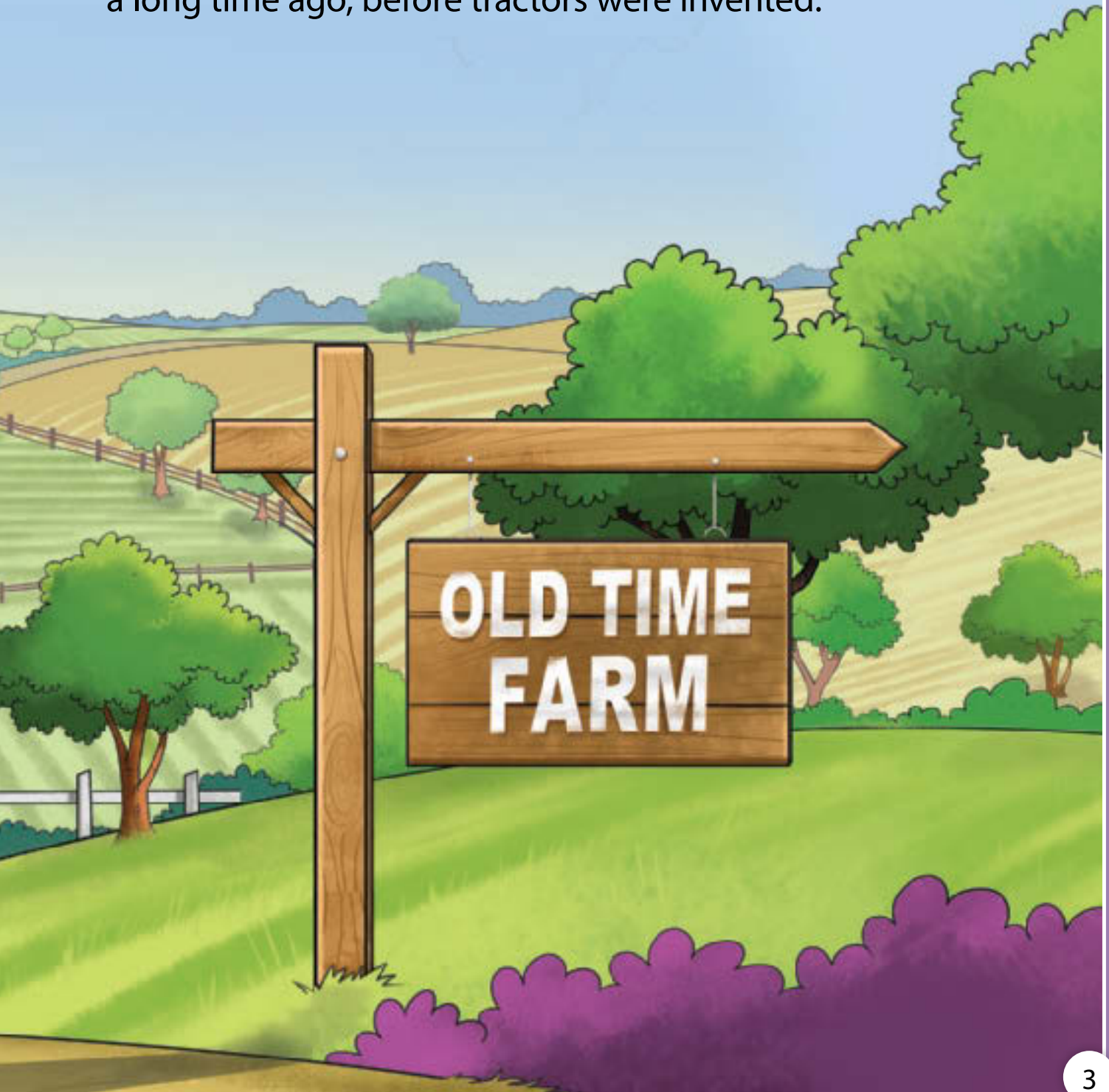
Ryan and Papa are doing something fun today. They are visiting Old Time Farm! Ryan will look for horses, cows, and chickens. He will see farmers growing fruits and vegetables.

At the farm, Ryan asks Papa, "Will we see a tractor? Do you think we can ride on one?"



“No way!” Papa says. “This farm does not have any tractors. And the buildings do not have electricity for heat or light.”

Papa explains that Old Time Farm is a historical farm. The farmers here raise crops and animals the way that pioneers did a long time ago, before tractors were invented.



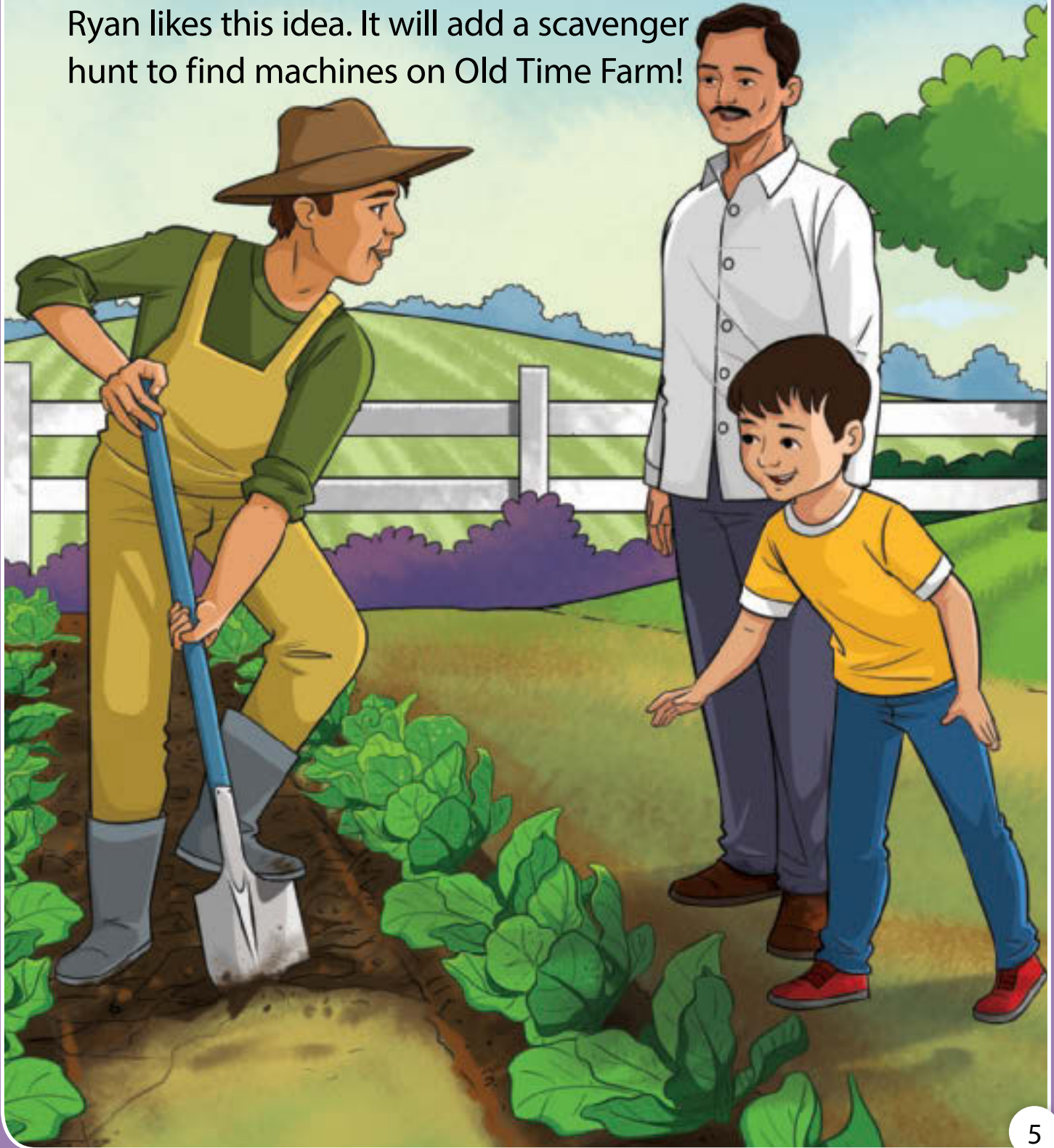
Ryan knows that farming is a lot of work. Farmers must dig and plow earth to grow crops. They must haul food for their animals. So much effort goes into being a farmer!

