

Soybeans Go To School

Updated May 2017



Teaching Materials Recommended for Grades 3, 4, and 5
Science and Social Science

www.michigansoybean.org
soyinfo@michigansoybean.org

Table of Contents

I.	Michigan Soybean Promotion Committee's Commitment to Education	p. a
II.	Authors and References	p. b
III.	Grade Level Content Expectations	p. c
IV.	Vocabulary	p. j
V.	Materials List	p. m
VI.	Resources to Further Learning Experiences	p. n

Theme 1 Racey Soys!

Guiding Questions:	What are soybeans? How do they grow and thrive?	p. 1
Lessons:	1. Examining the Bean	p. 2
	2. How Tall Will It Grow?	p. 10
	3. What do Plants Need to Survive?	p. 24
	4. Theme 1 Power Point	p. 37

Theme 2 Why Soybeans?

Guiding Question:	How do we use soybeans in our everyday lives?	p. 46
Lessons:	1. Those Oily Chips	p. 47
	2. Why Soybeans?	p. 51
	3. Theme 2 Power Point	p. 68

Theme 3 Where has the Soybean Been?

Guiding Question:	How do people from diverse cultures use soybeans?	p. 74
Lessons:	1. Contributions of Scientists Made Through Soybeans	p. 75
	2. Theme 3 Power Point	p. 84

Theme 4 Can the Golden Bean Be "Green"?

Guiding Question:	How do advancements in technology afford us different choices about the environment?	p. 90
Lessons:	1. Beans Give Gas: Soy Biodiesel Fuel	p. 91
	2. Growing a Car	p. 100
	3. A Line-up for Henry Ford's Assembly Line	p. 108
	4. Theme 4 Power Point	p. 144

Michigan Soybean Promotion Committee's Commitment to Education

Teachers face increasing pressures to include innovative instruction into their classrooms, which simultaneously meet those standards of the state. The Michigan Soybean Promotion Committee (MSPC) has a history of supporting teachers in their desire to integrate programs that complement classroom learning that also meet state benchmarks. As standards have again changed, the MSPC has updated its existing *Soybeans Go To School* curriculum to meet the Michigan Grade Level Content Expectations. Recognizing there is a growing interest in where food comes from, the MSPC responded by including themes that address: our concerns with our food, how its production impacts the environment and the role of the natural resources industry within the state. The lessons contained within this updated curriculum are designed to help students in 3rd - 5th grades master essential social science and science concepts.

The MSPC is committed to introducing students and teachers to, and deepening their understanding of, the soybean crop and its impact in Michigan. MSPC believes that soybeans help connect agriculture, food and the environment to real-world science instruction. Furthermore, MSPC recognizes that soybeans can play a significant role in providing a renewable resource to help solve some of Michigan's environmental dilemmas. Anyone who comes in contact with this curriculum quickly discovers that soybeans are linked to our everyday life in industrial products we use to the food on our tables.

This updated curriculum is designed to enhance usability for teachers and students. Each lesson plan contains activities designed to promote soybeans and the following three themes: where food comes from, the environmental impacts of soybean production and the strength of the natural resources industry as a means to Michigan's economic recovery and future.

This curriculum also includes an online component. Teachers and students can extend their learning via technology in multiple ways. First, the curriculum itself is downloadable from the website. Secondly, there are enhanced activities for each lesson plan that allow students to use the internet to further their understanding of these soybean-related concepts. Thirdly, there is media available in the form of videos to heighten learning. Finally, power point presentations are available for each theme supporting teacher understanding of these concepts.

AUTHORS:

Jennifer Rivera

Assistant Professor
Michigan State University
Department of Community, Agriculture, Recreation,
and Resource Studies

Rebecca Wittman

Graduate Student
Michigan State University
Department of Community, Agriculture, Recreation,
and Resource Studies

Makena Schultz

Graduate Student
Michigan State University
Department of Community, Agriculture, Recreation,
and Resource Studies

REFERENCES:

Iowa State University. (1994) *How a Soybean Plant Develops*. [Web].

Retrieved from <http://extension.entm.purdue.edu/fieldcropsipm/soybean-stages.php>

Michigan Soybean Promotion Committee (2004). Compare and Contrast Chart.

Soybeans Go To School. Cluster 1. 8. [Web].

Retrieved from <http://michigansoybean.org/MSPCSite/SchoolKit/cluster1.pdf>

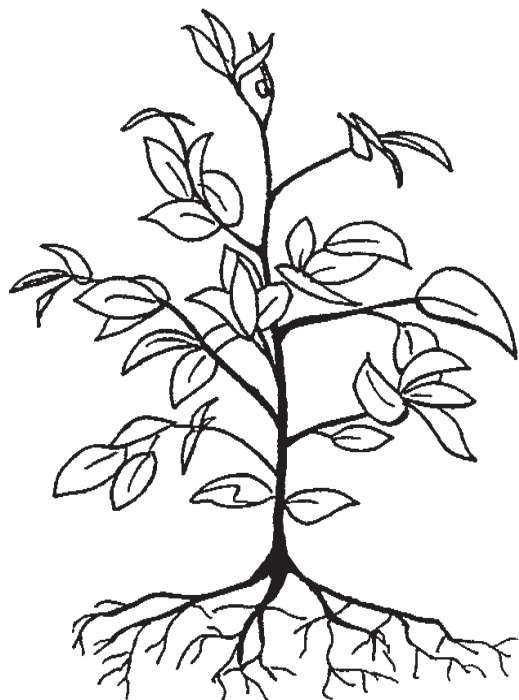
Michigan Soybean Promotion Committee (2004). Graph Height Chart.

Soybeans Go To School. Cluster 3. 31. [Web].

Retrieved from <http://michigansoybean.org/MSPCSite/SchoolKit/cluster3.pdf>

University of Texas Libraries. (2002, Jan). World Map. [Web].

Retrieved from http://www.lib.utexas.edu/maps/world_maps/world_pol02.jpg



b

Grade Level Content Expectations

Theme 1: What are soybeans? How do they grow and thrive?

1.1

3rd Grade

- S.RS.03.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.IA.03.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IP.03.11 Make purposeful observation of the natural world using the appropriate senses.

4th Grade

- L.OL.04.15 Determine that plants require air, water, light and a source of energy and building material for growth and repair.
- S.RS.04.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.IA.04.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IP.04.11 Make purposeful observation of the natural world using the appropriate senses.

5th Grade

- L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment.

1.2

3rd Grade (Social Science)

- L.OL.03.31 Describe the function of the following plant parts: flower, stem, root and leaf.

3rd - 4th Grade (Science)

- S.RS.XX.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IP.XX.16 Construct simple charts and graphs from data and observations.
- S.IP.XX.15 Make accurate measurements with appropriate units (centimeters, meters, Celsius, grams, seconds, minutes) for the measurement tool.
- S.IP.XX.14 Manipulate simple tools that aid observation and data collection (e.g., hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer).
- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.

4th Grade (Social Science)

- L.OL.04.15 Determine that plants require air, water, light and a source of energy and building material for growth and repair.

5th Grade

- S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
- S.IP.05.14 Use metric measurement devices in an investigation.
- S.IP.05.15 Construct charts and graphs from data and observations.
- S.IP.05.16 Identify patterns in data.
- L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment.

1.3

3rd Grade (Social Science)

- S.IP.03.14 Manipulate simple tools that aid observation and data collection (e.g., hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer).
- S.IP.03.15 Make accurate measurements with appropriate units (centimeters, meters, Celsius, grams, seconds, minutes) for the measurement tool.

3rd - 4th Grade (Science)

- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IP.XX.12 Generate questions based on observations.
- S.IP.XX.13 Plan and conduct simple and fair investigations.
- S.IP.XX.16 Construct simple charts and graphs from data and observations.
- S.IA.XX.11 Summarize information from charts and graphs to answer scientific questions.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IA.XX.13 Communicate and present findings of observations and investigations.
- S.IA.XX.14 Develop research strategies and skills for information gathering and problem solving.
- S.RS.XX.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.RS.XX.14 Use data/samples as evidence to separate fact from opinion.
- S.RS.XX.15 Use evidence when communicating scientific ideas.

4th Grade (Social Science)

- L.OL.04.15 Determine that plants require air, water, light and a source of energy and building material for growth and repair.

5th Grade

- S.RS.05.15 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.RS.05.12 Describe limitations in personal and scientific knowledge.
- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.
- S.IA.05.14 Use metric measurement devices in an investigation.
- S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.
- S.IP.05.15 Construct charts and graphs from data and observations.
- S.IP.05.16 Identify patterns in data.
- S.IP.05.11 Generate scientific questions based on observations, investigations and research.
- S.IP.05.12 Design and conduct scientific investigations.
- S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
- S.IP.05.14 Use metric measurement devices in an investigation.

Theme 2: How do we use soybeans in our everyday lives?

2.1

3rd - 4th Grade (Science)

- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IP.XX.13 Plan and conduct simple and fair investigations.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IA.XX.13 Communicate and present findings of observations and investigations.
- S.RS.XX.15 Use evidence when communicating scientific ideas.

5th Grade

- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

2.2

3rd Grade (Social Science)

- 3-G4.0.1 Describe major kinds of economic activity in Michigan today (e.g., agriculture) and explain the factors influencing the location of these economic activities.
- 3-G5.0.1 Locate natural resources in Michigan and explain the consequences of their use.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.

3rd - 4th Grade (Science)

- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IP.XX.12 Generate questions based on observations.
- S.IP.XX.13 Plan and conduct simple and fair investigations.
- S.IP.XX.16 Construct simple charts and graphs from data and observations.
- S.IA.XX.11 Summarize information from charts and graphs to answer scientific questions.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IA.XX.13 Communicate and present findings of observations and investigations.
- S.IA.XX.14 Develop research strategies and skills for information gathering and problem solving.
- S.RS.XX.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.RS.XX.14 Use data/samples as evidence to separate fact from opinion.
- S.RS.XX.15 Use evidence when communicating scientific ideas.

5th Grade (Social Science)

- S.IP.05.11 Generate scientific questions based on observations, investigations and research.
- S.IP.05.12 Design and conduct scientific investigations.
- S.IP.05.15 Construct charts and graphs from data and observations.
- S.IP.05.16 Identify patterns in data.
- S.IA.05.12 Evaluate data, claims and personal knowledge through collaborative science discourse.
- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.
- S.RS.05.12 Describe limitations in personal and scientific knowledge.

Theme 3: How do people from diverse cultures use soybeans?

3.1

3rd Grade (Social Science)

- 3-H3.0.1 Identify questions historians ask in examining the past in Michigan.
- 3-H3.0.8 Use case studies or stories to describe how the ideas or actions of individuals affected the history of Michigan.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.

3rd - 4th Grade (Science)

- S.RS.XX.19 Describe how people have contributed to science throughout history and across cultures.

5th Grade

- S.RS.05.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

Theme 4: How do advancements in technology afford us different choices about the environment?

4.1

3rd Grade

- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.
- 3-P3.1.1 Identify public issues in Michigan that influence the daily lives of its citizens.
- S.RS.03.16 Identify technology used in everyday life.
- S.RS.03.17 Identify current problems that may be solved through the use of technology.
- S.RS.03.18 Describe the effect humans and other organisms have on the balance of the natural world.
- E.ES.03.41 Identify natural resources (metals, fuels, fresh water, fertile soil and forests).
- E.ES.03.42 Classify renewable (fresh water, fertile soil, forests) and non-renewable (fuels, metals) resources.
- E.ES.03.43 Describe ways humans are protecting, extending and restoring resources (recycle, reuse, reduce, renewable).
- E.SE.03.32 Describe how materials taken from the Earth can be used as fuels for heating and transportation.

4th Grade

- 4-G5.0.1 Assess the positive and negative effects of human activities on the physical environment of the United States.
- 4-P3.1.1 Identify public issues in the United States that influence the daily lives of its citizens.
- S.RS.04.16 Identify technology used in everyday life.
- S.RS.04.17 Identify current problems that may be solved through the use of technology.
- S.RS.04.18 Describe the effect humans and other organisms have on the balance of the natural world.

4.2

3rd Grade (Social Science)

- E.SE.03.31 Identify Earth materials used to construct some common objects.
- E.ES.03.41 Identify natural resources (metals, fuels, fresh water, fertile soil and forests).
- E.ES.03.42 Classify renewable (fresh water, fertile soil, forests) and non-renewable (fuels, metals) resources.
- 3-H3.0.1 Identify questions historians ask in examining the past in Michigan.
- 3-H3.0.8 Use case studies or stories to describe how the ideas or actions of individuals affected the history of Michigan.
- 3-G4.0.1 Describe major kinds of economic activity in Michigan today (e.g., agriculture) and explain the factors influencing the location of these economic activities.
- 3-G5.0.1 Locate natural resources in Michigan and explain the consequences of their use.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.
- 3-E1.0.3 Analyze how Michigan's location and natural resources influenced its economic development.

3rd - 4th Grade (Science)

- S.RS.XX.16 Identify technology used in everyday life.
- S.RS.XX.17 Identify current problems that may be solved through the use of technology.
- S.RS.XX.18 Describe the effect humans and other organisms have on the balance of the natural world.
- S.RS.XX.19 Describe how people have contributed to science throughout history and across cultures.

4th Grade (Social Science)

- 4-H3.0.3 Describe how the relationship between the locations of natural resources and industries (post 1837) affected and continues to affect the location and growth of Michigan cities.

5th Grade

- S.RS.05.17 Describe the effect humans and other organisms have on the natural world's balance.
- S.RS.05.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

4.3

3rd Grade

- 3-H3.0.1 Identify questions historians ask in examining the past in Michigan.
- 3-H3.0.8 Use case studies or stories to describe how the ideas or actions of individuals affected the history of Michigan.
- 3-G4.0.1 Describe major kinds of economic activity in Michigan today (e.g., agriculture) and explain the factors influencing the location of these economic activities.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.
- 3-E1.0.3 Analyze how Michigan's location and natural resources influenced its economic development.
- 3-E1.0.4 Describe how entrepreneurs combine natural, human and capital resources to produce goods and services in Michigan.
- 3-E1.0.5 Explain the role of business development in Michigan's economic future.
- S.RS.03.19 Describe how people have contributed to science throughout history and across cultures.
- E.ES.03.41 Identify natural resources (metals, fuels, fresh water, fertile soil and forests).
- E.ES.03.42 Classify renewable (fresh water, fertile soil, forests) and non-renewable (fuels, metals) resources.

4.3

4th Grade

- 4-E1.0.2 Describe some characteristics of a market economy (e.g., private property rights, voluntary exchange, competition, consumer sovereignty, incentives, specialization).
- 4-E1.0.5 Explain how specialization and division of labor increase productivity (e.g., assembly line).
- 4-E1.0.6 Explain how competition among buyers results in higher prices and competition among sellers results in lower prices (e.g., supply, demand).

5th Grade

- S.RS.05.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

Vocabulary

Theme 1: What are soybeans? How do they grow and thrive?

1.1

- **Cotyledon:** the part of the seed that stores food for the seedling. Each bean has a pair of cotyledons forming a protective shield around the seedling.
- **Embryo:** a tiny plant.
- **Hypocotyl:** the part of the embryo that forms the stem.
- **Radicle:** the part of the embryo that forms the roots.
- **Seed:** a fertilized and mature egg that contains a tiny plant that grows and develops when placed in an environment containing air, water and warmth.
- **Seed coat:** a thin covering that protects the seed's embryo from insects, disease and damage.

1.2

- **Cotyledon:** while still in the seed, it stores food for the seedling; it becomes the first leaf or leaves that are developed by the seed.
- **Epicotyl:** the part of the plant that grows. The stem forms and grows from this point.
- **Flower:** the bloom or blossoms of the plant; the seed-producing structure of a plant.
- **Fruit:** a swollen mature flower (these are considered the fruits). Fruits normally contain stored energy and nutrients that help seeds grow during germination.
- **Germination:** the process of an embryo emerging from its seed.
- **Hypocotyl:** forms the stem below the cotyledon.
- **Leaves:** the major site of photosynthesis where oxygen is released and carbon dioxide is absorbed.
- **Roots:** the usually underground part of a seed plant body that: transports water and minerals, stores sugars produced by the plant and anchors that plant into the ground.
- **Seed pod:** the fruit of plants like legumes containing many seeds.
- **Stem:** stalk; a slender or elongated structure that supports a plant through which water, minerals and food are transported between the roots and the rest of the plant.

1.3

- **Control:** a sample in which a factor whose effect is being estimated is absent or is held constant in order to provide a comparison.
- **Data:** evidence or facts.
- **Hypothesis:** an educated guess based on observations and knowledge of the topic that can be tested by further investigation.
- **Scientific inquiry:** a process that is used to find answers to questions about the world around us.

Theme 2: How do we use soybeans in our everyday lives?

2.1

none

2.2

- **Chart:** a place to record data or observations.
- **Data:** evidence or facts.
- **Graph:** a diagram showing connections between data using dots, lines, etc.
- **Hypothesis:** an educated guess based on observations and knowledge of the topic that can be tested by further investigation.
- **Scientific inquiry:** a process that is used to find answers to questions about the world around us.

Theme 3: How do people from diverse cultures use soybeans?

3.1

- **Agriscientist (agricultural scientist):** a scientist researching the science of agriculture.
- **Physician:** a person trained in the art of healing, such as a doctor of medicine.
- **Scientific researcher:** someone that proposes hypothesis as explanations of phenomena and design experimental studies to test these hypothesis via predictions.

