

Planting & Harvesting

Why do we build different farm machines?

Introduction (~10 minutes)

Which comes first—planting or harvesting? It's safe to say this is an age-old question like “which comes first—the chicken or the egg?”

During much of human history, humans gathered food from wild plants. Around 12,000 years ago, humans turned to agriculture. Instead of searching for fruit and nuts to harvest, humans collected seed, spread that seed, and cared for the plants as they grew. Planting and harvesting seed by hand is easier than hunting and gathering. It's still hard work, though. As time and technology progressed, humans built machines to spread and harvest those seeds more and more easily.

Let's see how harvesters work.

First, thoroughly mix the rice, beans, and oregano from the materials list. Rice represents our desired seeds, and beans represent seeds from a different plant. Oregano represents the leaf litter that is sometimes mixed in with seed.

You will be using your fingers and/or your



Introduction/Explore Materials List

- Dry rice (30 mL or 2 Tbsp)
- Dry beans (15 mL or 1 Tbsp)
- Oregano, parsley flakes, or a similarly-sized plant fragment (5 mL or 1 tsp)
- Spoon
- Other tools for separation (e.g., fork, paper cup, sieve, fan)
- Timer

spoon to separate the desired seed (rice) from the other materials. How long do you think it would take for you to separate all the rice from the other materials? Write your prediction in the data table below.

Tool	Predicted Time	Actual Time
Hands & Spoon		

See how close your prediction is! Set a timer for 5 minutes, and see how much rice you can separate. Remember, you want to collect rice only—no beans or oregano.

When the timer goes off, estimate how long it would take you to separate all the rice. (For example, if you separated half of it in 5 minutes, the whole cup would take 10 minutes.)



Explore (~25 minutes)

Try a few more ideas. Can you find or make a reliable sieve? (A sieve is an object with holes to help separate materials based on size.)

Are there other methods or tools you could use to improve your process?

Before you try each idea, predict how long it would take to separate the rice using that tool,

and record your prediction on the previous page. Then, try it!

After you have tried each idea, estimate the actual time as you did before. Then make note of each tool's benefits and shortcomings in the table below. Don't forget that time could be an important benefit or drawback!

Tool or Method	Benefits	Shortcomings	Other Notes
Hands & spoon			

Explain (~15 minutes)

Which of the tools you tried worked best? What evidence do you have to support that claim?

How might you combine two methods to do the work better or faster than either method alone?



Engineers solve problems using science and math. What research or calculations could you do to make sure your method is the best one possible?

Modern combine harvesters use a series of tools to harvest only seed. Leaves, stems, cobs, and any other materials are left on the field. These

materials provide nutrients to future crops and can help prevent soil erosion.

Watch the video at
<https://vimeo.com/350413370>.

The video shows the series of tools used in harvesting most crops:

1. The header gathers and cuts the plants.
2. A belt under the cab carries the plant materials into the combine.
3. A variety of rotors and shaking screens break and separate the materials.
4. The heavier seed falls into a collection pan.
5. Fans blow the other materials behind the combine.

Extend (~20 minutes)

The harvester is only one machine that helps farmers. Mechanical planters use some of the same processes as harvesters.

Look back at the harvester steps at the top of this page. Which of these processes do you think are used in mechanical planting machines?

Watch a video of some planter processes at
<https://vimeo.com/433441222>.

Extend Materials List

- 16 colored paper punches or dried peas (to represent soybean seeds)
- 16 pennycress seeds, mustard seeds, or another small, untreated seed
- Yardstick or meter stick with inch marks

Starting with the row cleaner, what are some steps the mechanical planter takes?

1. Row cleaners brush away debris.
2. _____
3. _____
4. _____
5. _____



The video explains that corn is often planted 6 inches apart within its row. Soybeans are often planted 2 inches apart within their rows. Seed spacing reflects the size of the seed and the size of the plant.

What about a small-seeded plant like pennycress? Let's see what a field of pennycress would look like compared to soybeans.

Find an open area on the floor to plan a planting of soybeans. Bean rows are often planted 15 inches apart. Within each row, beans are planted 2 inches from each other.

Use paper punches and your yardstick to map out this spacing.

Domesticated pennycress plants are seeded by weight, not distance. Six pounds of seed are recommended for every acre.

- Each pound contains ~525,000 seeds.

- An acre measures about 6,000,000 inches in each dimension.

Let's calculate how far apart the pennycress seeds should be.

6 lbs./acre * _____, _____ seeds/lb. ÷

_____, _____, _____ square inches per acre =

____. _____ seeds per square inch.

If about half a seed will be planted every square inch, a full seed will be planted every 2 square inches. A seed could be placed at the corner of each rectangle measuring 2 in. x 1 in. Use small seeds to map this on a separate area of the floor.

How many pennycress plants would it take to fill the area used by the 16 soybean plants?

Reflect (~25 minutes)

Think back to the tool systems used in a corn or soybean planter. These tools are built for 15- or 30-inch rows. What would a machine look like that could drop seeds to make a 2-inch grid? Draw your idea for a pennycress planter below.

Air seeders are an option that allows for rows as close as 6 inches.

Watch a video to learn how an air seeder works:
<https://youtu.be/XvxMv6NTOfc>.

Compare your idea to the air seeder. What processes are found in both tools?



Again, compare your idea to the air seeder.
Which of your ideas might be better? Which of
the air seeder processes might be better?

List as many jobs as you can related to building,
maintaining, and using planters or harvesters.

Why do you think there are a lot of different
jobs related to the same tools?

Seed spacing is important. It gives plants room
to germinate and grow without leaving too
much bare soil. This helps prevent soil erosion.

Seed–soil contact is also important. It ensures
seeds will have easy access to water and other
nutrients in the soil.

Finally, seed depth is important. Each seed has
limited energy for the plant to begin growing.
The plant will need to grow out of the ground
far enough to capture energy from the sun.

Look back at your answers to the planter steps
on page 3. What would the effects be for the
young plant if you removed one or more of
these steps?

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Career Connection: Agricultural Engineer

Engineers solve problems related to structures, machines, and the
environment. An agricultural engineer can solve these problems and
more! In agriculture, there will always be a need for a greater yield,
better crop quality, and a safer environment.

Agricultural engineers must complete a four-year bachelor's degree.
Usually this is in agricultural or biological engineering. Some get a
master's degree to gain more specific knowledge.