"It must be hard to farm without machines," Ryan says to Papa.



"You might be surprised at the kinds of machines you can find even at Old Time Farm," Papa tells Ryan. "Let's look for all the things that these farmers use to help make their work easier."

Ryan likes this idea. It will add a scavenger hunt to find machines on Old Time Farm!



What Is a Ramp?

As soon as they enter the barnyard, Papa says, “I see a machine!”

Ryan looks around. He doesn’t see any machines. He sees only a big wooden barn. The barn is tall. It has doors at the bottom in front. It also has doors on the side that are much higher up. A stone wall slants upward to the high side door.



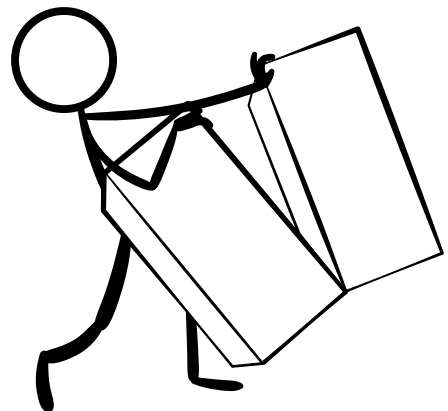
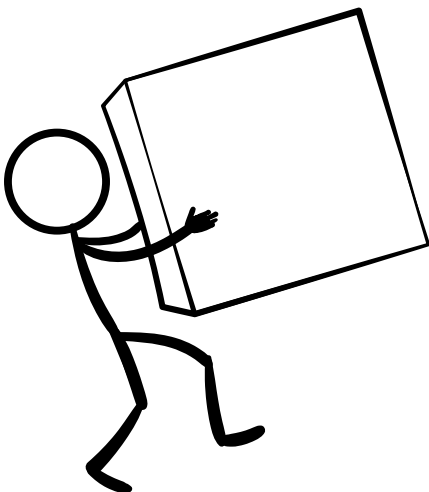
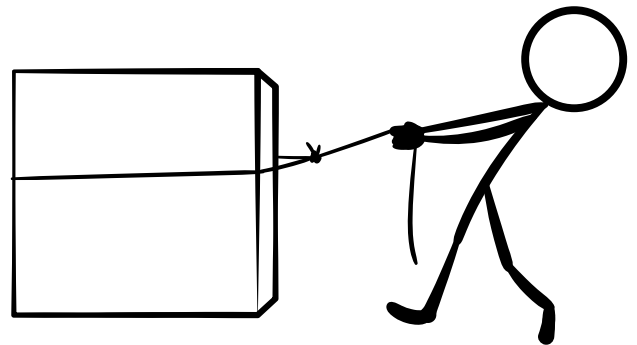
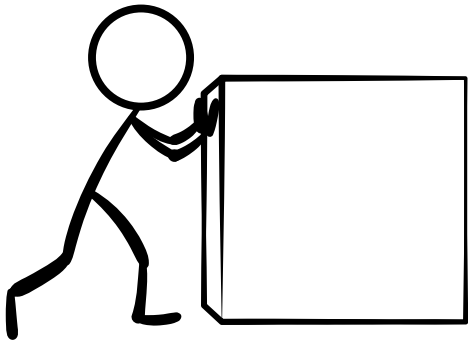
"Do you see the stone wall on the side of the barn?" Papa asks Ryan. "See how it slopes upward? That is a ramp," he says. "A ramp is a simple machine."

"But Papa," Ryan says, "that ramp doesn't do anything. It doesn't move. How can it be a machine?" Ryan is a little confused. The machines he knows about are things like tractors and lawn mowers and kitchen mixers.



Papa explains. A machine doesn't do a task itself. And it doesn't have to be made up of a bunch of moving parts. What makes an object a simple machine is that it makes work easier.

When you push, pull, lift, or split something to move it, that is work. Simple machines make work easier by changing how you push or pull on something.

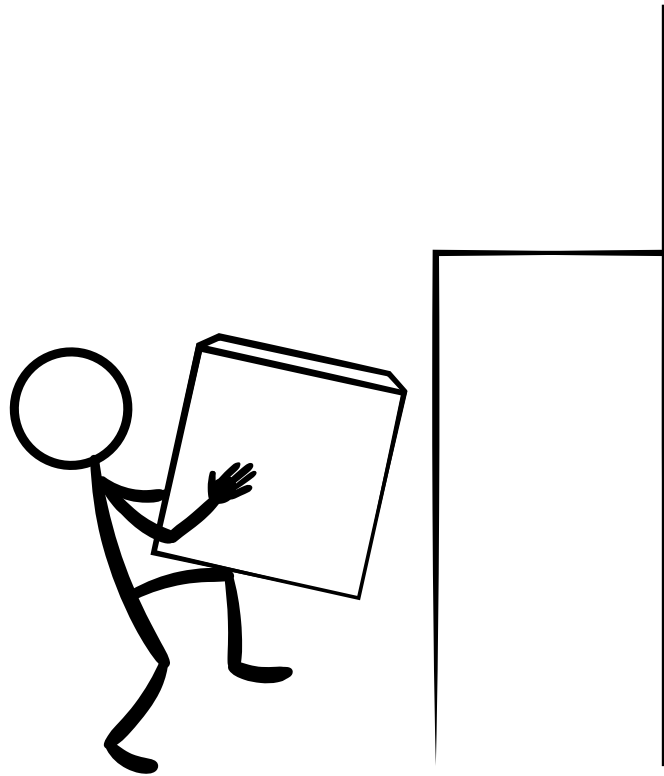


A machine can change how hard you push or pull a thing to move it. A machine can change the direction that you push or pull a thing to move it.