Theme 4: How do advancements in technology afford us different choices about the environment?

4.1

- **Biodiesel:** it is a renewable resource that is soy or vegetable oil- or animal fat based diesel.
- **Diesel fuel:** a fuel made from petroleum.
- **Fossil fuel:** a material that we can use for energy (like oil or coal) that is the remains of a once living plant or animal.
- **Fuel:** a material that produces heat or power by burning.
- **Natural resource:** available raw material in the Earth that can be drawn on by need.
- **Non-renewable resource:** raw material that cannot be replaced.
- **Petroleum:** an oil found underground; it's a fossil fuel.
- **Renewable resource:** raw material that can be replaced.

4.2

- **Capital resource:** a good produced for and used to make other goods or services (such as buildings, equipment, tools or cash).
- **Chemurgy:** the development of new industrial chemical products from raw materials, especially agricultural products.
- **Human resource:** the amount of labor/work people put into making a product (such as a cashier, a teacher or even a student).
- **Natural resource:** available raw material in the Earth that can be drawn on when wanted.
- **Non-renewable resource:** raw material that cannot be replaced.
- **Renewable resource:** raw material that can be replaced.

4.3

- **Assembly line:** a manufacturing process where the product being assembled passes consecutively from operation to operation until completed.
- **Division of labor:** a production process in which a worker or group of workers is assigned a specialized task in order to increase efficiency.
- **Law of demand:** as the cost of something increases, people will demand (or buy) less. The opposite is also true, if the cost of something decreases, people will demand (or buy) more.
- **Law of supply:** as the price of something increases, producers will produce or offer more. The opposite is also true, if the price of something decreases, producers will produce or offer less.
- **Production:** the way that something is made.
- **Specialization:** being allowed to do only one specific task.

Materials List

Theme 1: Racey Soys!

Soybean seeds (2 per student)
Cups (1 per set of soybeans)
Hand magnifiers (1 per student)
Peat pellets (1 per pair of students)
Rulers (1 per student)
Metric ruler (1 per student)

Theme 2: Why Soybeans?

Potato chips (1 bag per classroom)
Paper towels (1 per pair of students)
Product labels
Soybeans (1 per 3 students)

Theme 3: Where has the Soybean Been?

SoyNews

Theme 4: Can the Golden Bean be "Green"?

Soy biodiesel sample (1 per class)
SoyNews
Yarn
3"x5" index cards (11 per group)
Crayons (1 set per student)
*Tape



Videos and Other Ag Lessons:

<http://michigansoybean.org/checkoff-at-work/outreach/soybeans-go-to-school-kit/>

Theme 1 - *Racey Soys!*
Theme 2 - *Why Soybeans?*
Theme 3 - *Where has the Soybean Been?*
Theme 4 - *Can the Golden Bean Be Green?*
Agricultural Biotechnology from DNA to GMOs
Michigan Ag in the Classroom
Busy Beans
Discovering FARMLAND

Note to teacher:

The above materials are provided for you so you do not need to acquire them. To take full advantage of the entire curriculum, *you will need to use some materials that are probably already in your classroom and, if you want to take the extra step, bring some materials from home.

Resources to Further Learning Experiences

Below is a list of websites to support and enhance teacher and student learning about soybeans. You may access the websites by: clicking on the links; or by copying and pasting them into your browser.

Michigan Soybean Promotion Committee (MSPC)

<http://www.michigansoybean.org/index.html>

If you have an idea for your classroom and aren't sure where to look, contact MSPC and see if there is a way to help set it up.

Educational Websites Highlighting Soybeans or Agriculture:

USDA

<http://www.agclassroom.org/teacher/index.htm>

A large directory of engaging lesson plans for all grade levels.

Illinois Soybean Association presents "Pod to Plate"

<http://www.podtoplate.org/>

Interactive game for students about all facets of agriculture.

American Farm Bureau's - My American Farm

<http://www.myamericanfarm.org/>

Interactive games and includes activities teachers can use in classroom.

Information about Soybeans:

United Soybean Board

<http://www.unitedsoybean.org/>

General information.

Soyatech

http://www.soyatech.com/soy_facts.htm

Facts about soy.

Whole Foods

<http://www.whfoods.com/genpage.php?tname=foodspice&dbid=79>

Easy to read information about the history of soybeans, nutritional information, and uses.

National Soybean Research Lab

<http://www.nsrl.illinois.edu/>

Information about nutrition and how soybeans are used to help combat hunger by feeding people around the world.

Soybean Uses:

United Soybean Board

<http://soynewuses.org>

An extensive product guide of all things soy! It includes commercial products, industrial products and ingredients. There is a listing of companies that sell soybean based products (usually wholesale).

Production to Processing:

USDA

<http://www.ers.usda.gov/News/soybeancoverage.htm>

Background statistics about soybean production.

Iowa State University: Soybean Extension and Research Program

<http://extension.agron.iastate.edu/soybean/topicpage1.html>

Wide selection of topics related to production from seed varieties to harvest.

Includes great pictures of soybean growth stages. Also, look at soybean recipes, general statistics and production costs.

USDA - Agricultural Research Service

<http://www.ars.usda.gov/is/graphics/photos/k5267-7.htm>

Images of soybean seeds in range of colors and sizes.

North Carolina Soybean Producers Association

<http://www.ncsoy.org/ABOUT-SOYBEANS/History-of-Soybeans.aspx>

Background information including: a brief history of soybeans, production information, production pictures, soy uses, nutrition facts and a video on production.

Iowa State University: Soybean Extension and Research Program

<http://www.extension.iastate.edu/Publications/PM1636.pdf>

Sheet about soybean drying and storage.

Economic Information:

CME Group

<http://www.cmegroup.com/trading/agricultural/grain-and-oilseed/soybean.html>

Reference highlighting soybeans future.

North Dakota State University Extension

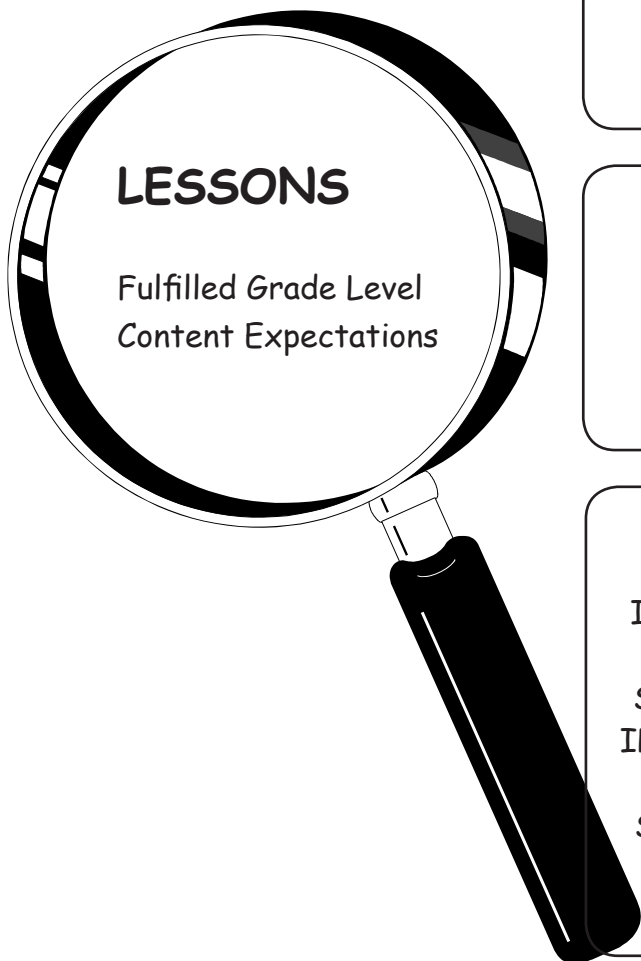
<http://www.ag.ndsu.edu/pubs/agecon/market/eb79.pdf>

Brazil's soybean production and the impacts of this industry.

Theme 1

Racey Soys!

What are soybeans?
How do they grow and thrive?



Examining The Bean

S.RS.03.11, S.IA.03.12, S.IP.03.11, L.OL.04.15,
S.RS.04.11, S.IS.04.12, S.IP.04.11, L.EV.05.12

Racey Soys!

L.OL.03.31, S.RS.03.11, S.IA.03.12, S.IP.03.16,
S.IP.03.15, S.IP.03.14, S.IP.03.11, L.OL.04.15,
S.RS.04.11, S.IA.04.12, S.IP.04.16, S.IP.04.15,
S.IP.04.14, S.IP.04.11, S.IP.05.15, S.IP.05.14,
S.IP.05.13, S.IP.05.16, L.EV.05.12

What Do Plants Need To Survive?

IP.3.11, IP.3.12, IP.3.13, IP.3.14, IP.3.15, IP.3.16,
IA.3.11, IA.3.12, IA.3.13, IA.3.14, S.RS.03.11,
S.RS.03.14, S.RS.03.15, IP.4.11, IP.4.12, IP.4.13,
IP.4.14, IP.4.15, IP.4.16, IA.4.11, IA.4.12, IA.4.13,
IA.4.14, L.OL.04.15, S.RS.04.11, S.RS.04.14,
S.RS.04.15, S.RS.05.15, S.RS.05.12, S.IA.05.13,
S.IA.05.14, S.IA.05.11, S.IP.05.11, S.IP.05.12,
S.IP.05.13, S.IP.05.14, S.IP.05.15, S.IP.05.16

Examining the Bean

Purpose

Observe and identify physical characteristics of soybean seeds as well as their functions.

GLCEs

3rd Grade

- S.RS.03.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.IA.03.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IP.03.11 Make purposeful observation of the natural world using the appropriate senses.

4th Grade

- L.OL.04.15 Determine that plants require air, water, light and a source of energy and building material for growth and repair.
- S.RS.04.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.IA.04.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IP.04.11 Make purposeful observation of the natural world using the appropriate senses.

5th Grade

- L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment.

Background

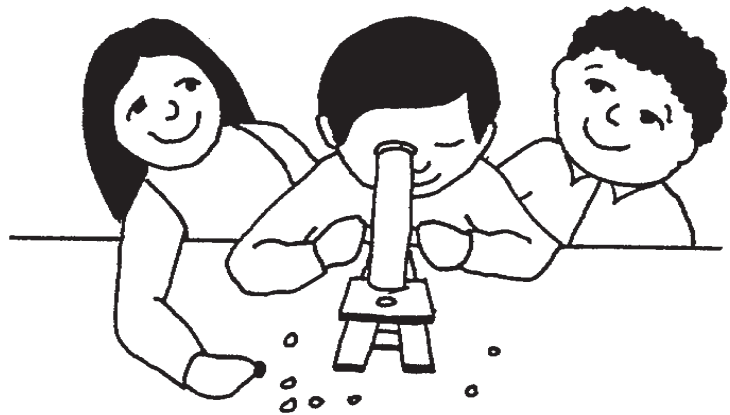
On a soybean seed there is an outer seed coat and every seed contains a tiny plant (embryo) that consists of leaves, stems and root parts. Certain conditions are necessary (such as temperature, moisture, air) to allow the seed to germinate and the plant to grow. The seed also contains a short-term food supply called the endosperm. This is formed at fertilization; however, it is not part of the embryo. Instead, it is used by the embryo to help its growth. The majority of a seed is its fleshy interior called the cotyledon, which stores food for germination.

Activity

Determining seed function through an examination of soybeans.

Materials

- 2 sets of soybeans (one per student)
- 1 large cup
- Hand magnifiers
- Reference sheet HO #1.1A
- Theme 1 Power Point
- Worksheet HO #1.1B-C



Definitions

- **Cotyledon:** the part of the seed that stores food for the seedling. Each bean has a pair of cotyledons forming a protective shield around the seedling.
- **Embryo:** a tiny plant.
- **Hypocotyl:** the part of the embryo that forms the stem.
- **Radicle:** the part of the embryo that forms the roots.
- **Seed:** a fertilized and mature egg that contains a tiny plant that grows and develops when placed in an environment containing air, water and warmth.
- **Seed coat:** a thin covering that protects the seed's embryo from insects, disease and damage.

**45
min.**

Procedure 1.1

Note: Save your dry seeds for future lessons.

Objective	Activity	Possible Responses/Notes
DAY ONE		
1	Preparation	<p>The evening before, fill a cup with water and enough soybeans for every student.</p> <p>Soak the seeds at least 8 hours.</p>
DAY TWO		
2	<p>Become familiar with soybeans</p> <p>Recognize soybeans as seeds</p> <p>Determine baseline knowledge of seed functions</p> <p>Generate ideas about the characteristics of a seed</p>	<p>Pass out 1 dry soybean per student</p> <p>Ask questions, solicit responses and record responses on the board:</p> <p>Q1 - What type of seeds are the seeds that I just handed out to you?</p> <p>Q2 - Soybeans are actually part of a plant. What part of the plant is the soybean?</p> <p>Q3 - What is the purpose of the seed? Why do plants have seeds?</p> <p>Q4 - We're going to actually get to look inside a soybean seed. What do you think the inside of a seed looks like?</p> <p>Q1 Notes: Soybeans</p> <p>Q2 Notes: The soybean is the seed.</p> <p>Seed: a fertilized and mature egg that contains a tiny plant that grows and develops when placed in an environment containing air, water and warmth.</p> <p>Q3 Notes: Has an embryo (tiny plant) inside that can grow into the same plant it came from; it's the plant's way of ensuring its species lives on; the tiny plants inside can be carried other places to grow (by wind, water and animals).</p> <p>Q4 Notes: A tiny plant, food, etc.</p>

3	Determine baseline knowledge of seed part identification	<p>Using HO #1.1A as a reference, review the basic parts of seeds.</p> <p>Direct students to observe which of them can be seen from the outside.</p>	<p>Outside: Seed coat: a thin covering that protects the seed's embryo from insects, disease and damage.</p> <p>Inside: Embryo: a tiny plant.</p> <p>Cotyledon: the part of the seed that stores food for the seedling. Each bean has a pair of cotyledons forming a protective shield around the seedling.</p> <p>Hypocotyl: the part of the embryo that forms the stem.</p> <p>Radicle: the part of the embryo that forms the roots.</p>
4	Use observation skills to determine cause and effect with seeds	<p>Pass out a soybean to each student from the cup with water, ask questions and solicit responses:</p> <p>Q1 - Compare your two seeds, what are the similarities and differences?</p> <p>Q2 - How did this happen to the second soybean?</p>	<p>Q1 Notes: One is wet and soggy and larger than the other.</p> <p>Q2 Notes: It was soaked in water for a period of time and it absorbed the water and swelled.</p>
5	Foster observation skills	<p>Direct students to carefully pry their wet seed open, using their thumbs, directly down the middle crack.</p> <p>Ask questions and solicit responses:</p> <p>Q1 - What do you see inside?</p>	<p>Answers vary, the students may not have any idea what they are looking at.</p>

6	<p>Foster observation skills</p> <p>Generate ideas about what the seed parts they are seeing do</p>	<p>Direct students to observe both seeds.</p> <p>Direct them to use a piece of paper and crayons, markers, etc. to draw what they see inside the one soybean and outside of the other. Give them 8-10 minutes.</p> <p>Have them write down their ideas to describe the parts inside the seed and the function of each part.</p>	
7	<p>Foster communicating ideas to others and listening</p>	<p>Direct students to share their pictures and guesses with each other.</p>	
8	<p>Instruction about seed part identification and function</p>	<p>Draw a big soybean seed on the board, outside and inside, and label the following parts:</p> <p>Seed coat, Embryo, Radicle, Hypocotyl, Cotyledon</p> <p>Discuss the function of each part.</p>	<p>See reference HO #1.1A</p>
9	<p>Connect and compare student generated ideas about part functions with real function</p>	<p>Ask questions and solicit feedback:</p> <p>Q1 - Looking at what you wrote, did anyone think of functions of their seed parts that are similar to the functions we just learned about?</p>	<p>Answers will depend on students.</p>

10		Pass out Worksheet HO #1.1B and direct students to label the parts matching what's on the board and fill out a quick description of its purpose.	
11	Summarize content learned Connect learning to requirements for germinating seed	Ask questions and solicit feedback: Q1 - What did we learn today that soybean seeds have inside them? Follow-up Q2 - If it didn't have that part, what would happen? Q3 - What do these seeds need to grow?	Answers vary: Q1 Notes: Food for the tiny plant. A tiny plant. Q2 Notes: The tiny plant wouldn't survive dormancy; the seed couldn't form a new plant. Q3 Notes: Air, light, moisture and soil with nutrients.
SAVE DRY SEEDS			

Extended Online Activities

1. *Compare soybean seed sizes and colors.*
 Sizes of soybean seeds can range from that of a pea to that of a cherry. Generally, field-type soybeans have small seeds while those for vegetable consumption are large seeds. Colors of the beans can include: black, brown, blue, yellow, green and mottled.
<http://www.ars.usda.gov/is/graphics/photos/k5267-7.htm>
2. *Compare soybean seed shapes.*
 Shapes are generally round in nature but can vary in the degree that they are oblong.
http://www.soyatech.com/soy_facts.htm



HO #1.1A & C

Soybean Seed Reference Sheet

Seed Part Identification and Function

Seed: a fertilized and mature egg that contains a tiny plant that grows and develops when placed in an environment containing air, water and warmth.

