

# Macromolecules in food

<b>Focus questions</b>	What are the differences in macromolecules between corn and soybeans? What effect do those differences have on their uses?
<b>Learning target</b>	Students will compare the relative amounts of protein, sugar and starch in soy and corn.
<b>Vocabulary</b>	Monosaccharide, starch, protein

## MS-LS1-7: From Molecules to Organisms: Structures and Processes

<b>Performance expectation</b> MS-LS1-7	<b>Classroom connection:</b> Students discover the differences between soybean and corn seeds, in order to understand that photosynthesis results in food that is rearranged through chemical reactions forming new molecules within organisms.
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## Science and engineering practices

<b>Constructing Explanations and Designing Solutions</b>	<b>Classroom connection:</b> Students will begin the process of modeling the differences between corn and soy once they discover each has differing amounts of macromolecules.
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## Disciplinary core ideas

<b>MS-LS1.C Organization of Matter and Energy Flow in Organisms</b>	<b>Classroom connection:</b> Students will determine how these plants might have differing amounts of macromolecules.
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## Cross-cutting concepts

<b>Energy &amp; Matter</b>	<b>Classroom connection:</b> Students will discover the relative amounts of energy (nutrients) of different types within each organism and how that impacts their use.
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## Background

Nutrients occur in varying amounts within the seeds of all plants. Dent corn grown as a commodity crop has a much larger complex carbohydrate (starch) content than soybeans. Soybeans have a larger amount of protein and lipids. Sweet corn will have a larger amount of monosaccharides. Because of these differences, soybean and corn are used to produce different fuels and other products.

Soybeans have fats or lipids that result in vegetable oil when extracted from the crushed bean. That oil is used to produce biodiesel with a by-product of glycerin.

Dent corn has a high amount of complex carbohydrate (starch) that can be broken down by yeast in the presence of enzymes to produce ethanol, a biofuel with coproducts of corn oil, carbon dioxide and distillers grain that contain the remaining protein, fat, minerals and vitamins. Once the distillers grains are dried, they make a valuable feed for livestock.

## Materials

Provide the following materials to each student group.

- Corn flour
- Soybean flour
- Corn seeds
- Soybean seeds
- Coffee grinder
- Balance
- Distilled water
- Mortar and pestle
- Filter paper
- Funnel
- Small beaker
- Test tube
- Test tube holder
- Hot plate
- Beaker with water for water bath
- Vortex (optional)

## Teacher preparation

Students should work together in groups of 2–4 to complete the nutrient analysis tests.

*Note:* A Bradford Assay using Coomassie dye may be used to determine the change in protein content, a more sensitive test that can be used with the solution alone, or as an assay using a spectrophotometer to compare to a standard curve.

Ask students to make a data table to compare the soybean flour and soybean seed to the corn flour and corn seed in terms of starch, glucose and protein.

## Differentiation

Other ways to connect with students with various needs:

- **Local community:** Students may investigate the use of corn and soy in pet/animal feed in their local area. Students may choose to interview a farmer, local farmer cooperative, or animal supply store. Students can communicate with their findings with their classmates and their local community.
- **Students with special needs (auditory/visual/language/reading):** See the extra support below.
- **Extra Support:**
  - See Uses of corn: [www2.education.uiowa.edu/html/eportfolio/tep/07es102folder/miniweb/usesofcorn.htm](http://www2.education.uiowa.edu/html/eportfolio/tep/07es102folder/miniweb/usesofcorn.htm)
  - See uses of soybeans: [toskglobal.com/2021/05/18/soybeans-healthy-meals-and-biofuels-uses-across-industries/](http://toskglobal.com/2021/05/18/soybeans-healthy-meals-and-biofuels-uses-across-industries/)
- **Extensions:** Students may compare the different uses/products of soybeans and corn. Students may investigate how each plant differs genetically to produce the different levels of macromolecules within each seed.

## Assessments

### Rubric for assessment

Skill	Developing	Satisfactory	Exemplary
Develop an "infographic" to show the differences between relative amounts of sugar, starch and protein in soybeans and corn.	Student has collected data about relative amounts of sugar, starch and protein.	Student has collected data about relative amounts of sugar, starch and protein; and has compared relative amounts in a visual way.	Student has collected data about relative amounts of sugar, starch and protein; and has compared relative amounts in a visual way; displayed in a creative, graphic visual.

### Rubric for self-assessment

Skill	Yes	No	Unsure
I generated data to compare nutrient content differences between corn and soybeans.			
I can explain why corn is used for ethanol production and soybeans are used for biodiesel.			