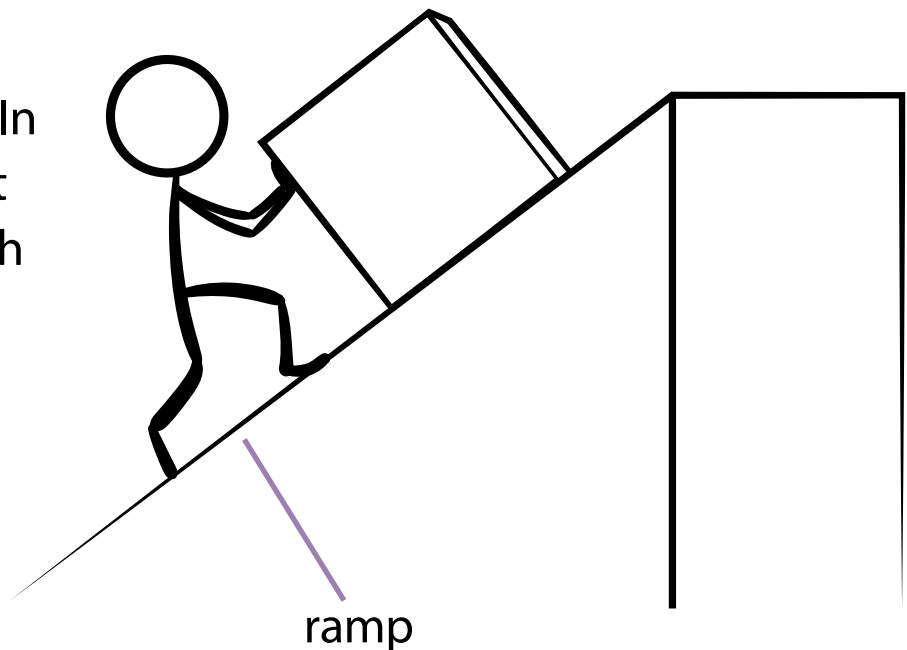
Papa says, "Imagine that barn without the ramp. Suppose there was just a ladder to the high door. How would you get things into the upstairs rooms of the barn? It would be difficult, wouldn't it?"



When you want to move something to a higher level, how do you do it? Some things you can easily pick up and lift to a higher place. But what if the object is too heavy to lift? What if the object is too big to get ahold of?



You can slide or roll a big or heavy object up a ramp. Moving the object up a ramp is easier than picking it up. In the end, the object has been lifted with less effort.



When you move an object on a ramp, you move it a longer distance. But the push or pull you use to move the object does not have to be as strong. The distance is longer, but the force of the push or pull is less. It's easier!



What Is a Wheel and Axle?

Ryan wonders what the farmers might move up the ramp to the upstairs rooms in the barn. Before long, he thinks he has an idea. He spots a wagon piled full of hay.



"That's right," Papa says. "You have also found your second simple machine! That wagon has four wheels on two axles. A wheel and axle make up another simple machine."

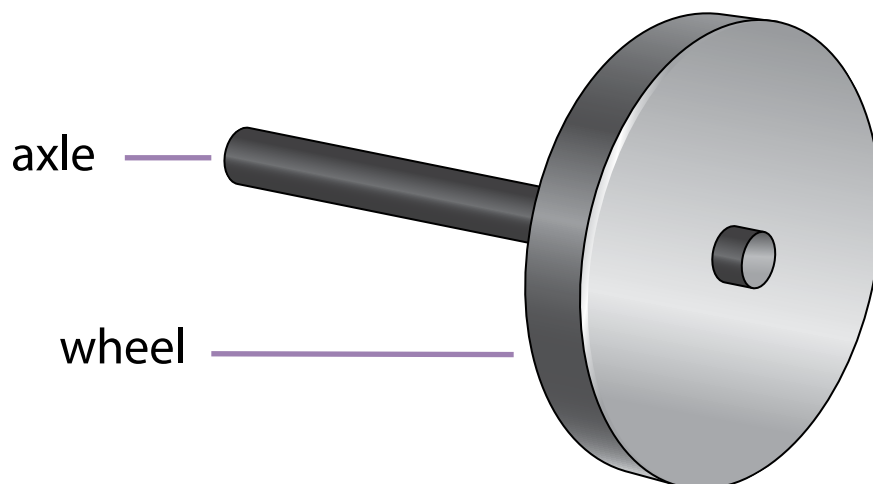
Ryan knows all about wheels! He has them on his bike, his scooter, and his skates. There are wheels on Papa's car and on his lawn mower. Ryan's school bus has wheels. So do the book carts in the library and the grocery carts at the store.



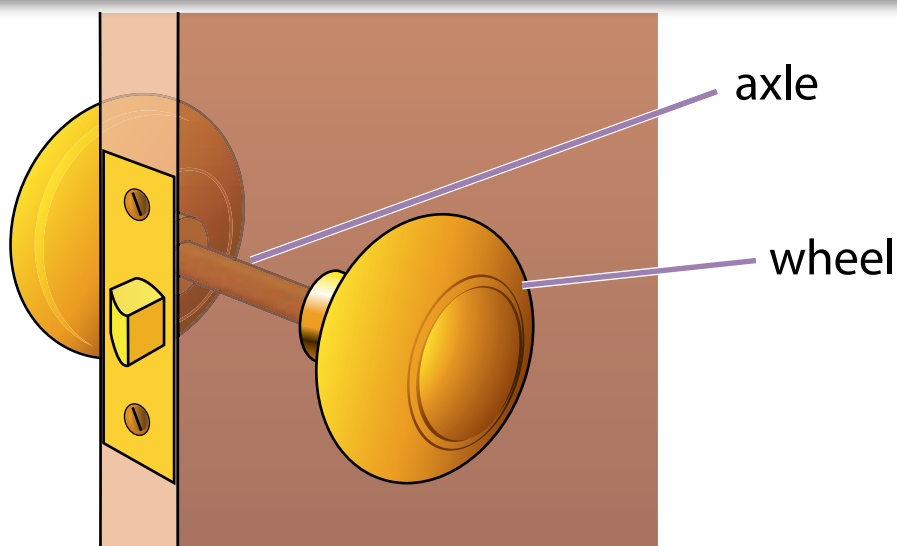
Ryan thinks about the field of pumpkins at the farm. What if he collected all the pumpkins into a box and slid it across the ground? That would be hard! It is much easier to push a load of pumpkins in a wheelbarrow. It rolls on a wheel! A simple machine like a wheel and axle makes the effort easier.