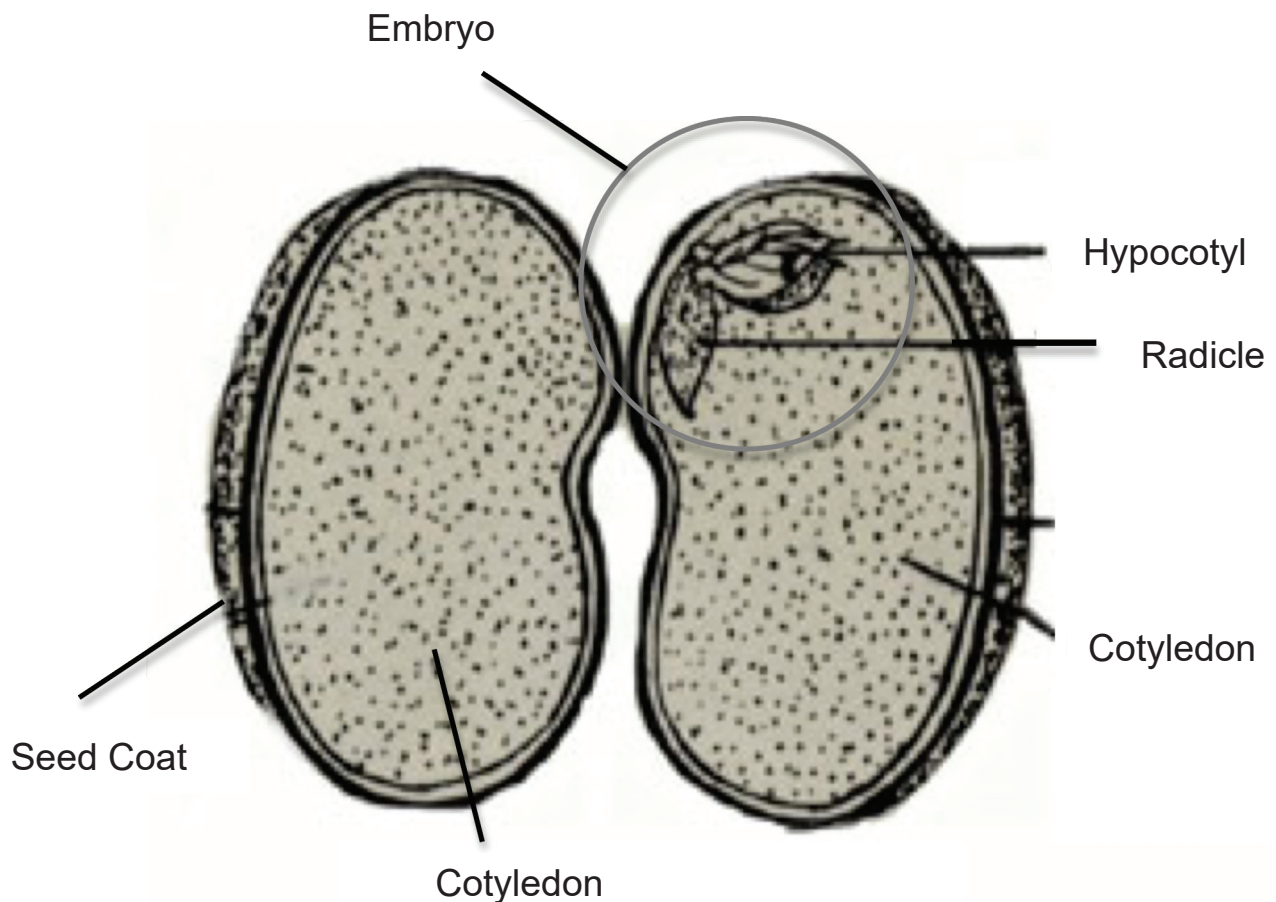
Seed coat: a thin covering that protects the seed's embryo from insects, disease and damage.

Embryo: a tiny plant inside a seed.

Cotyledon: the part of the seed that stores food for the seedling. Each bean has a pair of cotyledons forming a protective shield around the seedling.

Radicle: the part of the embryo that forms the roots.

Hypocotyl: the part of the embryo that forms the stem.



Name: _____ Date: _____

Soybean Seed Reference Sheet

Seed Part Identification and Function

For each seed part listed below, write in its function and label that part on the seed below.

Seed (do NOT need to label):

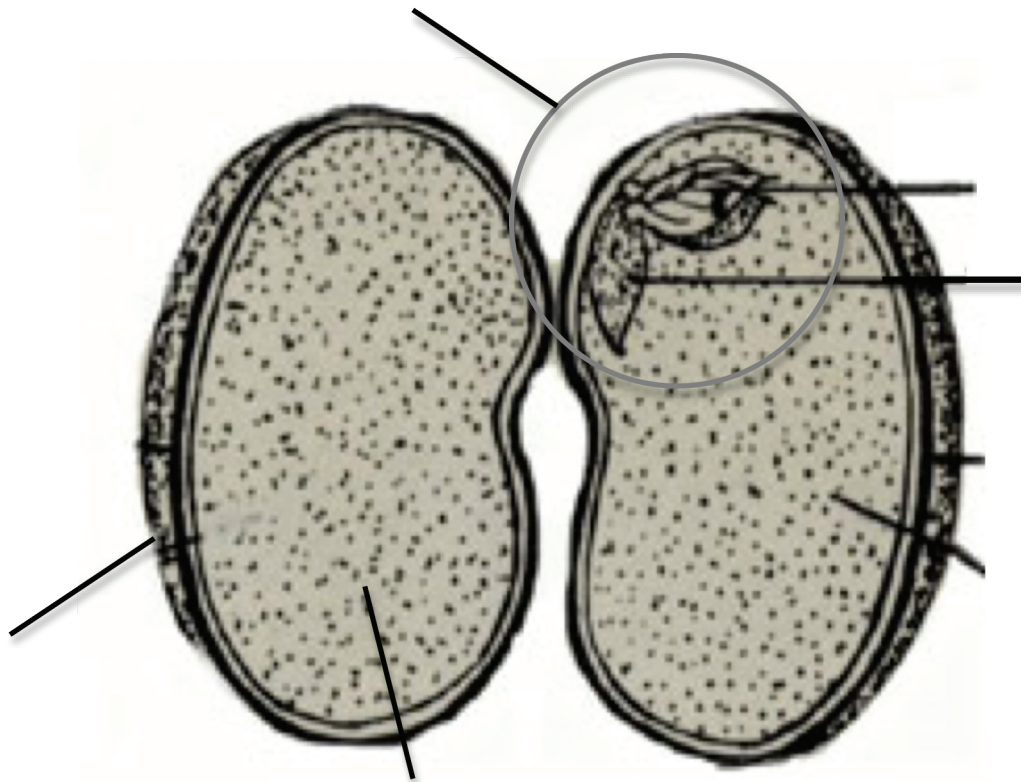
Seed coat:

Embryo:

Cotyledon:

Radicle:

Hypocotyl:



How Tall Will It Grow?

Purpose

1. Observe and identify physical characteristics of soybean plants as well as their functions.
2. Grow soybeans.
3. Chart and graph observations.

GLCEs

3rd - 4th Grade (Science)

- S.RS.XX.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IP.XX.14 Manipulate simple tools that aid observation and data collection (for example: hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer).
- S.IP.XX.15 Make accurate measurements with appropriate units (centimeters, meters, Celsius, grams, seconds, minutes) for the measurement tool.
- S.IP.XX.16 Construct simple charts and graphs from data and observations.

3rd Grade

- L.OL.03.31 Describe the function of the following plant parts: flower, stem, root and leaf.

4th Grade

- L.OL.04.15 Determine that plants require air, water, light and a source of energy and building material for growth and repair.

5th Grade

- S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
- S.IP.05.14 Use metric measurement devices in an investigation.
- S.IP.05.15 Construct charts and graphs from data and observations.
- S.IP.05.16 Identify patterns in data.
- L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment.

Background

Over 3,000 years ago, the Chinese cultivated soybeans. At that time the bean had only small seeds and grew flat on the ground. Farmers selected seeds of plants with larger fruits (the seeds) and those that grew more upright. Over many years, the once wild soybean was domesticated into a bushy plant with easy to see seeds.

Just like other plants, soybeans grow roots that provide functions including: (a) anchoring the plant into the ground for support, and (b) absorbing water and nutrients that are vital for growth and repair. They can even store sugars and carbohydrates to help carry out other plant functions. Stems carry water and nutrients from the roots to the leaves. Stems also act as a support for the plant to allow it to reach necessary sunlight for food production. Leaves catch light and have the important task of photosynthesis: the process of creating the plant's own energy by converting carbon dioxide, water and light energy into glucose. They release oxygen in the process. Finally, flowers are necessary to produce seeds. Soybeans are self-pollinating, meaning they possess both male and female parts to pollinate themselves. Different varieties of soybeans produce white, purple and pink flowers.

Soybeans are an annual plant, completing their life cycle in less than one year. They are planted in the spring and harvested in the fall. After a soybean seed grows from spring to fall, the leaves and stalks turn brown and it is typically harvested. The bean itself is the "gold" of the plant and is the part most sought by producers and consumers.

Activity

Determining plant part functions through the process of growing soybeans.

Materials

- Soybean seeds
- Peat pellets
- Cups
- Hand magnifiers
- Lab Sheets HO #1.2A-B
- Soybean Growth Diagram HO #1.2 C
- Theme 1 Power Point

Vocabulary

- Cotyledon
- Epicotyl
- Flower
- Fruit
- Germination
- Hypocotyl
- Leaves
- Roots
- Seed pod
- Stem

Day One
(20 min.)

6 Additional
Observation Periods:

Repeat every 2-3 days for 14 days
(25 min. each)

Definitions

- **Cotyledon:** while still in the seed, it stores food for the seedling; it becomes the first leaf or leaves that are developed by the seed.
- **Epicotyl:** the part of the plant that grows. The stem forms and grows from this point.
- **Flower:** the bloom or blossoms of the plant; the seed producing structure of a plant.
- **Fruit:** a swollen mature flower (these are considered the fruits). Fruits normally contain stored energy and nutrients that helps seeds grow during germination.
- **Germination:** the process of an embryo emerging from its seed.
- **Hypocotyl:** the part of the embryo that forms the stem.
- **Leaves:** the major site of photosynthesis where oxygen is released and carbon dioxide is absorbed.
- **Roots:** the underground part of a seed plant body that: transports water and minerals, stores sugars produced by the plant and anchors the plant into the ground.
- **Seed pod:** the fruit of plants like legumes containing many seeds.
- **Stem:** stalk; a slender or elongated structure that supports a plant through which water, minerals and food are transported between the roots and the rest of the plant.



Procedure 1.2

Note: It is useful to do this lesson in succession with lessons 1.1 and 1.3.

Objective	Activity	Possible Responses/Notes
DAY ONE		
*Plant 10 extra seeds in case any of the students' seeds do not germinate.		
1	Review students' existing knowledge of the criteria plants need for growth and repair	<p>Ask questions and solicit responses:</p> <p>Q1 - What resources do plants need to grow and repair?</p> <p>Q2 - How do plants use these resources?</p> <p>Q3 - What is the process of growing a plant from a seed called?</p> <p>Q1-2 Notes: Air: necessary for photosynthesis in leaves. Water: used in photosynthesis; aids roots in absorbing nutrients from the soil; assists germination; transpiration. Light: photosynthesis Nutrient rich soil: used for energy and building blocks.</p> <p>Q3 Notes: Germination: the process of an embryo emerging from its seed.</p>
2	Plant soybeans	<p>Divide students up into groups of two.</p> <p>Give each group a peat pellet.</p> <p>Soak the peat pellets in a cup with water until they swell.</p> <p>Using a pencil to push in the seed, plant the bean seed about 1/4" deep in each peat pot.</p> <p>A peat pellet is made from sphagnum gathered peat from peat bogs. Lime and a special fertilizer with low ammonium content are added to the peat in order to stimulate growth. Peat pellets are ideal for starting seeds indoors. Just put a few seeds in each pellet and add water. The peat pellets expand into a self-contained soil container held together by degradable netting. The netted container can be sown directly into the ground or planter pot.</p>

Over the next 14 days, observe at least every 2-3 days (for a total of 5 observation periods):			
3	Measure the growth of the soybean	Direct groups to observe their plants and measure its height in centimeters from the soil to the tip of the tallest part of the plant.	
4	Observation periods	<p>For each observation period, direct student groups to record their observations of soybean growth on the Racey Soys Lab Sheet HO #1.2A:</p> <p>Students should fill in the date of the observation, the height of their plant and draw a detailed picture of what their plant looks like that day.</p>	
5	Graphing growth	<p>For each observation period, direct student groups to graph their plant's growth on the plant growth sheet HO #1.2B:</p> <p>First, have students decide on what progression in centimeters they are going to label the graph with (e.g., by one's, two's, fives's, etc.)</p> <p>Direct students to fill in the x-axis from left to right in centimeters from lowest to highest using the progression they decided upon.</p> <p>Direct students to fill in the y-axis from bottom to top with number of days since planting.</p> <p>For each observation period, direct students to mark the point in the graph that corresponds with the number of days since planting and the height of the plant. At the end of the observation period, students can connect the dots to form a line.</p>	

6	<p>Summarize findings</p> <p>Personalize learning experience</p>	<p>Ask questions and solicit responses:</p> <p>Q1 - What patterns do you notice in your graphs of the growth process?</p> <p>Q2 - What patterns do you notice in your charts of the growth process?</p> <p>Q3 - What have you discovered about soybean growth?</p>	<p>Answers vary.</p>
<p>SIMULTANEOUSLY</p>			
7	<p>Observe plant parts on a growing soybean plant</p> <p>Link observations of plant parts with their functions</p> <p>Build on new knowledge</p>	<p>As the following plant parts begin to develop and emerge, consider the following parts and their functions:</p> <p>Ask questions and solicit responses:</p> <p>Q1 - What do you see that's different from your last observation?</p> <p>Q2 - What is the purpose of the [cotyledon]?</p> <p>Q3 - What are some things that would happen if the plant didn't have a [cotyledon]?</p> <p>Instruct students to draw a picture and write a small paragraph saying what would happen if a soybean plant was missing the stem and had no leaves.</p> <p>Inform them that they will be making a book using all of the pages they create for 1st graders to learn about how soybeans grow (roots, stems, flowers, leaves and seed pods).</p> <p>REPEAT for each of the other two plant parts: stem and leaves.</p>	<p>Q1-3 Notes:</p> <p>Cotyledon: while still in the seed, it stores food for the seedling; it becomes the first leaf or leaves that are developed by the seed.</p> <p>Stem: stalk; a slender or elongated structure that supports a plant and through which water, minerals and food are transported between the roots and the rest of the plant.</p> <p>Leaves: major site of photosynthesis where oxygen is released and carbon dioxide is absorbed.</p>

8	<p>Observe plant parts on growing soybean plant</p> <p>Link observations of plant parts with their functions</p>	<p>Direct students to observe these as well.</p>	<p>Refer to HO #1.2C to see what these look like and where they are located on the plant.</p> <p>Epicotyl: the part of the plant that grows. The stem forms and grows from this point.</p> <p>Hypocotyl: forms the stem below the cotyledon.</p>
9	<p>Acknowledge hidden parts of growing soybean plant</p>	<p>Ask questions and solicit responses:</p> <p>Q1 - Do you think we can see the entire plant?</p> <p>Q2 - If not, what can't be seen?</p> <p>Q3 - What are the functions of the roots?</p>	<p>Q1 Notes: No.</p> <p>Q2-3 Notes: Roots: usually the underground part of a seed plant body that: transports water and minerals, stores sugars produced by the plant and anchors the plant into the ground.</p>
10	<p>Make assumptions about future plant development</p> <p>Recognize the importance of functions of plant parts not yet observed</p>	<p>Unfortunately you will not have time to see flowers and seed pods develop within the duration of this lesson.</p> <p>Ask students and solicit responses:</p> <p>Q1 - Do you think the soybean plant is done growing? Do you think it will change from how it looks now?</p> <p>Q2 - If it continues to grow, how will it change in appearance?</p> <p>Q3 - What is the function of the flower on a soybean plant?</p> <p>Q4 - What are the functions of the seed pods on a soybean plant?</p>	<p>Q1 Notes: No. Yes.</p> <p>Q2 Notes: It will develop both flowers and seed pods.</p> <p>Q3 Notes: Flower: the bloom or blossoms of the plant; the seed-producing structure of a plant.</p> <p>Q4 Notes: Seed pod: the fruit of plants like legumes containing many seeds.</p>

11	Link existing knowledge to soybean context	<p>Ask questions and solicit feedback:</p> <p>Q1 - What are some examples of fruits that you find in the grocery store?</p> <p>Define fruit.</p> <p>Explain that a seed pod is the soybean's "fruit".</p>	<p>Q1 Notes:</p> <p>Fruit: a swollen mature flower (these are considered the fruits). Fruit normally contains stored energy and nutrients that help seeds grow during germination.</p>
12		Direct students to fill out worksheet HO #1.2D on soybean plant identification and function.	

SAVE the plants for future lessons.

Optional Activity

1. Observe parts of other plants. Compare and classify the similarities and differences. Discuss the functions of the plant parts. Are the "roles" the same for different plants?
2. Create an "Art Soybean Plant". Give the students a variety of art supplies: construction paper, tissue paper, pipe cleaners, scissors, glue and crayons. On a piece of construction paper, have students design a soybean plant. Their plant should show at least three of the six different plant parts with labels describing the functions of the three parts.

Searchable Internet Questions

1. Compare growth rates of Michigan soybeans and soybeans grown in Brazil.
2. Compare planting seasons of Michigan soybeans and soybeans grown in Brazil.
3. How are soybeans measured (yield, bushel, market rates, etc.)?