Wheels on a wagon are not attached directly to the wagon. The center of each wheel is fixed to a rod called an axle. The wheel and axle move together. If you turn one of them, the other turns with it.



Wheels and axles are useful in ways other than making things roll, too. A doorknob is a wheel and axle. The knob part that you turn with your hand is the wheel. That knob is attached to an axle, a rod that goes through the door. The axle moves parts inside the door when you turn the knob. It's easier to turn the knob than to turn the rod all by itself.



Ryan and Papa find another wheel and axle on the farm in an unexpected place. The old water well has a bucket attached to a chain. The chain is wrapped around an axle. When the wheel is turned, the chain wraps around the axle and raises the bucket full of water from the well. It's a lot easier than pulling the heavy bucket straight up.

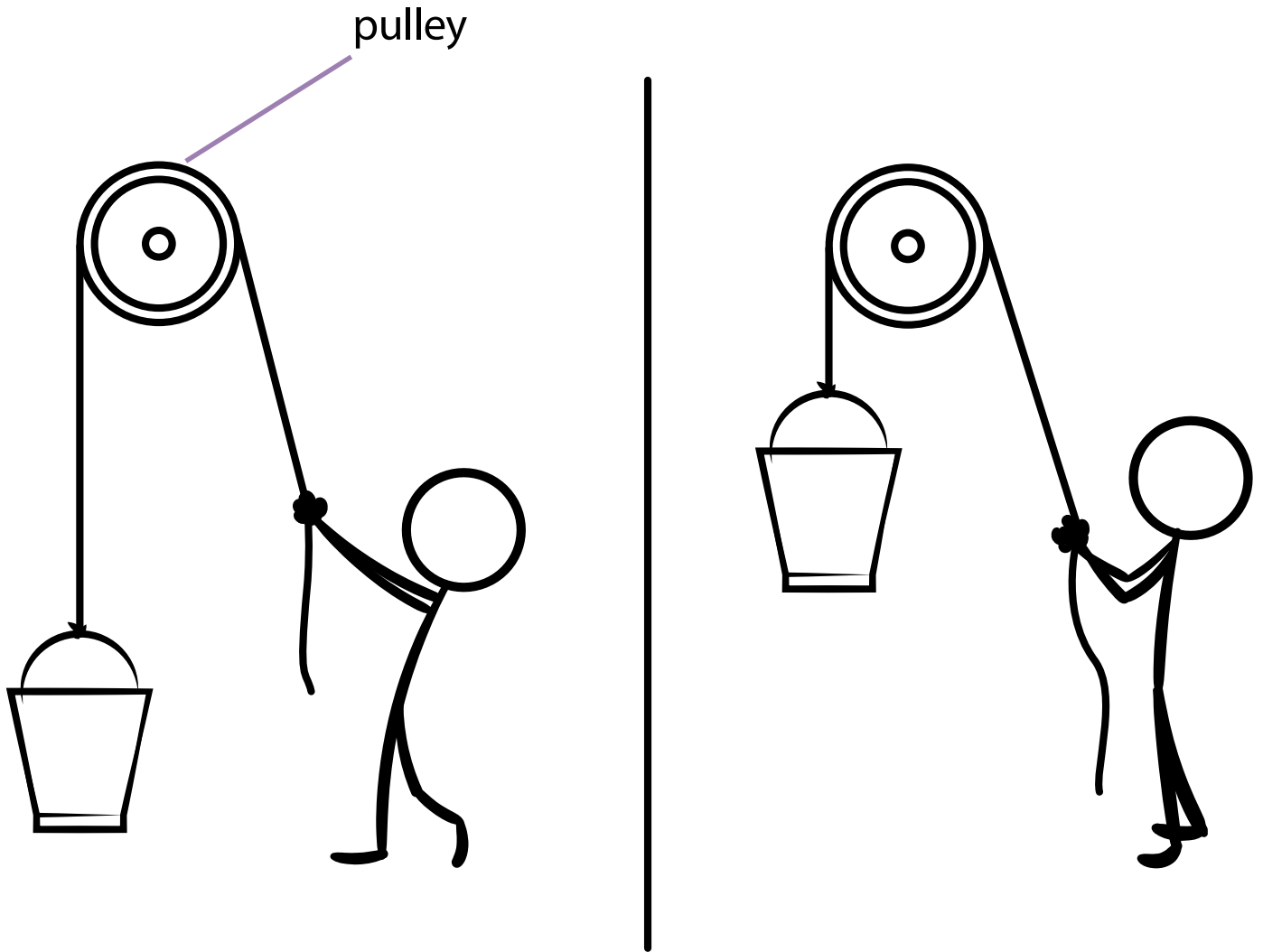


What Is a Pulley?

Ryan spots another well. He looks for the wheel and axle. He sees a wheel, but something about this well is different. The bucket rope hangs over the grooved wheel. But there is no way to turn the wheel.



Papa congratulates Ryan. He has found his third simple machine! The wheel with the rope is called a pulley. Pulling down on the rope across the wheel lifts the bucket.



Papa leads Ryan to another small barn on the farm to look for more examples. Ryan spots another pulley right away.

Like the first barn they saw, this barn has a door high above the ground. Papa explains that the upstairs area in a barn is called a loft. Ryan figures out that farmers must use the pulley to help them lift things into the loft.

Pulleys change the direction of a pulling force. They allow people to lift objects upward by pulling downward.



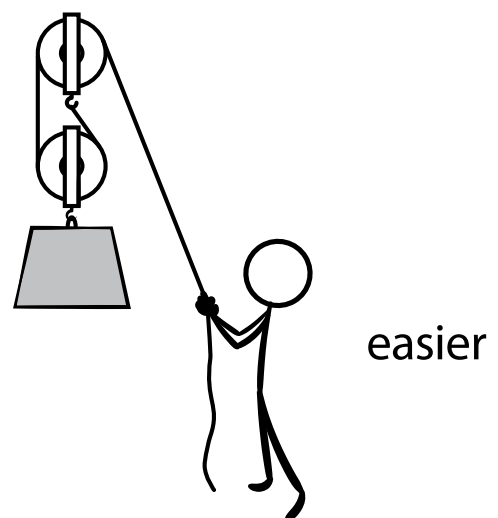
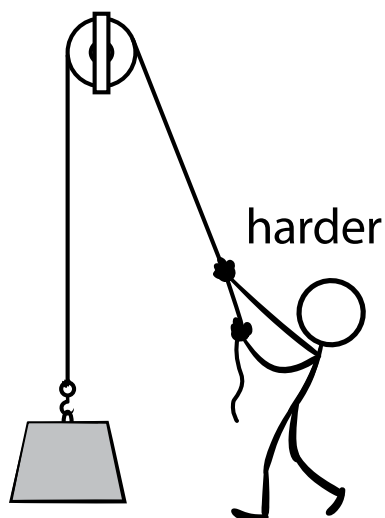
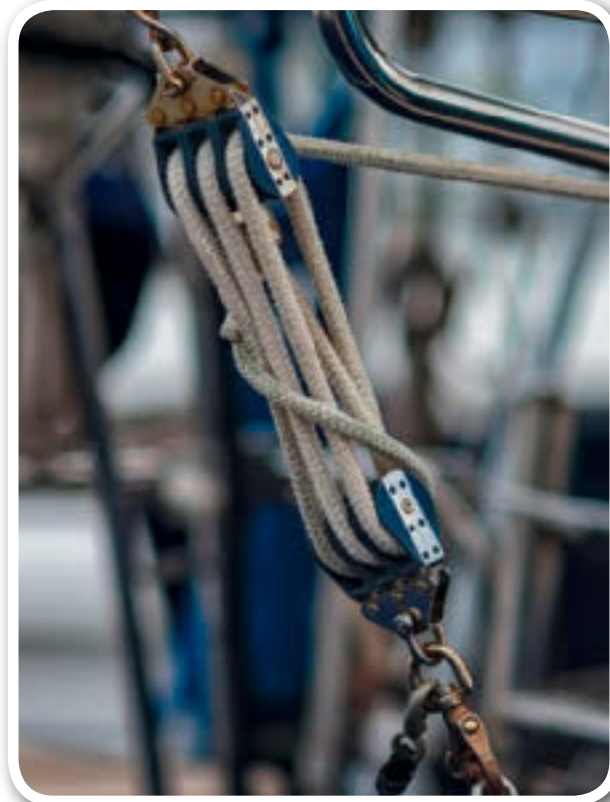
Pulleys are used in many places besides farms. Pulleys are used to raise and lower flags on flagpoles. They are used to raise and lower sails on sailboats. They are even used when exercising.



Roofers sometimes use pulleys to lift shingles up to a roof. A crane uses pulleys to lift pieces into place for the construction of buildings. Elevators inside tall buildings use pulleys to lift people and cargo from one floor to another.



Often pulleys are used in sets. Two or more pulleys used together with one rope make it much easier to lift a heavy load. A system of two or more pulleys together is called a block and tackle. This is not a simple machine though. It is called a compound machine.



What Is a Lever?

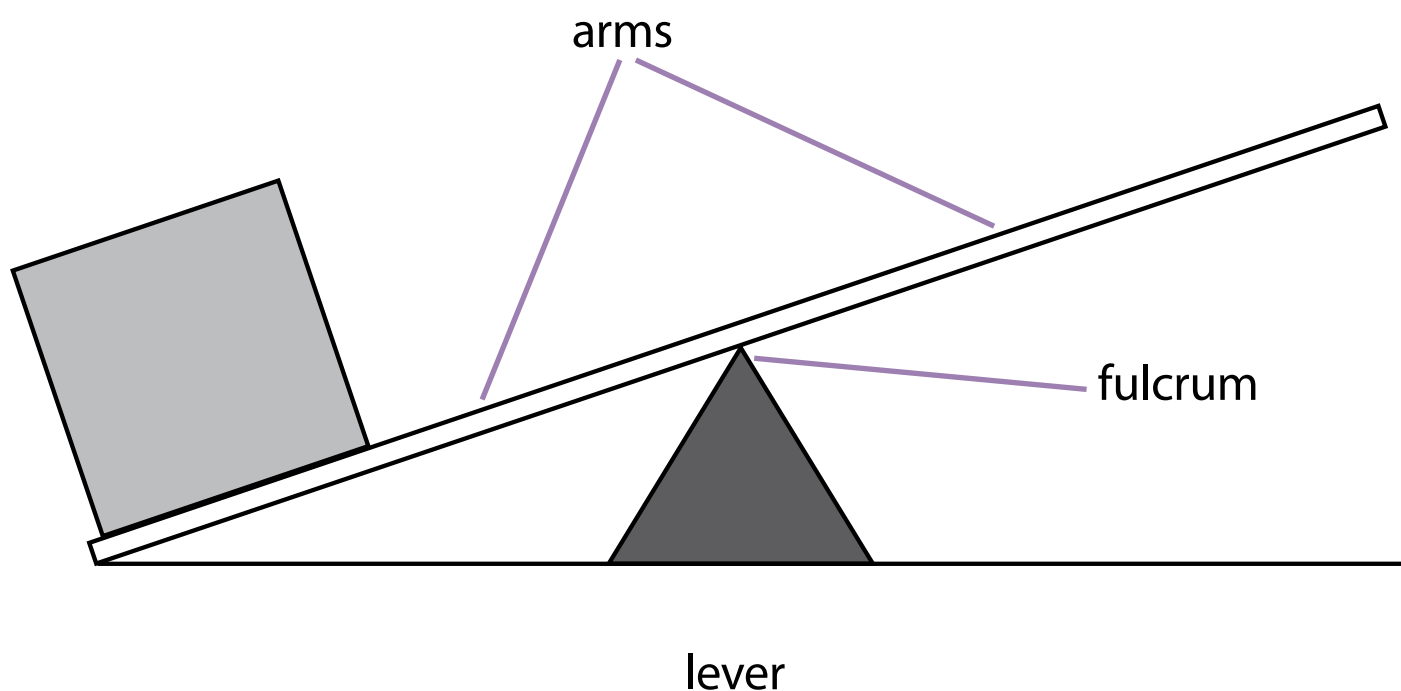
A lot of work happens at the farm, but Ryan also finds a place to play. “Look,” Ryan says. “It’s an old wooden seesaw!”

Ryan climbs onto one end of the seesaw, and Papa straddles the other end. When Papa sits down on his end, Ryan is lifted high at the other end.

“This is also a machine!” Papa explains. “A seesaw is a simple machine called a lever.”



A lever is made up of a board or rod that rocks back and forth. It balances on a point called a fulcrum. The two sides of the lever are called arms. When you push down on one arm of a lever, the arm on the opposite side of the fulcrum moves up. After a little fun on the seesaw, Ryan and Papa set out to see if they can find more levers on the farm.