HO #1.2A

Name: _____ Date: _____

Racey Beans

Date	Height (cm)	Drawing of Plant

Name: _____ Date: _____

Title: _____

**N
U
M
B
E
R

o
f

c
m

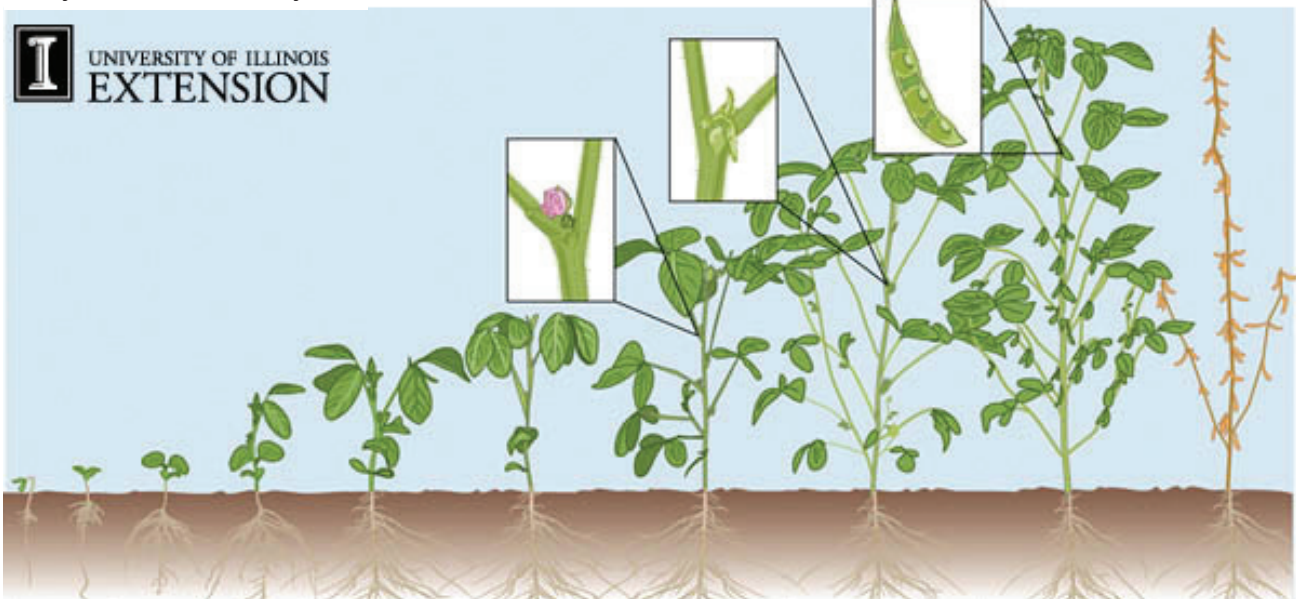
T
A
L
L**

NUMBER of DAYS

HO #1.2C & E

Soybean Plant Reference Sheet

Soybean Growth Cycle



This is a simple chart to show the growth of soybeans from seedling through the process of growing into a mature plant. This involves developing flowers and the progression from those flowers into seed pods. The last stage on the right illustrates that all the leaves fall off and the plant consists mostly of soybean pods on the stem ready to be harvested.

Soybean Plant and Function

Roots: the usually underground part of a seed plant body that: transports water and minerals, stores sugars produced by the plant and anchors the plant into the ground.

Stem: stalk; a slender or elongated structure that supports a plant and through which water, minerals and food are transported between the roots and the rest of the plant.

Leaves: the major site of photosynthesis where oxygen is released and carbon dioxide is absorbed.

Flower: the bloom or blossoms of the plant; the seed producing structure of a plant.

Seed pod: the fruit of plants like legumes containing many seeds.

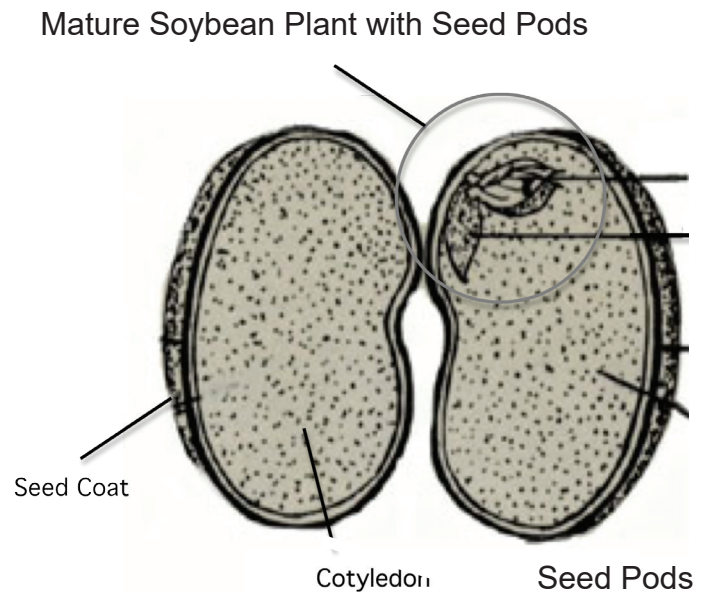
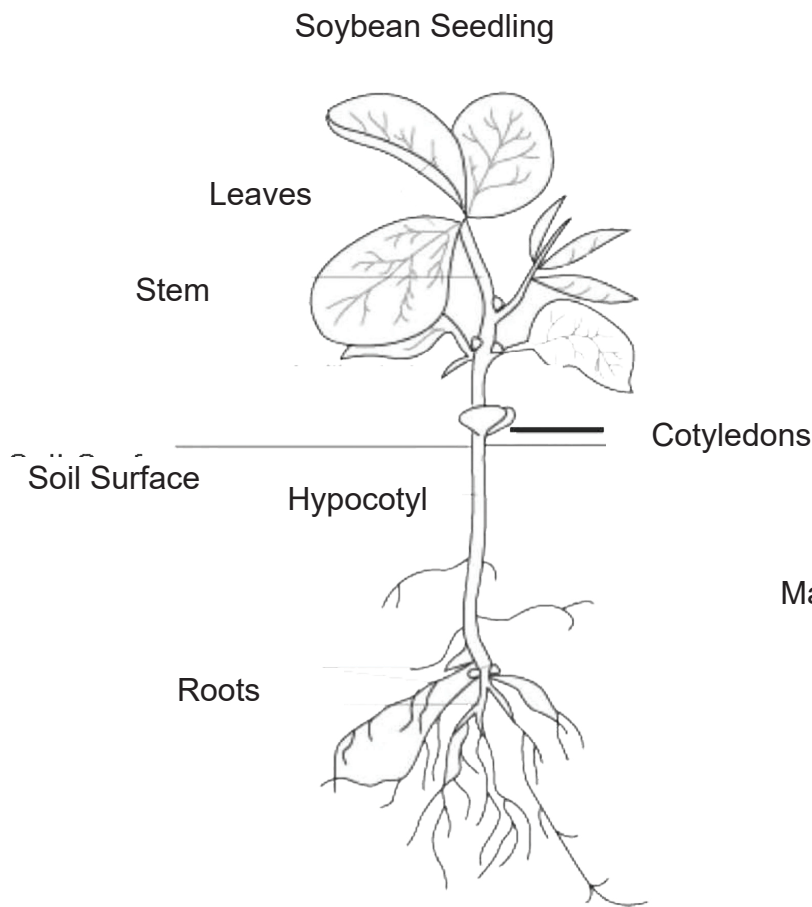
HO #1.2C & E

Fruit: a swollen mature flower (these are considered the fruits). Fruit normally contains stored energy and nutrients that help seeds grow during germination.

Germination: the process of an embryo emerging from its seed.

Hypocotyl: forms the stem below the cotyledon.

Cotyledon: while still in the seed, it stores food for the seedling; it becomes the first leaf or leaves that are developed by the seed.



Name: _____ Date: _____

Soybean Plant Growth Worksheet

For each part listed below, write in its function and label the part on either the soybean seedling or the mature soybean plant on the back. TWO of the parts listed below get labeled on the SAME part of the plant.

Soybean Plant Identification and Function

Germination (don't label):

Roots:

Stem:

Leaves:

Flower (don't need to label):

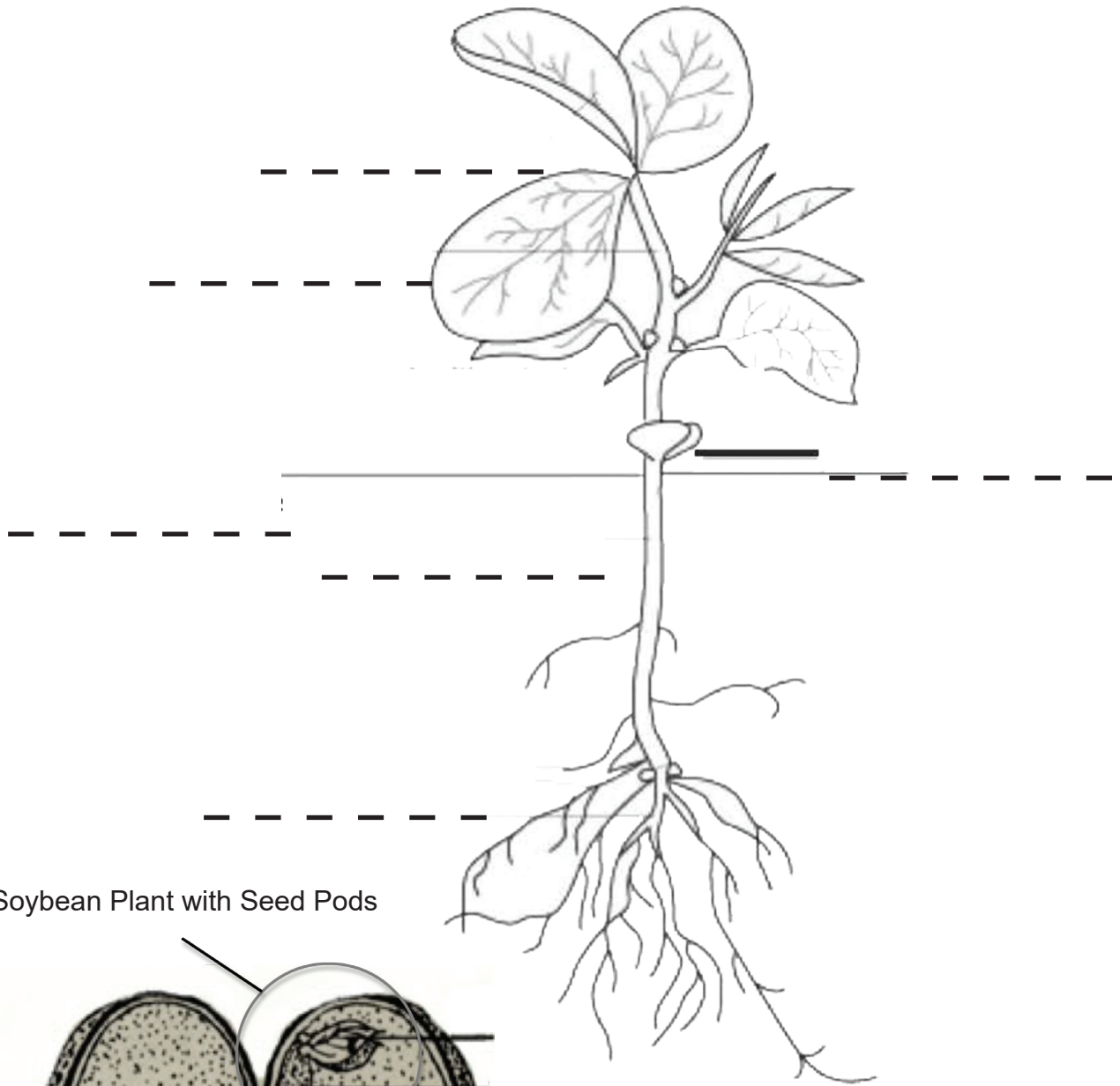
Seed pod:

Fruit:

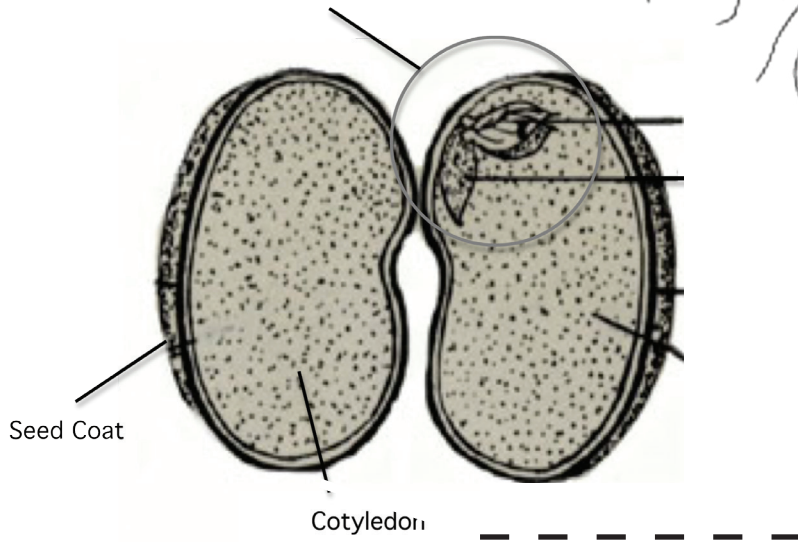
Hypocotyl:

Cotyledon:

Soybean Seedling



Mature Soybean Plant with Seed Pods



What Do Plants Need to Survive?

Purpose

- Students should understand that plants require certain conditions to grow and thrive.
- Students will utilize the scientific method.
- Students will analyze data with the use of charts and graphs.

GLCEs (continue on next page)

3rd - 4th Grade (Science)

- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate sense.
- S.IP.XX.12 Generate questions based on observations.
- S.IP.XX.13 Plan and conduct simple and fair investigations.
- S.IP.XX.16 Construct simple charts and graphs from data and observations.
- S.IA.XX.11 Summarize information from charts and graphs to answer scientific questions.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IA.XX.13 Communicate and present findings of observations and investigations.
- S.IA.XX.14 Develop research strategies and skills for information gathering and problem solving.
- S.RS.XX.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.RS.XX.14 Use data/samples as evidence to separate fact from opinion.
- S.RS.XX.15 Use evidence when communicating scientific ideas.

3rd Grade

- S.IP.03.14 Manipulate simple tools that aid observation and data collection (e.g., hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer).
- S.IP.03.15 Make accurate measurements with appropriate units (centimeters, meters, Celsius, grams, seconds, minutes) for the measurement tool.

4th Grade

- L.OL.04.15 Determine that plants require air, water, light and a source of energy and building material for growth and repair.

GLCEs (continued)

5th Grade

- S.IP.05.11 Generate scientific questions based on observations, investigations and research.
- S.IP.05.12 Design and conduct scientific investigations.
- S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
- S.IP.05.14 Use metric measurement devices in an investigation.
- S.IP.05.15 Construct charts and graphs from data and observations.
- S.IP.05.16 Identify patterns in data.
- S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.
- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.
- S.IA.05.14 Use metric measurement devices in an investigation.
- S.RS.05.15 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.RS.05.12 Describe limitations in personal and scientific knowledge.

Background

Plants use air, water, the energy from light, minerals and nutrients to grow, reproduce, and repair themselves. Soil is necessary for a few reasons. Soil contains the vital water and minerals roots absorb. Soil supports the plant and allows the plant to anchor its roots down. Decaying plants and animals leave behind minerals in the soil that are essential for plant growth. Plants also need sunlight to grow properly. They use light energy to change carbon dioxide and water into food substances via the process of photosynthesis (sugars or glucose). Without light, a green plant can't produce food.

Water is necessary for all life forms. In plants, water is a component required for photosynthesis, helps roots absorb nutrients in the soil, assists with the germination process and helps with the transpiration process. Transpiration is the loss of water and air directly from the leaves. Clean air is also a necessity; with it green plants take in carbon dioxide from air and use it during photosynthesis to make food. Without clean air, smog blocks sunlight. Without sufficient space, plants will be small and stunted, so plants need enough room to allow for all their roots and branches.

Soybeans are an annual plant, completing their life cycles in less than one year. They are planted in the spring and harvested in the fall. Many factors, other than time of year can affect the yield and germination rate of the seeds. Temperature, precipitation, disease or pests can help or hurt a soybean seed's ability to grow.

Activity

Experimenting to determine the requirements needed for a plant to survive.

Materials

- Soybean seeds
- Peat pellets
- Potting soil
- Metric ruler
- Lab Sheets HO #1.3B-C
- Scientific Method HO #1.3A
- Cups
- Theme 1 Power Point

Definitions

- **Control:** a sample in which a factor whose effect is being estimated is absent or is held constant, in order to provide a comparison.
- **Data:** evidence or facts.
- **Hypothesis:** an educated guess based on observations and your knowledge of the topic that can be tested by further investigation.
- **Scientific inquiry:** a process that is used to find answers to questions about the world around us.



Day One
(45 min.)

6 Additional
Observation Periods:

Repeat every 2-3 days for 14 days
(15-20 min. each)

Procedure 1.3

Note: This lesson requires using soybean plants that are **ALREADY** germinated; therefore, it's useful to do this one along with lesson 1.2.