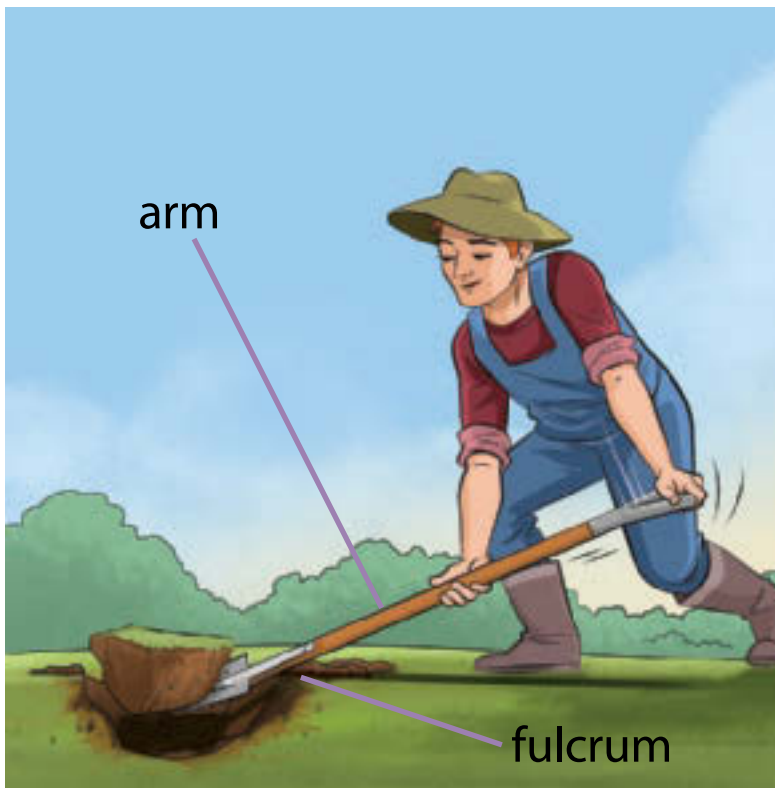


A lever makes it easier to lift a load or pry things apart. Ryan and Papa find a fence gate that has a lever for a latch. When Ryan pushes down on one arm of the latch, the other arm lifts off of the plank to let the gate open. Where is the fulcrum for the lever in this picture?

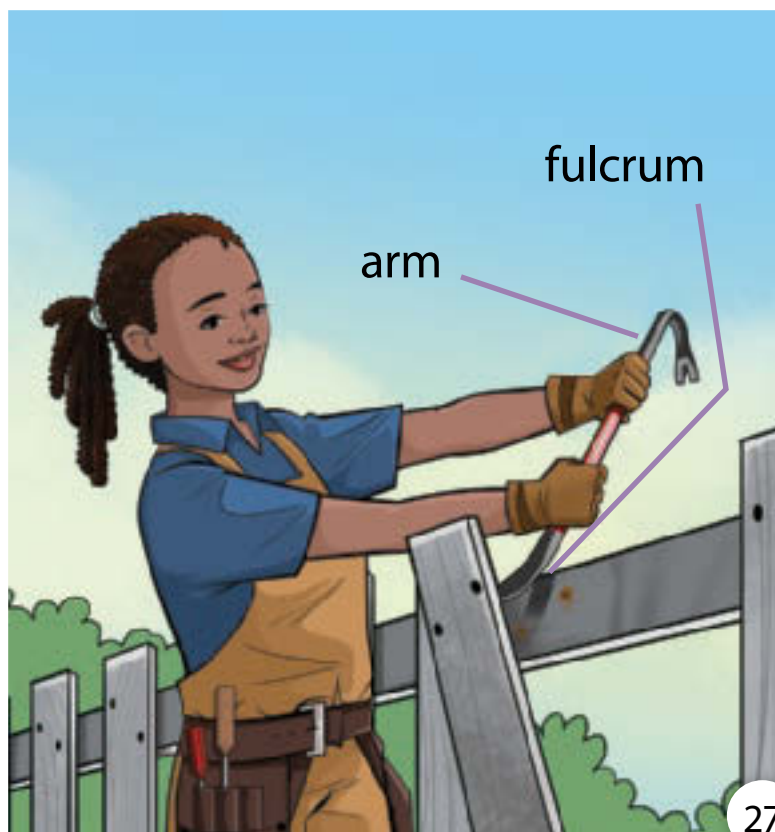


Ryan soon meets some volunteers working on the farm. He learns that they are all using different types of levers!

One volunteer digs with a shovel. The flat end is one arm of a lever. The handle end of the shovel is the other arm. The ground is the fulcrum. When the volunteer pushes down on the handle arm, the spade arm pushes dirt up to leave a hole. Lifting the dirt with a lever makes the effort easier!



Another volunteer is repairing the orchard fence. She uses a lever to pry a broken board from the fence. The lever pushes the board from the fence rail the way the shovel pulls dirt out of a hole. Imagine how hard this would be without using a lever!



A volunteer is sweeping the kitchen porch with a broom. The bristle end of the broom is the arm of a lever. The broom moves dirt a greater distance for the person sweeping the floor. It saves the person effort.



Inside Old Time Farm's kitchen, Papa spots another lever. It is a balance scale used to weigh foods such as fruit or grains. When items on both arms of the scale weigh the same, they balance equally on the fulcrum. Ryan says, "It's just like a seesaw!"



What Are a Wedge and a Screw?

Outside the farm kitchen, Ryan and Papa meet a farmer who is splitting big logs into firewood. He uses an iron wedge. Ryan thinks its shape looks like a slice of cake. Ryan learns that wedges are simple machines, too.



To split the wood, the farmer puts the narrow end of the wedge against the log and pounds the thick end of the wedge with a mallet. Each time the farmer hits the wedge, the narrow end drives deeper into the log. It makes the crack in the log bigger until the wood splits apart. Using a wedge makes splitting a log a lot easier than pulling it apart. "That would be impossible!" Ryan says.



The head of an axe is also a wedge. A woodcutter can swing the axe to split the wood. The axe is a wedge that makes the effort easier.