Objective	Activity	Possible Responses/Notes	
DAY ONE			
*Use saved soybean plants from Racey Soys lesson plan 1.2.			
1	<p>Introduce students to requirements that plants need to grow and thrive</p> <p>Foster group discussion</p>	<p>Put students in small groups (2-3 people).</p> <p>Ask questions, solicit group discussion (approximately 5 minutes) and direct students to write down their group's answers.</p> <p>Q1 - What do plants need to grow and develop?</p> <p>Solicit group answers and record all answers on the board under list of Life Requirements.</p>	<p>Q1 Notes: Accept all answers.</p> <p>Don't acknowledge what's right or wrong at this point.</p> <p>Actual Life Requirements: air, water, energy from the sun, soil with nutrients, right temperatures, etc.</p>
2	<p>Establish baseline knowledge of life requirements for plants</p>	<p>Using a select number of answers from the students' lists of Life Requirements, ask questions and solicit feedback:</p> <p>Q1 - Has anyone seen what happens to a plant when it doesn't have [insert student guessed Life Requirement]?</p> <p>Q2 - What about [a different suggestion from the list]? Has anyone seen what happens when a plant doesn't have this?</p> <p>Q3 - What about soil? Has anyone seen what happens then? Can soys grow without soil? Hydroponic?</p>	

3	Introduce students to the problem statement	Q1 - What is essential for plant survival and what happens if plants get too much of these natural elements?	
4	Link students to the scientific method as a means for inference as to HOW, WHAT, WHEN and WHY?	<p>Introduce and define the scientific method as a means to find solutions to our class problem:</p> <p>Q1 - What is the scientific method?</p>	<p>Q1 Notes: A process that is used to find answers to questions about the world around us.</p> <p>Use the Scientific Method Sheet HO #1.3A as reference.</p>
5		<p>Direct students to return to pairings in Racey Soys lesson.</p> <p>Combine pairs to form groups of 4 students each.</p>	
6	Introduce the first step of the scientific method	<p>Introduce and define hypothesis.</p> <p>Give an example of a problem and a few hypothesis that could explain it.</p> <p>Problem: The class rabbit is getting much fatter lately.</p> <p>Possible hypothesis: The class pet is pregnant.</p> <p>Possible hypothesis: The janitor has also been feeding the class rabbit an extra helping of food each night.</p> <p>Instruct students that these are both our guesses for what is happening to the rabbit. We use the scientific inquiry to help us find out if one of them is right.</p>	<p>Hypothesis: an educated guess based on observations and your knowledge of the topic that can be tested by further investigation.</p>

7	Reviewing our problem statement	<p>Ask question and solicit feedback:</p> <p>Q1 - Who remembers what our problem is that we said we just found out about growing healthy plants?</p> <p>Restate the problem:</p> <p>"We have some ideas about what plants need to survive, but we don't know what really happens to a plant if they get too little or too much of those requirements."</p> <p>Instruct students to try to answer our problem statement, we are going to use the scientific inquiry to help us solve this, meaning we'll be doing an experiment.</p>	<p>Q1 Notes:</p> <p>"We have some ideas about what plants need to survive, but we don't know what really happens to a plant if they get too little or too much of those requirements."</p>
8	Provide examples of hypothesis for our problem statement	<p>Share examples of hypothesis for our problem:</p> <p>Soybean plants will turn yellow if they aren't given water.</p> <p>OR</p> <p>Soybean plants will keep growing leaves even if they are put in a closet.</p>	
9	Have students create hypothesis in response to the problem statement	<p>Direct and assist groups to come up with 1 hypothesis about soybean plants. Usually, you want to test for real life requirements so students can see changes (air, water, nutrients, minerals, space, temperatures, energy from the sun).</p> <p>Direct them to think about what will happen to the plant to assist formulation of hypothesis. Possible questions include: Will it change color? Keep growing tall? Stop growing? Will the roots shrink? Will the leaves fall off?</p> <p>Verify and approve each of the group hypothesis statements before moving on.</p>	<p>Examples can range from:</p> <p>Soybean plants can still grow in height even without water.</p> <p>Soybean plants will die without soil.</p> <p>Soybean plants will turn brown if they are put in a very small space.</p>

10	Introduce concept of data	Define data	Data: evidence or facts
11	Introduce concept of control	Define control Explain to the students that for one plant you will not change the natural requirements (control) and for the other plant (experimental plant) you will change the natural requirement that they are hypothesizing will have a changed effect.	Control: a sample in which a factor whose effect is being estimated is absent or is held constant in order to provide a comparison. SAVE 1 plant for each group (control), only experiment with 1 plant per group.
Follow-up every 2-3 days over next 2 weeks (a total of 6 times).			
12	Observation and data collection	At LEAST every 2-3 days, have the groups observe their plants to measure and record height (cm) from the top layer of soil to the tip of the tallest part of the plant.	
13	Recording data	Each observation period, direct student groups to record their observations of soybean growth on the Lab Sheet HO #1.3B. Students should fill in the date of the observation, the height of their plant and draw a detailed picture of what their plant looks like that day. Use colors if possible.	

14	Graphing data	<p>Each observation period, direct student groups to graph their plant's growth on the plant growth sheet HO #1.3C:</p> <p>First, have students decide on what progression in centimeters they are going to label the graph with (e.g., by one's, two's, five's, etc.)</p> <p>Direct them to fill in the row at the bottom of the chart using that progression starting from the left.</p> <p>Direct students to fill in the column on the right, from the bottom - up, with how many days it has been since the process began.</p> <p>For each observation period, direct students to draw a big dot on the point in the graph that corresponds with the number of days since the experiment began and height of the plant. At the end of the observation period, students can connect the dots to form a line.</p>	
15	Reference back to original problem statement	<p>Direct students to return to small groups from DAY 1.</p> <p>Write yesterday's problem statement on the board:</p> <p>"We have some ideas about what plants need to survive, but we don't know what really happens to a plant if they get too little or too much of those requirements."</p>	Reference back to original problem statement.

16	<p>Review concepts of hypothesis, data, scientific inquiry</p> <p>Determine students' memory of original concepts</p>	<p>Ask students and solicit feedback.</p> <p>Q1 - What is the process of scientific inquiry?</p> <p>Q2 - What would we use scientific inquiry for?</p> <p>Q3 - What is a hypothesis?</p> <p>Q4 - Can someone give me an example of a hypothesis for this problem:</p> <p>"There is water leaking from the ceiling."</p> <p>Q5 - What is data?</p>	<p>Accept answers near:</p> <p>Hypothesis: a process that is used to find answers to questions about the world around us.</p> <p>It is an educated guess based on observations and your knowledge of the topic that can be tested by further investigation.</p> <p>Answers vary but could be something like:</p> <p>It is raining and there is a leak.</p> <p>Data: evidence or facts.</p>
17	<p>Students gain experience collectively compiling data</p> <p>Foster positive group work skills</p> <p>Summarize findings</p> <p>Personalize learning experience</p>	<p>Direct groups to repeat their group hypothesis, ask questions and solicit responses within groups:</p> <p>Q1 - What patterns do you notice in your graphs?</p> <p>Q2 - What patterns do you notice about your charts?</p> <p>Q3 - When compared to your control plant, what differences or similarities do you notice?</p> <p>Q4 - What have you learned based on your observations and data that you recorded?</p>	<p>Answers will vary:</p> <p>Our plant grew at least a centimeter each observation period.</p> <p>Our plants took a long time to get yellow and then turned brown very quickly.</p> <p>We notice that our soybean plant's leaves are folded in more than the control plant.</p>
18	<p>Foster ability to make determinations about hypothesis based on data</p> <p>Foster equal group communication</p>	<p>Ask questions, direct discussion among groups:</p> <p>Q1 - Based on what your group found, do you think your hypothesis is true or false?</p> <p>Q2 - Is there any group that thinks they can't answer their hypothesis yet? Why?</p>	<p>Answers will vary.</p>

19	<p>Foster public speaking</p> <p>Foster skills of defending hypothesis based on evidence</p>	<p>Ask questions, record hypothesis is (true or false) on the board:</p> <p>Direct groups to share their hypothesis and whether they think their hypothesis is true or not using a few items of evidence they found.</p>	<p>Answers will vary.</p> <p>Example:</p> <p>Our hypothesis is that soybean plants will die if put in the closet.</p> <p>There are no more leaves on it, its stems are brown and break easily.</p>
20	Obtain some greater perspective on soybeans as a class	Summarize list of hypothesis noting if they were true or false.	<p>Answers can vary but should resemble something like:</p> <p>Our class found that soybean plants really need the right amount of air, water, nutrients, light, space and minerals to survive.</p>
21	Link new knowledge about soybean plants to further inquiry	<p>Ask questions and solicit feedback:</p> <p>Q1 - What additional experiments can we conduct to further test what we found about life requirements?</p>	Answers will vary.

Searchable Internet Questions

1. What equipment was used to plant and harvest soybeans from 1920 to present? Make a timeline.
2. How are soybeans stored?
3. Map out the path of soybeans from farmer to the dinner plate.

The Scientific Method

HO #1.3A

Ask Question

Do Background Research

Determine what information already exists about your question under inquiry.

Construct Hypothesis

Build upon your existing knowledge and/or prior research in formulating your "educated guess".

Test with an Experiment

Choose a specific procedure for testing your hypothesis and collect and record your data and observations while carrying it out. Make sure your procedure is something that could be repeated by others.

Collect Data

Analyze Results & Draw Conclusions

What do you notice about your data and observations? Do they support your hypothesis or not?

YES

NO

Hypothesis is TRUE

Hypothesis is FALSE or PARTIALLY TRUE

Report Results

Document your conclusions about your results.

Try Again



HO #1.3B

Name: _____ Date: _____

Racey Beans

Date	Height (cm)	Drawing of Plant

Name: _____ Date: _____

Title: _____

**N
U
M
B
E
R

o
f

c
m

T
A
L
L**

NUMBER of DAYS

Racey Soys!



*What are soybeans?
How do they grow and thrive?*

Parts of a Soybean Seed

- Seed
- Seed Coat
- Embryo
- Cotyledon
- Radicle



Background photo courtesy of @Makena Schultz

Use with Lesson 1.1

Seed



Q1 - What type of seeds are these?

Q2 - What part of the plant is the soybean?

Q3 - Why do plants have seeds?

Q4 - What do you think the inside of a seed will look like?

Q1 Notes:

Soybeans

Q2 Notes:

The soybean is the seed.

Seed: a fertilized and mature egg that contains a tiny plant that grows and develops when placed in an environment containing air, water and warmth.

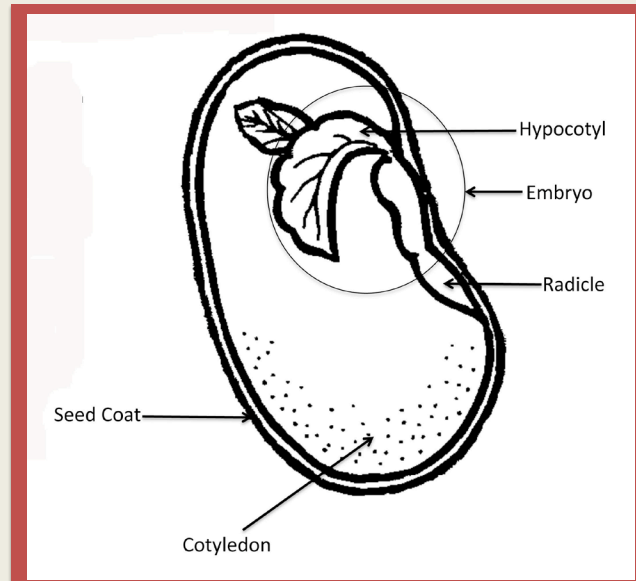
Q3 Notes:

Has an embryo (tiny plant) inside that can grow into the same plant it came from; it's the plant's way of ensuring its species lives on; the tiny plants inside can be carried other places to grow (by wind, water and animals).

Q4 Notes:

A tiny plant, food, etc.

What are these parts called?



Use with H.O. #1.1A

Outside:

Seed coat: a thin covering that protects the seed's embryo from insects, disease and damage.

Inside:

Embryo: a tiny plant.

Cotyledon: the part of the seed that stores food for the seedling. Each bean has a pair of cotyledons forming a protective shield around the seedling.

Radicle: the part of the embryo that forms the roots.

Hypocotyl: the part of the embryo that forms the stem.

Parts of a Soybean Plant

- Roots
- Stem
- Flower
- Fruit
- Leaves
- Seed Pod



Background photo courtesy of @Makena Schultz

Use with Lesson 1.2

Stem & Leaves



Use with Procedure Step 7

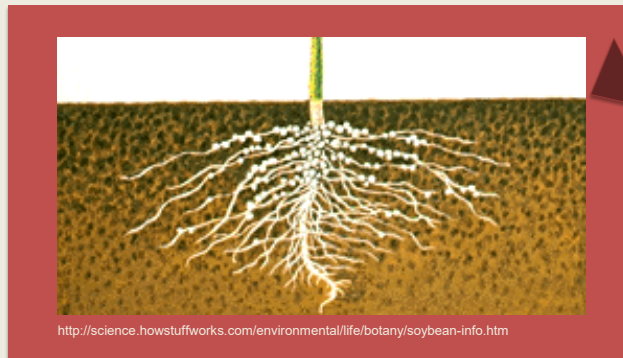
Q2 - What is the purpose of the [stem/leaves]?

Q3 - What are some things that would happen if the plant didn't have stem or leaves?

Stem: stalk; a slender or elongated structure that supports a plant and through which water, minerals and food are transported between the roots and the rest of the plant.

Leaves: major site of photosynthesis where plants use water and carbon dioxide to make food and release oxygen.

Roots



Procedure Step 9

Q1 - Do you think we can see the entire plant?

Q2 - If not, what can't be seen?

Q3 - What are the functions of the roots?

Q1 Notes:

No

Q2-3 Notes:

Roots: the usually underground part of a seed plant body that: transports water and minerals, stores sugars produced by the plant and anchors the plant into the ground.

Flower, Seed Pod & Fruit



Procedure Step 10

Q3 - What is the function of the flower on a soybean plant?

Q4 - What are the functions of the seed pods on a soybean plant?

Q3 Notes:

It will develop both flowers and seed pods.

Flower: the bloom or blossoms of the plant; the seed producing structure of a plant.

Q4 Notes:

Seed pod: the fruit of plants like legumes containing many seeds.

Procedure Step 11

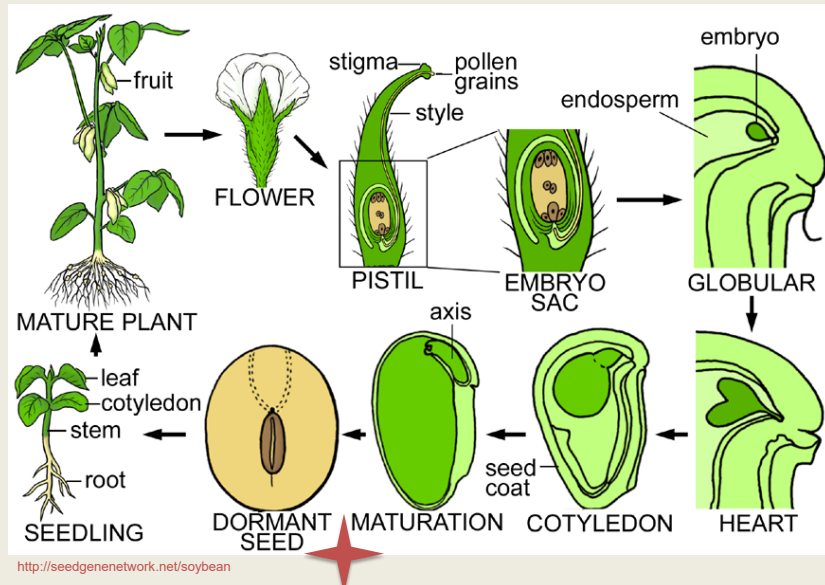
Q1 - What are some examples of fruits that you find in the grocery store? Explain that a seed pod is soybean's "fruit"?

Q1 Notes:

Fruit: a swollen mature flower (these are considered the fruits). Fruits normally contain stored energy and nutrients that helps seeds grow during germination.

Continue discussion by having students complete H.O. #1.2D.

Soy Plant Life Cycle

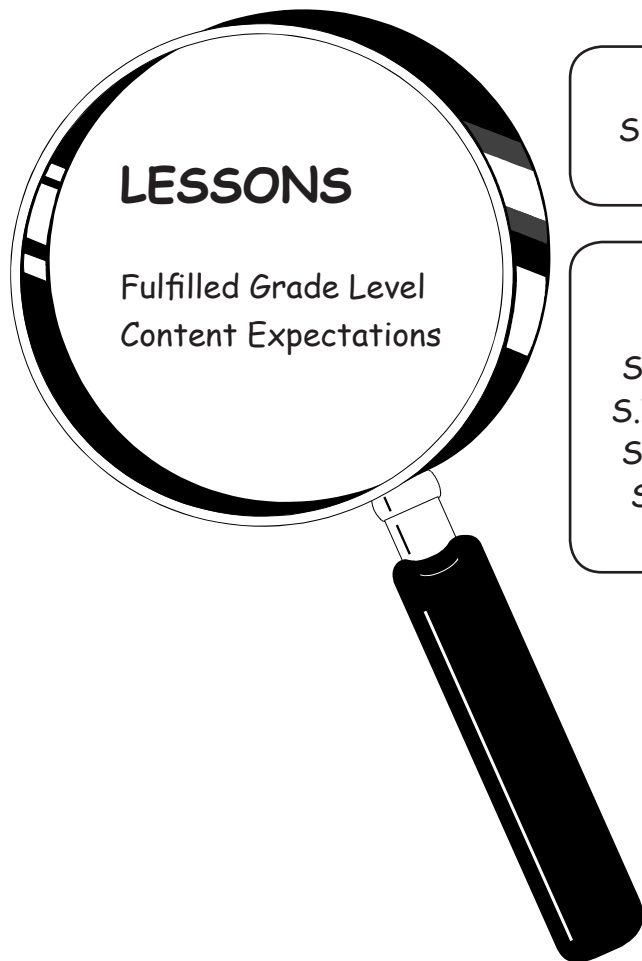


This is a chart showing the stages of a soybean plant's growth from dormant seed to mature flowering plant, then back to seed development.

Theme 2

Why Soybeans?

How do we use soybeans in our everyday lives?



Those Oily Chips!

S.IP.XX.11, S.IP.XX.13, S.IA.XX.12, S.IA.XX.13,
S.RS.XX.15, S.IA.05.13

Why Soybeans?

3-G4.0.1, 3-G5.0.1, 3-G5.0.2, S.IP.XX.II,
S.IP.XX.12, S.IP.XX.13, S.IP.XX.16, S.IA.XX.11,
S.IA.XX.12, S.IA.XX.13, S.IA.XX.14, S.RS.XX.11,
S.RS.XX.14, S.RS.XX.15, S.IP.05.11, S.IP.05.12,
S.IP.05.15, S.IP.05.16, S.IA.05.12, S.IA.05.13,
S.RS.05.12

Those Oily Chips!

Purpose

Link soybeans to students' lives and motivate students about exploring soybeans further.

GLCEs

3rd and 4th Grade (Science)

- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IP.XX.13 Plan and conduct simple and fair investigations.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IA.XX.13 Communicate and present findings of observations and investigations.
- S.RS.XX.15 Use evidence when communicating scientific ideas.

5th Grade

- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.

Background

Soybeans are a source of oil and protein, both of which can be used to produce hundreds of foods and other products. Soybean oil is widely used in cooking oil, biodiesel fuel, crayons, and printing ink. Take a look at the potato chip package provided. Notice that soybean oil was used to cook the chips. As an ingredient, soybean oil is commonly referred to by many names including: "vegetable oil" or "vegetable shortening."

Activity

Observe a common food item that contains a soybean product.

Materials

- Packaged potato chips
- Paper towels

30 min.

Procedure 2.1

	Objective	Activity	Possible Responses/Notes
1	Establish a baseline of prior soybean knowledge with your students	<p>Poll students:</p> <p>Who has eaten soybeans? Do you think soybeans would taste good?</p> <p>Ask questions, record student answers on the board and solicit responses:</p> <p>Q1 - Have any of you ever eaten soybeans before? (For those who have, find out when they have eaten soybeans and what they tasted like. For students that say they haven't had soybeans, find out what they think soybeans might taste like.)</p> <p>Q2 - If you had your choice to eat soybeans or potato chips, which would you choose?</p>	Answers will vary
2	Observe characteristics of a potato chip	<p>Hold up the bag of potato chips.</p> <p>Ask questions, record student answers on the board and solicit responses:</p> <p>Q1 - What do you think these chips are made of?</p>	<p>Q1 Notes: Potatoes Corn Kale Etc.</p> <p>Stress potato chips in this example.</p>
3	<p>Foster curiosity about a familiar food in students' lives</p> <p>Use charts for compiling information</p>	<p>Pair up the students and ask them the following question:</p> <p>Q1 - How do you think these chips are cooked?</p> <p>Direct paired students to write down their group answer.</p> <p>Invite the paired students to share their answers with the class. Record these on a class chart for students to see.</p>	Q1 Notes: Fried

4	Use a simple investigation to determine how the chips were cooked	Introduce the concept of conducting a small investigation to determine how the chips were cooked.	
5	Foster observation skills Foster positive group work Foster the use of using evidence to make conclusions	Place a chip on a paper towel for each pair. Residue will be left on the towel. Direct students to talk to their partner and use their senses to answer the following questions. Assist with the progression of these questions: Q1 - What do you see on the paper towel? Q2 - What happened to the paper towel when we put the chip on it? Q3 - How does this tell us how the chip was cooked? Q4 - What is the oil made from?	Q1 Notes: The paper towel is wet. Q2 Notes: The paper towel became wet from the oil from the chip. Q3 Notes: It tells us the chip was cooked (fried) in oil. Q4 Notes: Vegetable oil, probably from soybeans.
6	Foster the perspective of the greater class	Invite partners to share conclusions with the class. Q1 - What are your groups conclusions? Q2 - Were there different ideas about anything in your group? If there were different ideas, what were the differences about?	Answers will vary.
7	Confirm whether or not the group conclusions were accurate	Ask a pair to examine the label on the chips to confirm that it contains vegetable oil (or something similar).	
8		Explain to students that most chips are cooked by frying them and that most oils to fry chips are made from some kind of vegetable. Common oils include: canola oil, vegetable oil, soybean oil or even combinations of oils, etc.	

9	Foster use of senses to guide discussion	Invite students to eat chips. Direct students to think about how the chips taste and discuss with group for 3-5 minutes.	
10	Link a familiar food and its taste to containing a soy ingredient	Reference the initial polls. Ask questions and solicit responses. Q1 - What did the chips taste like? Q2 - Did the chips taste like soybeans? Q3 - Have your thoughts about eating soybeans changed at all? If so, how?	Answers will vary.

Extended Activity

Explore whether other chips are cooked with soy ingredients.

Extended Online Activities

1. *What is a company in Michigan that produces soy oil?*
Answers could include: American Soy Products Inc. (Saline, MI) or Zoye Oil by Zeeland Food Services Inc. (Zeeland, MI)
2. *About how many companies in Michigan make soybean oil?*
Seven
http://www.manta.com/mb_44_C304b_23/soybean_oil_mills/michigan
3. *About how many companies in the United States make soybean oil?*
145
http://www.manta.com/mb_34_C304B_000/soybean_oil_mills

Why Soybeans?

Purpose

1. Determine the role of soybeans in everyday products and classify such products into categories.
2. Analyze packaging labels.
3. Provide introduction to the Scientific Method.

GLCEs

3rd Grade (Social Science)

- 3-G4.0.1 Describe major kinds of economic activity in Michigan today (e.g., agriculture) and explain the factors influencing the location of these economic activities.
- 3-G5.0.1 Locate natural resources in Michigan and explain the consequences of their use.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.

3rd - 4th Grade (Science)

- S.RS.XX.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities.
- S.RS.XX.14 Use data/samples as evidence to separate fact from opinion.
- S.RS.XX.15 Use evidence when communicating scientific ideas.
- S.IP.XX.16 Construct simple charts and graphs from data and observations.
- S.IP.XX.11 Make purposeful observation of the natural world using the appropriate senses.
- S.IP.XX.12 Generate questions based on observations.
- S.IP.XX.13 Plan and conduct simple and fair investigations.
- S.IA.XX.11 Summarize information from charts and graphs to answer scientific questions.
- S.IA.XX.12 Share ideas about science through purposeful conversation in collaborative groups.
- S.IA.XX.13 Communicate and present findings of observations and investigations.
- S.IA.XX.14 Develop research strategies and skills for information gathering and problem solving.

5th Grade (Social Science)

- S.IP.05.11 Generate scientific questions based on observations, investigations and research.
- S.IP.05.12 Design and conduct scientific investigations.
- S.IP.05.15 Construct charts and graphs from data and observations.
- S.IP.05.16 Identify patterns in data.
- S.IA.05.12 Evaluate data, claims and personal knowledge through collaborative science discourse.
- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.
- S.RS.05.12 Describe limitations in personal and scientific knowledge.

Background

Soybeans are an important source of protein and oil that are used in food, animal feed, paint, ink and industrial applications all over the world. A 60-pound bushel of soybeans makes about 11 pounds of oil and 48 pounds of soybean meal (the ground up pulp).

Soybeans have the following additional ingredients, which are also used in a range of foods and products including: soy flour, soy lecithin (which is extracted from soybean oil) and soy fibers. There are hundreds, and perhaps thousands, of products in which soybeans are an ingredient. Soybeans are used to make products such as tofu and tempeh.

Soybean oil is used in margarine, mayonnaise, salad dressing, cooking oil and pharmaceuticals. Often soy cooking oil is sold at the grocery store labeled as "vegetable oil" or "vegetable shortening".

Soybean meal is a protein-rich food that can be refined and made into soy flour, soy concentrate or soy isolates. Soy flour can be used in baked goods; isolates can be used in high-protein drinks. Lecithin, extracted from soybean oil, can be used in pharmaceuticals and as a natural emulsifier in chocolate candy.

There is just as much diversity in the types of inedible products that soybeans are found in. Soybean oil can be found in such products as: cosmetics, herbicides, disinfectants and as an emulsifying agent in baked goods and candy. Soybean meal is used in everything from adhesive to antibiotics to plywood.

Activity

Examine common food and household products to determine their ingredients.

Materials

- Product labels
- Soybeans
- Venn Diagram Chart HO #2.2A
- Soybean Processing/Use Chart HO #2.2B
- Scientific Method HO #2.2C
- Worksheets HO #2.2D-E
- Theme 2 Power Point

Vocabulary

- Chart
- Data
- Graph
- Hypothesis
- Scientific inquiry

Day One
(45 min.)

Day Two
(45 min.)

Definitions

- **Chart:** a place to record data or observations.
- **Data:** evidence or facts.
- **Graph:** a diagram showing connections between data using dots, lines, etc.
- **Hypothesis:** an educated guess based on observations and your knowledge of the topic that can be tested by further investigation.
- **Scientific method:** a process that is used to find answers to questions about the world around us.



Procedure 2.2

Objective	Activity	Possible Responses/Notes
DAY ONE		
1	<p>Introduce students to think about what is in our daily food</p>	<p>Put students in small groups (2-3 people) and show the class the labels included (do NOT pass them out yet).</p> <p>Ask question, solicit group discussion of about 5 minutes and direct students to write down their group's answers:</p> <p>Q1 - What MIGHT these foods have in common?</p>
2	<p>Use Venn Diagrams to support observations</p>	<p>Solicit group answers and record answers.</p> <p>Have each group share with the class what they found.</p> <p>Use the Venn Diagram Chart HO #2.2A to record all groups' answers.</p>
3	<p>Introduce the concept of soybeans being in many foods</p>	<p>Pass out 2-3 labels per group (may need to make copies).</p> <p>Ask question, solicit group discussion of about 5 minutes and direct students to write down their group's answers:</p> <p>Q1 - Reading the labels, what product(s) do they all have in common?</p>
4	<p>Foster student observation skills</p> <p>Reference students back to their earlier guesses</p>	<p>As a class, come back to the class' initial guesses in the Venn Diagram. Was soybeans something that was included on the board?</p>

5	Establish a baseline of knowledge about the soybean	<p>Ask questions and solicit responses:</p> <p>Q1 - What is a soybean plant?</p> <p>Q2 - What does a soybean seed look like?</p> <p>If students haven't had contact with soybeans before through previous lessons, give small groups of students a soy to examine. Discuss its physical characteristics.</p>	<p>Q1 Note:</p> <p>A soybean plant is a legume, meaning it has seed pods and the seeds are edible. Soybeans may be yellow, green, brown, black or spotted. Other legumes include: peanuts, peas and green beans. Soybeans belong to a plant family called <i>Leguminosae</i>.</p>
6	Determine students' knowledge of foods containing soybeans	<p>Ask question, solicit responses and record them:</p> <p>Q1 - What kinds of foods have you eaten that contain soybeans?</p>	<p>Students may not know: Use list of soybean uses as a reference.</p>
7	Establish a baseline of soybean product knowledge prior to use of scientific method	<p>As a class, brainstorm a list of products that students think MIGHT have soybean products in them.</p>	<p>Answers vary: Record anything students suggest.</p>
8	Establish a baseline of knowledge about soybeans prior to activity of scientific method	<p>Ask questions, record some answers on the board and solicit comments:</p> <p>Q1 - What have we discovered about soybeans today?</p> <p>Q2 - How do humans use soybeans?</p> <p>Q3 - How often do you use something with soybeans in it?</p>	<p>Q1-3 Notes:</p> <p>Answers will vary, but could include: soybeans are found in foods and non-edible items. We sometimes eat soybeans in these products. Soybeans can appear as ingredients in various forms such as oil, protein, lecithin, etc.</p>
9	Link students to the scientific method as a means for obtaining answers about the world	<p>Introduce and define the scientific method.</p>	<p>Scientific method: a process that is used to find answers to questions about the world around us.</p>

10	Introduce the first step of the scientific method	<p>Introduce and define hypothesis.</p> <p>Give an example of a problem and a hypothesis.</p> <p>Problem: The teacher didn't wear shoes today.</p> <p>Possible hypothesis 1: The teacher forgot her shoes.</p> <p>Possible hypothesis 2: The teacher was running late and didn't have time to put them on.</p> <p>Possible hypothesis 3: The teacher broke the strap of her shoe walking to class.</p>	<p>Hypothesis: an educated guess based on observations and your knowledge of the topic that can be tested by further investigation.</p>
11	Determine our problem statement	<p>Restate that we have a problem.</p> <p>We know very little about how we use soybeans in our everyday lives.</p> <p>Share examples: Soybean ingredients are found in many types of cereals.</p> <p>OR</p> <p>Soybean ingredients can only be found in things we eat.</p>	
12	Foster student creation of hypothesis in response to the problem statement	<p>Direct and assist groups to come up with 1 hypothesis about soybeans.</p> <p>Personally approve hypothesis before moving on.</p> <p>**Make sure they are not too complicated; you want students to be able to find evidence of these products mostly at home OR the internet if they really have to.</p>	<p>Examples can range from:</p> <p>Soybean ingredients are not in dairy products (like milk or cheese).</p> <p>All foods have some kind of soybean ingredient in them.</p> <p>Soybean ingredients are found in frozen foods.</p>
13	Introduce concept of data	Introduce and define data.	<p>Data: evidence or facts.</p>

14	Foster data gathering	<p>Handout the homework sheet HO #2.2D.</p> <p>Direct students to write down their group's hypothesis on the top.</p> <p>Direct students to find data to support their hypothesis and help them solve the problem about our knowledge about soybeans.</p> <p>Direct them to find 5 items (at home preferably) that support their group's hypothesis.</p> <p>Tell students, if they need to, they can use the internet.</p>	<p>Examples:</p> <p>Hypothesis - soybean ingredients are found in frozen foods.</p> <p>Data can be:</p> <p>Frozen edamame</p> <p><i>Lean Cuisine</i>® frozen dinner</p> <p>Frozen pizza</p> <p><i>Hungry-Man</i> frozen dinner</p> <p><i>Banquet</i>® frozen dinner</p>
DAY TWO			
15	Reference back to previous day's problem statement	<p>Direct students to return to small groups from DAY ONE.</p> <p>Write yesterday's problem statement on the board:</p> <p>We know very little about how we use soybeans in our everyday lives.</p>	
16	Review concepts of hypothesis, data, scientific method	<p>Ask students and solicit feedback:</p> <p>Q1 - Who remembers what scientific method is?</p> <p>Q2 - What would we use scientific method for?</p> <p>Q3 - What is a hypothesis?</p> <p>Q4 - Can someone give me an example of a hypothesis for this problem:</p> <p>"There is water leaking from the ceiling."</p> <p>Q5 - What is data?</p>	<p>Accept answers that are close to:</p> <p>Scientific method: a process that is used to find answers to questions about the world around us.</p> <p>Hypothesis: an educated guess based on observations and your knowledge of the topic that can be tested by further investigation.</p> <p>Answers vary:</p> <p>It is raining and there is a leak.</p> <p>Data: evidence or facts.</p>

17	Foster collective data compilation Foster positive group work skills	Direct groups to repeat their group hypothesis and begin to share data found as a group. Direct students to fill out group worksheet HO #2.2E. Give them 8-10 minutes.	
18	Foster observation skills with data Foster equal group communication	Ask question, direct discussion among groups: Q1 - Looking at your list of items, do you notice any patterns at all? Any similarities? Or any differences?	Answers can vary. Example: We notice that there are lots of different types of frozen foods that we have as evidence such as pizza and TV dinners.
19	Foster ability to make determinations about hypothesis based on data Foster equal group communication	Ask questions, direct discussion among groups: Q1 - Based on what your group found last night, do you think your hypothesis is true or false? Q2 - Is there any group that thinks they can't answer their hypothesis yet?	Answers will vary.
20	Foster public speaking Foster defending hypothesis based on evidence	Record hypothesis and whether it's true on the board. Direct groups to share their hypothesis and whether they think their hypothesis is true or not using a few items of evidence they found.	Answers will vary. Example: Our hypothesis is that soybean ingredients are found in frozen foods. We think that our hypothesis is true because we found soybeans in things like: frozen edamame, frozen TV dinners and frozen pizza.
21	Foster greater perspective on soybeans as a class	Summarize list of hypothesis and whether they are true.	Answers can vary: Our class found that soybeans are found in lots of frozen foods, baby foods and even snack foods; however, there aren't any in milk or cheese.