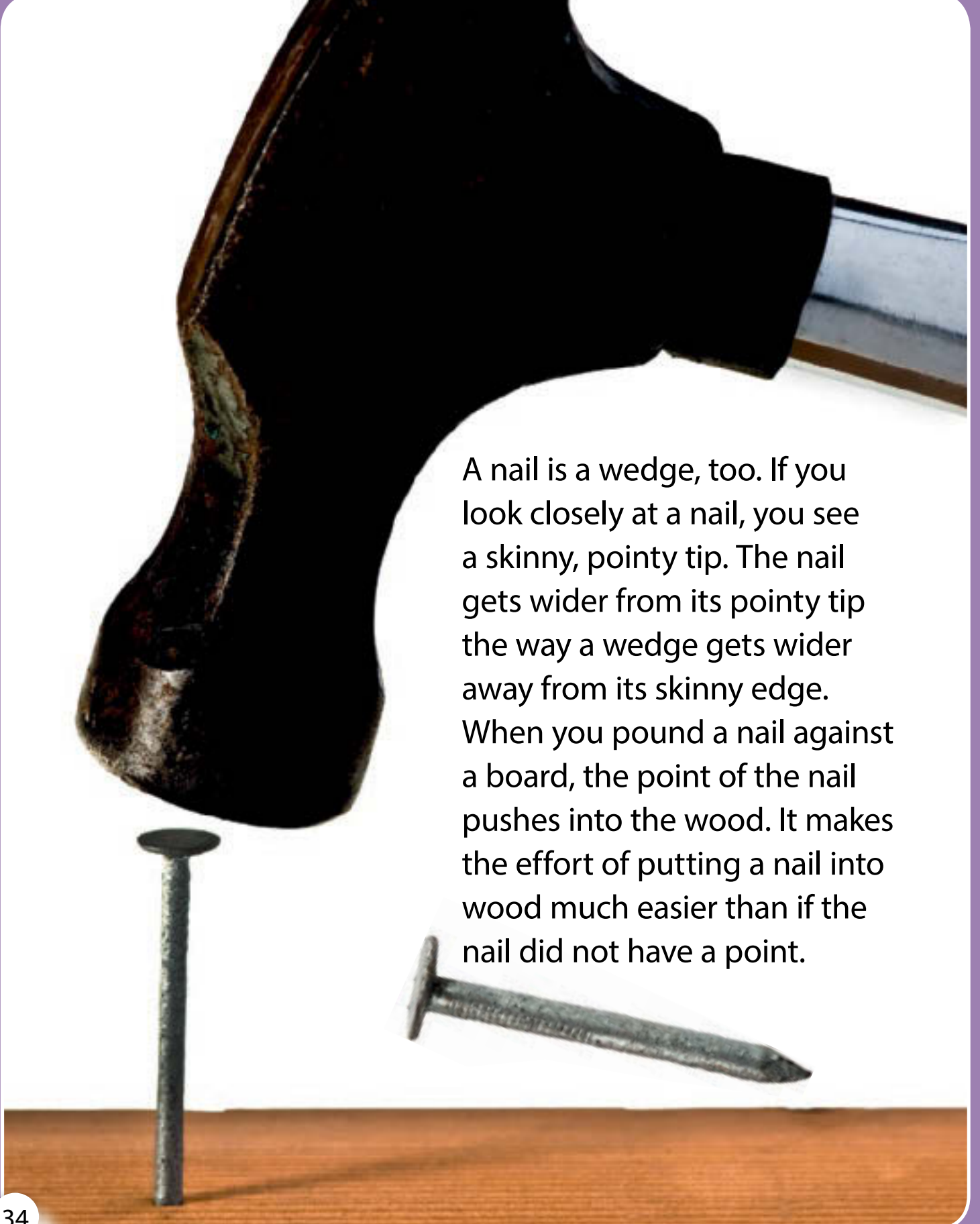


Smaller wedges allow carpenters and wood-carvers to more carefully shape wood. Wedges such as these are called chisels.



You can find wedges in your home, too. A knife is a wedge that cuts food apart. A doorstop is a wedge, too. You push the doorstop in under the door. The doorstop changes the direction of the push. It pushes up against the door and down against the floor. Those pushes hold the door in place.



A close-up photograph of a hammer head, which is dark and worn, positioned above a wooden surface. Below the hammer, two nails are shown. One nail is driven vertically into the wood, showing its flat head and the point buried inside. The other nail lies horizontally on the wood, clearly showing its pointed tip and the way its body tapers to a point, demonstrating its wedge-like shape. The background is a plain, light-colored surface.

A nail is a wedge, too. If you look closely at a nail, you see a skinny, pointy tip. The nail gets wider from its pointy tip the way a wedge gets wider away from its skinny edge. When you pound a nail against a board, the point of the nail pushes into the wood. It makes the effort of putting a nail into wood much easier than if the nail did not have a point.

A screw is also a type of wedge. It is a wedge that is wrapped around a stick shape, or cylinder. When you rotate a screw, the wedge enters the wood and acts like an axe, pushing the wood apart. The motion of turning the screw pulls the screw deeper into the material.



Science in Action

Meeting a Toolmaker

Ryan and Papa meet a blacksmith at Old Time Farm. The blacksmith makes things out of iron by heating the metal and then shaping it. She makes all kinds of tools used on the farm. She makes some simple machines. She makes axes and wedges and iron bars for levers. Sometimes two or more simple machines can be used together. Many useful devices are combinations of two or more simple machines working together.



Two or more simple machines combined in the same device are called a compound machine. For example, remember the shovel that Ryan learned is really a lever? The sharp edge of the spade end of the shovel is a wedge. That edge pushes earth apart when pushed into the ground. A shovel is made of a lever and a wedge, so it is a compound machine.



lever

wedge

The blacksmith shows Ryan some compound machines in her workshop. She uses big pliers to hold hot metal as she shapes it. Pliers are a compound machine. There are two levers. The bolt that holds the two long pieces together is the fulcrum for both levers.

Scissors are compound machines, too. Like pliers, they are two levers attached in the middle at a fulcrum. The sharp cutting edges of scissors are wedges.

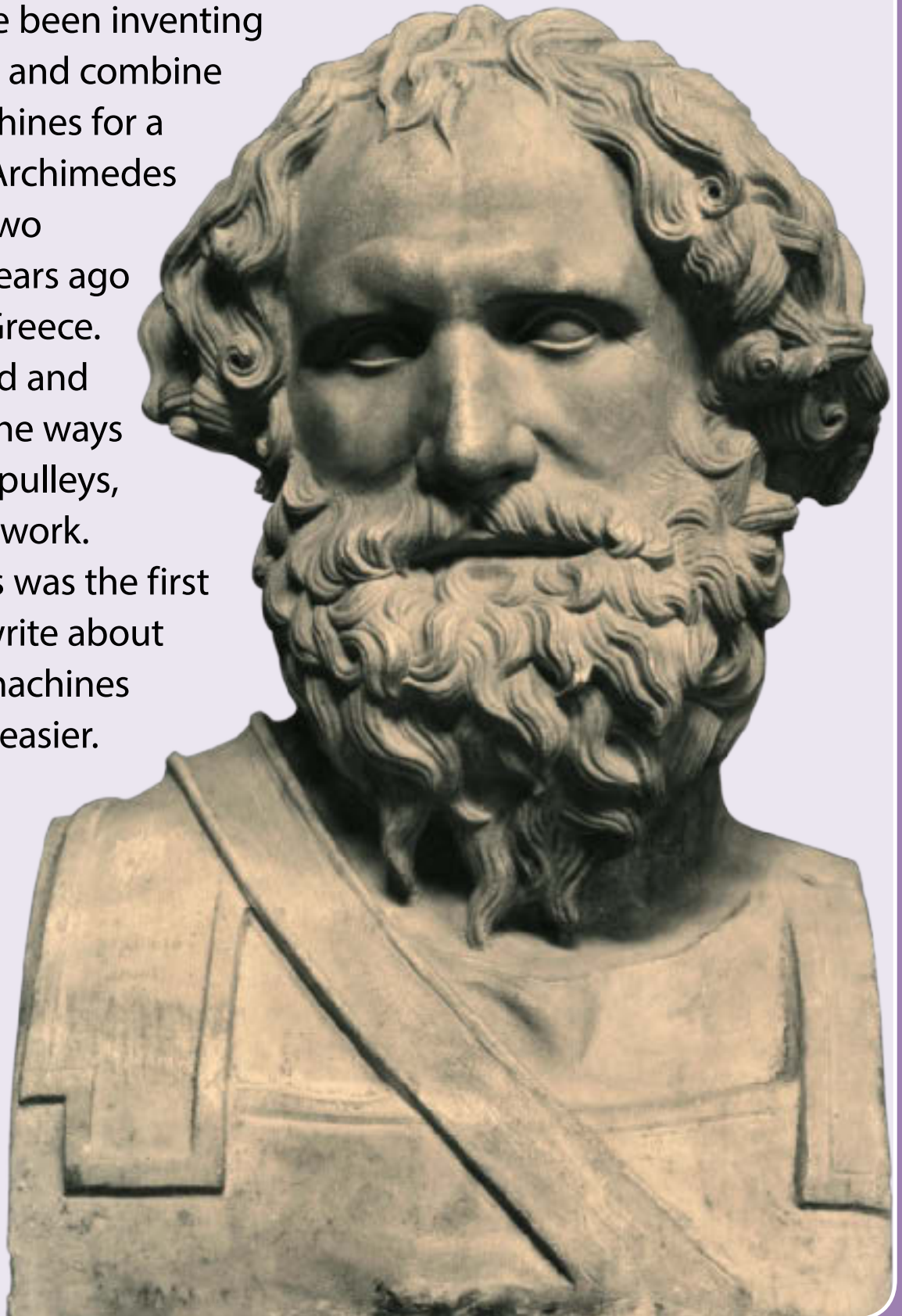


Recently the blacksmith has repaired a plow. This plow is a farm tool on wheels. It is pulled by a horse. The farmer walks behind the plow to guide it. The plow has a wedge that cuts into the earth. It pushes the soil apart for planting crops. The plow has a wheel and axle, another simple machine. Ryan knows that a plow is a compound machine.

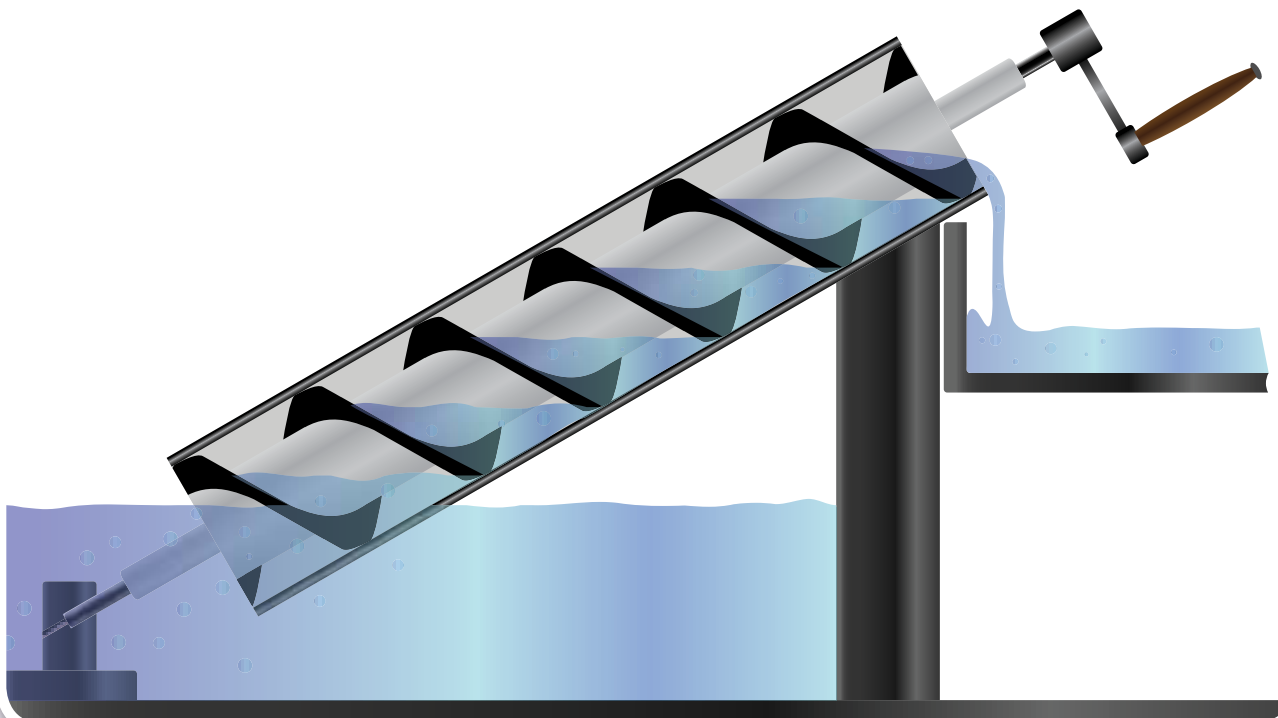


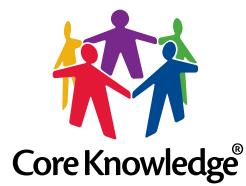
Archimedes

People have been inventing ways to use and combine simple machines for a long time. Archimedes lived over two thousand years ago in ancient Greece. He observed and described the ways that levers, pulleys, and screws work. Archimedes was the first person to write about ways that machines make tasks easier.



Archimedes invented a way to use a screw to lift water. The screw fits snugly inside a pipe. Rotating a crank at the top turns the screw. The wedge that spirals around the screw pushes water up through the pipe. Turning the crank is easier than lifting many buckets of water out of this river.





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