22	Reference back to and expand upon initial knowledge about soybeans	<p>Direct students to return to questions of DAY ONE.</p> <p>Ask questions and solicit feedback:</p> <p>Think about your answers from yesterday to the following questions.</p> <p>Q1 - After your research, how would you answer these questions now?</p> <p>Q2 - What have we discovered about soybeans today?</p> <p>Q3 - How do humans use soybeans?</p> <p>Q4 - How often do you use something with soybeans in it?</p>	<p>Answer will vary: Humans use soybeans for various uses both edible and non-edible things.</p> <p>We use soybeans in our everyday lives.</p> <p>Ingredients will vary.</p>
23		<p>A comment about hypothesis: Scientists and researchers often find that their hypothesis was false, and in such cases they will construct a new hypothesis starting the entire process of the scientific method over again. Even if they find that their hypothesis was true, they may want to test it again in a new way.</p>	
24	Link new knowledge about soybean uses to where they come from	<p>Ask questions and solicit comments:</p> <p>Q1 - Does anyone know where soybeans currently grow?</p>	<p>Acceptable answers can include: United States, Michigan, China, Brazil, Argentina.</p>

25	<p>Link new knowledge about soybean uses directly to Michigan</p> <p>Identify Michigan as a significant producer of soybeans</p> <p>Identify the impact Michigan's soybean production has on our economy, the country and internationally</p>	<p>Instruct students:</p> <p>Michigan grows many different types of agricultural products and soybeans are the top third product grown by Michigan farmers. The climate here in Michigan has created a very good place for soybeans to be grown, and companies have found many uses for this product that generate a lot of money for the state and the people that live here. People spend a lot of money in our country and even outside the country everyday on these products and help our state.</p>	
----	---	---	--

Extended Activity

Make a soybean collage. Show students the page of soybean uses so they can locate pictures of products containing soybeans in magazines and newspapers. They can also use labels from products found at home.

Extended Online Activities

1. *What part of the soybean do animals consume?*

"The high-protein fiber (that which remains after processing has removed the oil) is toasted and prepared into animal feed for poultry, pork, cattle, other farm animals and pets. The poultry and swine industries are major consumers of soybean meal. Over half of the soybeans processed for livestock feed are fed to poultry, about one-quarter is fed to swine and the rest is used for beef cattle, dairy cattle and pet food." - North Carolina Soybean Producers Association

<http://www.ncsoy.org/ABOUT-SOYBEANS/Uses-of-Soybeans.aspx>

2. *Which animals consume the most soybean meal?*

Swine & Poultry

http://www.growinginagriculture.com/index.php?option=com_content&task=view&id=125



3. *What are the potential health benefits of consuming soy?*

Answers could include: heart health, bone strength, decrease menopause symptoms, source of fiber, prostate problem prevention, reduce effects of endometriosis.

http://www.healthcastle.com/herb_soy.html

<http://www.womentowomen.com/healthynutrition/healthbenefitsofsoy.aspx>

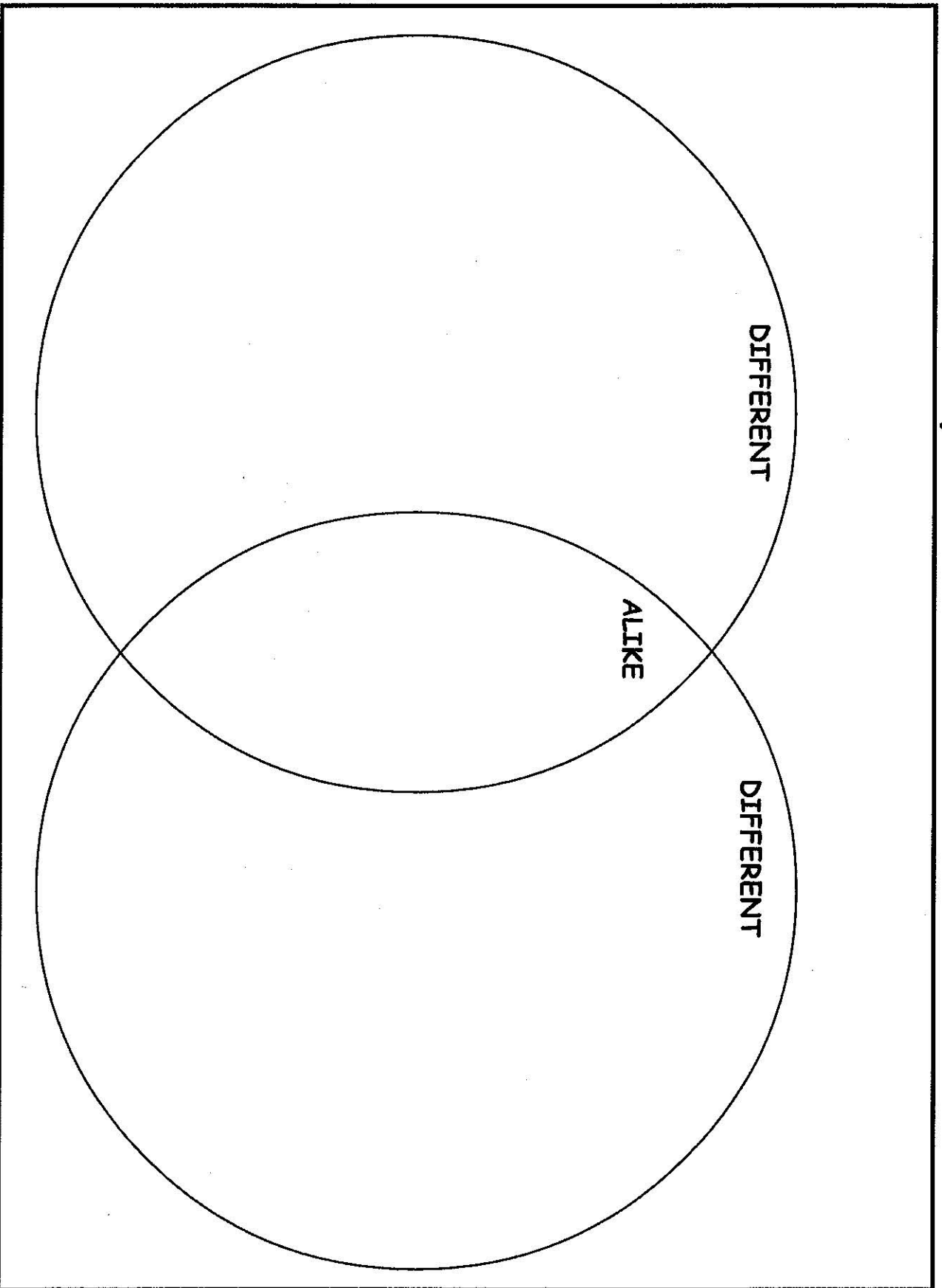
http://astronutrition.com/blog/5_health_benefits_eating_soy

<http://www.umm.edu/altmed/articles/soy-000326.htm>

http://www.nutritionmd.org/nutrition_tips/nutrition_tips_understand_foods/soy_benefits.html

Compare and Contrast Chart

(Venn Diagram Chart)



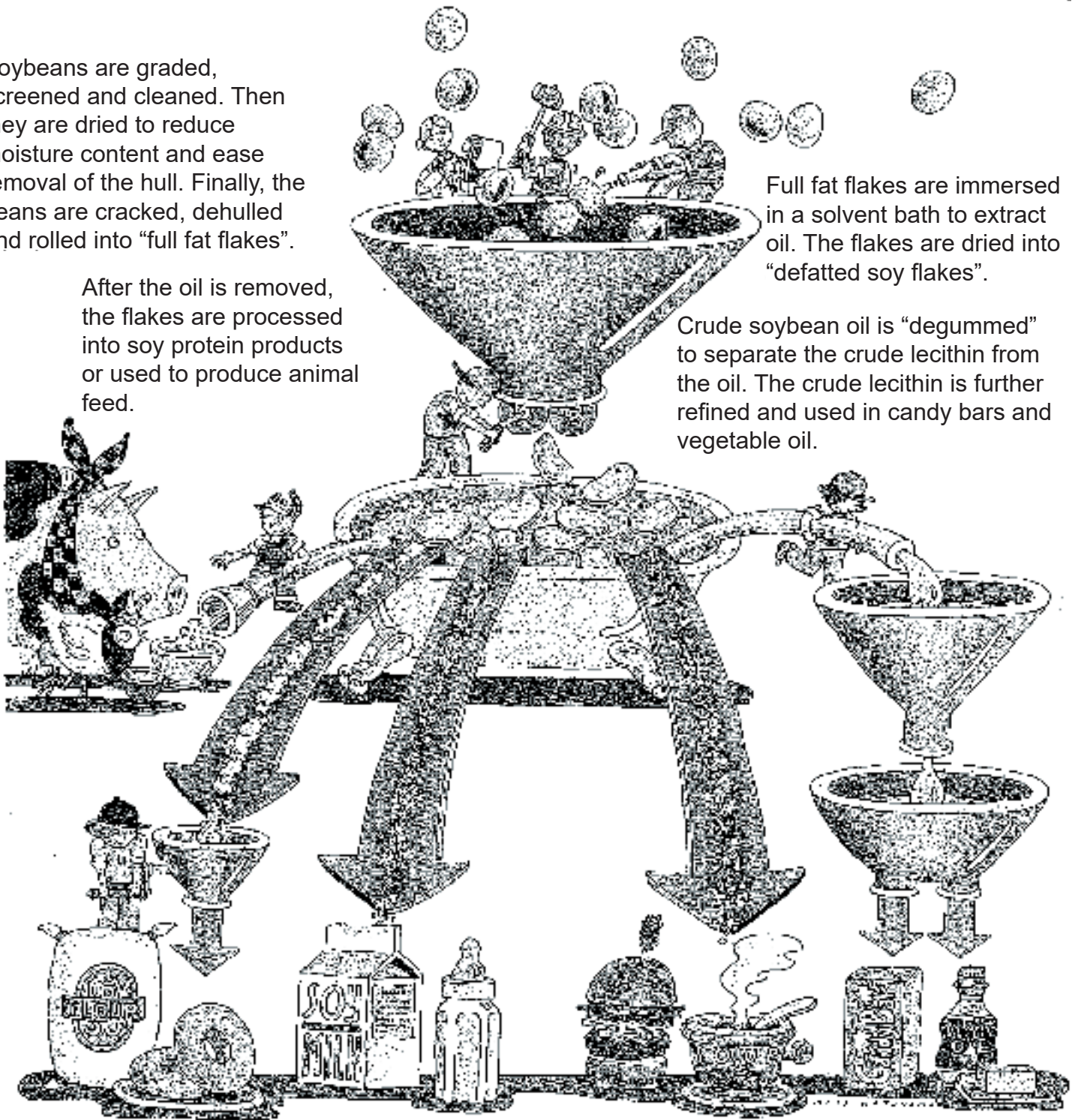
How the Soybean is Processed

Soybeans are graded, screened and cleaned. Then they are dried to reduce moisture content and ease removal of the hull. Finally, the beans are cracked, dehulled and rolled into "full fat flakes".

After the oil is removed, the flakes are processed into soy protein products or used to produce animal feed.

Full fat flakes are immersed in a solvent bath to extract oil. The flakes are dried into "defatted soy flakes".

Crude soybean oil is "degummed" to separate the crude lecithin from the oil. The crude lecithin is further refined and used in candy bars and vegetable oil.



Defatted soy flakes are made into soy protein products including soy flour, soy concentrates and soy isolates.

A Short List of Soybean Uses

SOYBEAN OIL PRODUCTS

Edible Uses:

Bakery products
 Candy products
 Chocolate coatings
 Coffee whiteners
 Cooking oils
 Creamers
 Filled milks
 Liquid shortening
 Margarine
 Mayonnaise
 Medicines
 Salad dressings
 Sandwich spreads
 Vegetable shortening

Technical Uses:

Alcohol manufacturing
 Anti-foam agent
 Caulking compounds
 Cosmetics
 Disinfectants
 Electrical insulation
 Emulsifying agent
 Insecticides/herbicides
 Medical use
 Paint manufacturing
 Pesticides
 Printing inks
 Protective coatings
 Putty soap

Technical Uses continued:

Rubber manufacturing
 Stabilizing agent
 Wallboard manufacturing
 Waterproof cement
 Yeast manufacturing

SOYBEAN MEAL PRODUCTS

Edible Uses:

Antibiotics
 Baby food
 Bakery ingredients
 Beer and ale
 Candy products
 Cereals
 Confections
 Food drinks
 Hypo-allergenic milk
 Meat products
 Noodles
 Prepared mixes
 Special diet foods
 Yeast

Feed Uses:

Calf milk replacers
 Fish food
 Livestock and poultry feeds
 Pet foods
 Protein concentrates

Industrial Uses:

Adhesive
 Insecticide sprays
 Linoleum backing
 Paint
 Particle board
 Plywood

SOYBEAN FLOUR

Bread
 Candy
 Doughnut mix
 Frozen desserts
 Instant milk drinks
 Pan grease extender
 Pancake flour
 Pie crust
 Sweet goods

ROASTED SOYBEANS

Candy ingredients
 Confection
 Cookie ingredient
 Crackers
 Dietary items
 Fountain topping
 Soy coffee
 Soynut butter

SOYBEAN DERIVATIVES

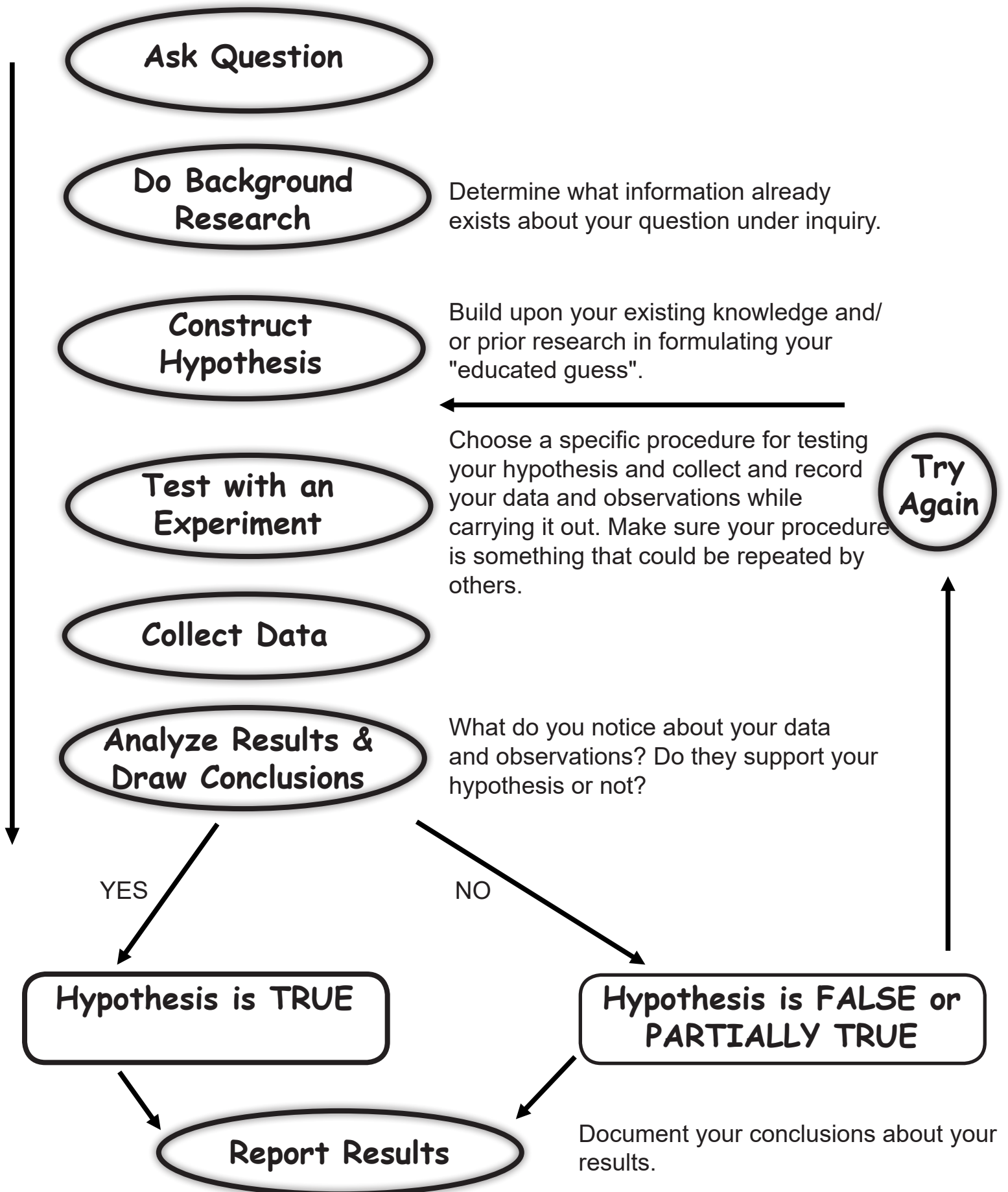
Soy sauce
 Tempeh
 Tofu

WHOLE SOYBEAN PRODUCTS

Baked soybeans
 Seed soy sprouts
 Stock feeds

The Scientific Method

HO #2.2C



HO #2.2D HOMEWORK SHEET

Name: _____ Date: _____

Get a clue about the things in your home made from SOYBEANS.

Your Group's HYPOTHESIS:

**Find at least 5 items in your home (or online if needed) to be your EVIDENCE/DATA.
Write the name of each specific item:**

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11

12.

HO #2.2E

Your Group's HYPOTHESIS:

Your group's EVIDENCE/DATA. Write the name of each specific item:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.

Why Soybeans?



How do we use soybeans in our everyday lives?

What do all these products have in common?



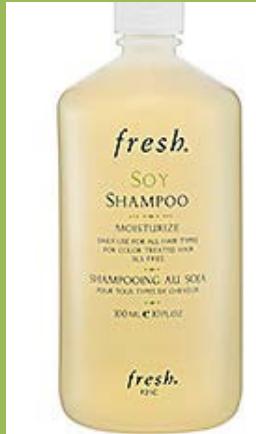
Use with Lessons 2.1 & 2.2



http://i-cdn.apartmenttherapy.com/images/kitchen/2008_04_16-Edamame.jpg



http://i3.getstatic.com/images?i=tbln:ANd9GoB1MYBtIS5FUR9GKB5oDnIRixh0DIEFGK34Kv5Wv_pov5kran9-UL9oOILXA



<http://www.fresh.com/haicare/shampoo/soy-shampoo?gclid=CKy9u7qx6wCFUJrkGod1W44nA>



<http://www.dnsmcibased.ca/images/Bio-Based%20Fluids.png>



<http://www.mojoprint.pl/images/soy-inks.jpg>



http://www.brandsoftheworld.com/sites/default/files/styles/logo-thumbnail/public/082010/Printed_with_Soy_Ink_edit-



http://www.patentbaristas.com/wp/wp-content/uploads/2010/07/soy_meal.jpg

Soybeans!



Theme 3

Where has the Soybean Been?

How do people from diverse cultures use soybeans?



LESSONS

Fulfilled Grade Level
Content Expectations

Contributions of Scientists Made Through Soybeans

3-H3.0.1, 3-H3.0.8, 3-G5.0.2, S.RS.03.19,
S.RS.04.19, S.RS.05.19

Contributions of Scientists Made Through Soybeans

Purpose

1. Locate where the soybean originated.
2. Understand how soybeans have been used in different countries.
3. Develop an awareness of the contributions made to science by people of diverse backgrounds around the world.

GLCEs

3rd Grade

- 3-H3.0.1 Identify questions historians ask in examining the past in Michigan.
- 3-H3.0.8 Use case studies or stories to describe how the ideas or actions of individuals affected the history of Michigan.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.

3rd and 4th Grade (Science)

- S.RS.XX.19 Describe how people have contributed to science throughout history and across cultures.

5th Grade

- S.RS.05.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

Activity

Research the lives and accomplishments of prominent scientists.

Materials

- *SoyNews*
- World Map HO #3.1A
- Worksheets HO #3.1B-C
- Theme 3 Power Point

Vocabulary

- Agriscientist
- Physician
- Scientific researcher

Day One
45-50 min.

Background

Soybeans originated in Asia; farmers in China have been producing soybeans for over 5,000 years. Aside from food, the Chinese also used soybeans for fertilizer, animal feed, medicines and oils. The soybean first entered America between the late 1700's and early 1800's and was produced for feeding both people and animals. For example, during the Civil War, a coffee substitute made from roasted soybeans was used in place of the scarce coffee beans (called coffee berries).

Today, the leading producers of soybeans respectively are Brazil, America and Argentina. The top places importing them include: China, the European Union, Japan and Mexico. This list differs slightly from the top soybean consumers, which include: America, Brazil, Argentina and China.

George Washington Carver and Percy Lavon Julian were both African-American scientists who contributed significantly towards soybean advancements despite facing great adversity. Washington Carver (born in 1864) and his mother were kidnapped by Confederates when he was an infant. Fortunately, Carver was later rescued and raised by an African-American farmer and his wife. George Washington Carver became an agriscientist. In addition to discovering that soybeans are a significant source of protein and oil, he used soybeans in creating soymeal, a coffee substitute and breakfast foods. He also saw the soybean and other agricultural crops as being useful for industry, such as the automobile industry.

Percy Lavon Julian (born in 1899) also faced hardship. He had little formal schooling due to the limited educational access for African-Americans. However, due to his parents' strong belief in education, Julian received sufficient informal educational experiences to be accepted as a student to DePauw University. He became a researcher and physician who used soybeans for medical-related inventions like a synthetic version of cortisone. This was incredibly beneficial for relieving the pain of rheumatoid arthritis and was drastically cheaper than real cortisone, making it accessible to the general public. Later, Julian invented aero-foam, a flame retardant that was used considerably by the Navy in World War II.

Definitions

- **Agriscientist** (agricultural scientist): a scientist researching the science of agriculture.
- **Physician**: a person trained in the art of healing, such as a doctor of medicine.
- **Scientific researcher**: someone that proposes hypothesis as explanations of phenomena, and design experimental studies to test these hypothesis via predictions.

Procedure 3.1

Objective	Procedure	Possible Responses/Notes
DAY ONE		
1	Foster reading skills	Assign <i>SoyNews</i> "Where has the Bean Been?" for homework or as a pre-reading assignment
DAY TWO		
2	Process critical points from the article	<p>Class discussion about the <i>SoyNews</i> article "Where's the Bean Been?" Direct students to refer to their copies.</p> <p>Ask questions, record answers on the board and solicit responses:</p> <p>Q1 - What were some key points in the article that you didn't know before you read it for homework?</p> <p>Q2 - What was the main point of the article?</p>
3	Understand the distance the soybean has traveled	<p>Pull out the world map and post up for the class to see (either HO #3.1A, a globe, or a large world map).</p> <p>Ask questions, record answers on the board and solicit responses:</p> <p>Q1 - What countries were mentioned in the article?</p> <p>Q2 - Which of those countries mentioned is the furthest away from Michigan?</p>

4	<p>Connect U.S. soybean use with similar use worldwide</p>	<p>Ask questions, record answers on the board and solicit responses:</p> <p>Q1 - How has soybean use changed since they originated in the U.S.?</p> <p>Q2 - Do you think soybeans are the only product that we eat and use here that didn't originally come from our country?</p> <p>Q3 - If not, what other types of products do we consume that are originally from other places in the world?</p> <p>Brainstorm for 1-2 minutes of foods that are incorporated into our American culture.</p>	<p>Q1 Notes: From article, uses included: food, medicine, livestock feed, protein replacement (for vegetarians).</p> <p>So the answer is: They have not changed and are used for similar goods.</p> <p>Q2 Notes: No</p> <p>Q3 Notes: Tortillas, sushi, spaghetti, certain spices (saffron, etc.)</p>
5	<p>Make the connection of global inventions to specific soybean inventions</p> <p>Introduce new career concepts</p>	<p>Write a T-Chart on the board labeled "Then" and "Now".</p> <p>Instruct students they will be reading about two men that invented different things made from soybeans here in the U.S. Instruct students that both of these men were African-American. Percy Lavon Jackson was born in 1899. George Washington Carver was born in 1864 (while the Civil War and slavery were still going on).</p> <p>Ask questions, record answers on the board and solicit responses:</p> <p>Q1 - Percy Lavon Jackson was a researcher and a physician. Describe the duties of a researcher and a physician.</p> <p>Q2 - George Washington Carver was an agricultural scientist (or an agriscientist for short). What do you think an agriscientist studies?</p>	<p>Concepts from article:</p> <p>Scientific researcher: someone that proposes hypothesis as explanations of phenomena and design experimental studies to test these hypothesis via predictions.</p> <p>Physician: a person trained in the art of healing, such as a doctor of medicine.</p> <p>Agriscientist (agricultural scientist): a scientist researching the science of agriculture.</p>

6	Understand the impact of these scientists' work	<p>Ask questions, record answers on the board and solicit responses:</p> <p>Q1 - What was it like for African-Americans in the U.S. during the century these two men were born and raised?</p> <p>Q2 - What is society like for African-Americans today and what are some examples?</p> <p>Summarize differences on T-Chart.</p>	<p>Answers vary:</p> <p>One grew up as slavery was ending and both grew up prior to the Civil Rights Movement. These men lived most of their lives in a time period when African-Americans were treated poorly and denied the same rights in every aspect as other Americans (education, job opportunities, etc.)</p>
7		<p>Divide the class into two groups for reading (silently at their own seats) from <i>SoyNews</i>. One group will read about George Washington Carver and the other about Percy Lavon Julian.</p> <p>Instruct students as they read to refer to the previous class discussion.</p>	
8		<p>Once they have completed the readings, pass out HO #3.1B and give students 8-12 minutes to read and fill out their handouts.</p>	

Extended Activities

1. Coordinate a World Feast Day. Either students, parents or teachers prepare foods made from soybeans (and other dishes) that originate from diverse countries. Following the meal, students could present reports on different people who might have prepared the food they brought.
2. Break the students into cooperative groups. Have them select a recipe from the *SoyNews* section: "Cookin' Around the World..." to prepare for a tasting party. Assign students in the groups to bring the necessary food items and eating utensils. The group should also prepare a summary of the origin of their food product.

Extended Online Activities

1. *Michigan exports soybeans to which countries?*
Mexico, European Union, India, Eastern Europe, Japan, Taiwan, Commonwealth of Independent States (former Soviet Republics)

"The Michigan Department of Agriculture and Rural Development said growth in the state's soybean exports in 2010 was particularly dramatic, raising more than 40 percent from 2009. Soybeans and soybean products represent

the largest sector of Michigan's 2010 exports and reached \$588.7 million followed by feed and grain exports which totaled \$276.3 million; and wheat and wheat by-products, like flour, at \$194.3 million."

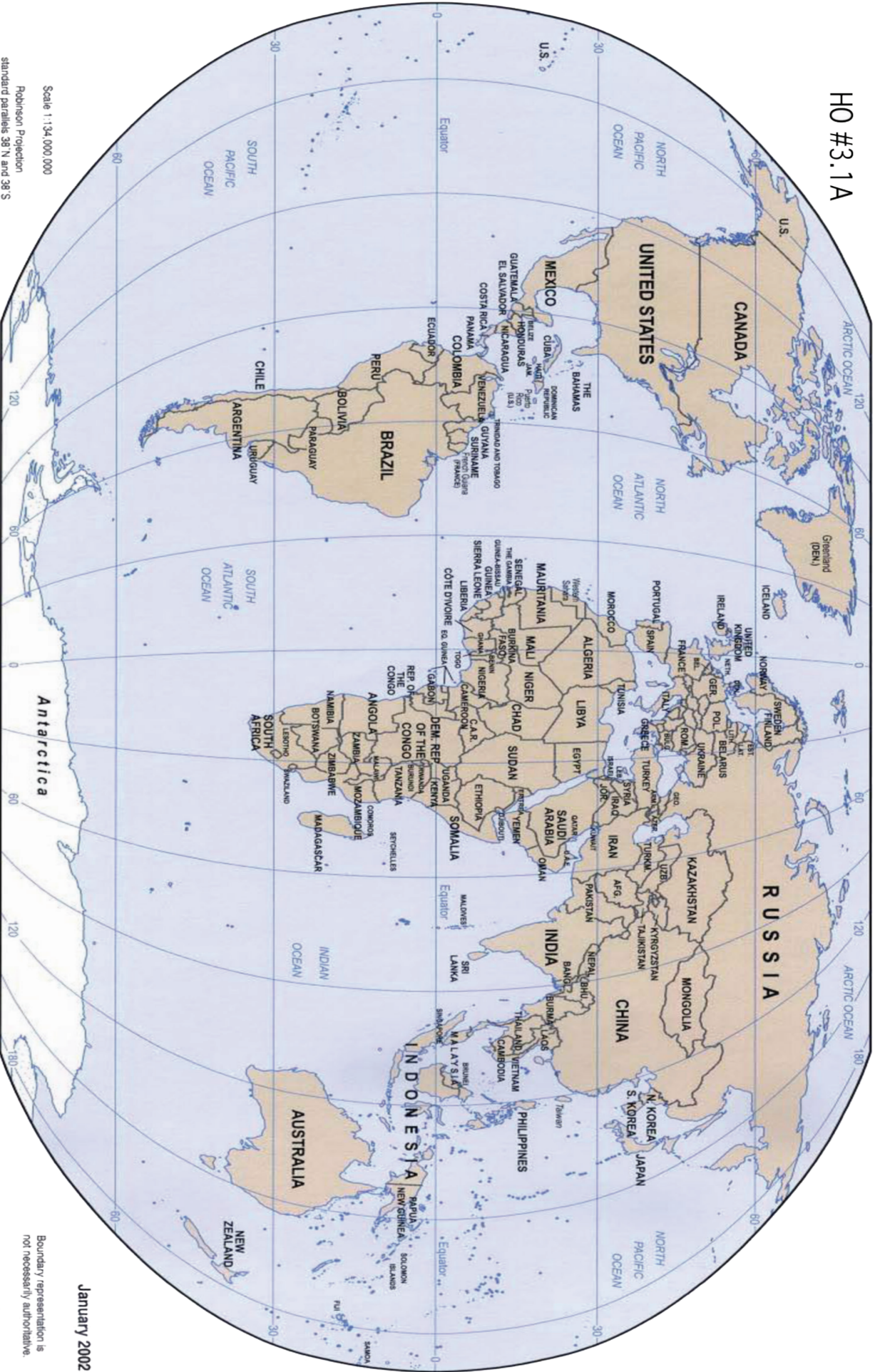
<http://www.craigslist.com/article/20110807/SUB01/30807997/michigan-briefs-soybeans-feed-states-agricultural-export-growth#>

2. *Countries are using imported soybeans for what uses?*

Answers could include: meal, oil, animal feed, flour, tofu, soy milk, yogurts, lecithin, biodiesel, soy methyl esters, ink, plastics, solvent, grease, hydraulic oil, etc.



HO #3.1A



Scale 1:1,34,000,000

Robinson Projection
standard parallels 38° N and 38° S

January 2002

Boundary representation is
not necessarily authoritative.

8028044A (R00352) 12-01

Name: _____ Date: _____

**Profiles of Two African Americans:
Scientist Percy Lavon Julian and Agriscientist George Washington Carver**

Write one paragraph of the scientist that you read about as if you were writing a newspaper article about him and his work on soybeans. Choose one of the following ways to write your article and support it with **examples**.

Here are some ideas:

1. Write an article for your local community newspaper celebrating the work of one of these scientists.
2. Write what you personally think of the inventions this scientist developed, and if possible, which ones you use (or would like to use) today.
3. Pretend the scientist is still living and you have the opportunity to interview him. Write 3-4 questions you would ask him and why you chose those questions.

FACTS ABOUT AFRICAN-AMERICAN HISTORY

George Washington Carver (born in 1864)

About 90% (or 9 out of every 10 African-Americans) in the United States at this time were enslaved. The few that were free generally lived in northern states.

Slave children were usually forced to start working for their owners when they were 3 or 4 years old. They were not given any formal education. Adult slaves could not vote and could be sold by their master to another slave owner at any time.

The Civil War started in 1861 and ended in 1865. The Emancipation Proclamation declared that slavery was illegal, however, it wasn't until the 13th Amendment was ratified in 1865 that it was officially illegal to own slaves.

There were very few laws to protect slaves. This meant that slave owners could treat their slaves however they wanted. There were many slave owners who were very cruel to their slaves.

One of the reasons that the Civil War broke out between the northern states and southern states was disagreement about slavery.

Percy Lavon Jackson (born in 1899)

African-Americans were realizing that in the South, even though they were free, they were still being trapped into things that were only slightly better than slavery, like share-cropping. To get away, between 1910-1960, millions of African-Americans moved north.

In 1945, Jackie Robinson was the first African-American to be able to sign a contract with a major baseball team. He played his first professional game in 1947.

The Harlem Renaissance was an exciting time in the 1920's and early 30's. There were many African-American artists, musicians and writers gathering in Harlem, New York to share their work.

There is still on-going violence against African-Americans throughout the country.

Where has The Soybean Been?



How do people from diverse cultures use soybeans?

Asia



<http://www.iike2learn.com/like2learn/Continent%20Maps/maps/AsiaPolitical.Large.gif>

Background:

"Soybeans originated in Asia; farmers in China have been producing soybeans for over 5,000 years. Aside from food, the Chinese also used soybeans for fertilizer, animal feed, medicines and oils. The soybean first entered America between the late 1700's and early 1800's and was produced for feeding both people and animals. For example, during the Civil War, a coffee substitute made from roasted soybeans was used in place of the scarce coffee beans (called coffee berries)."

Use with discussion in Procedure 3.1 Step 2.

Countries from the article



3.1 Procedure Step 3

- Q1 - What countries were mentioned in the article?
 Q2 - Which of those countries mentioned is the furthest away from Michigan?

Q1 Notes:
 China, Japan, Holland, America

Measure the distance from the state capitol of Lansing to the capitol of each country.

From Lansing, Michigan to:
 Amsterdam, Holland 3,964.8 miles
 Beijing, China 6,473.2 miles
 Tokyo, Japan 6,356.1 miles

Soybeans in the U.S.



http://www.indianagrains.com/media/images/blog_entries/243.jpg

3.1

Procedure Step 4

Q1 - How has soybean use changed since they originated in the U.S.?

Q2 - Do you think soybeans are the only product that we eat and use here that didn't originally come from our country?

Q3 - If not, what other types of products do we consume?

Q1 Notes:

From the article, soybean uses included: food, medicine, livestock feed, protein replacement (for vegetarians).

So the answer is: They have not changed and are used for similar goods.

Q2 Notes:

No

Q3 Note:

Tortillas, sushi, spaghetti, certain spices (saffron, etc.)

Percy Lavon Jackson



http://jameslogancourier.org/media/1/20070401-150px-Percy_Lavon_Julian.jpg

3.1

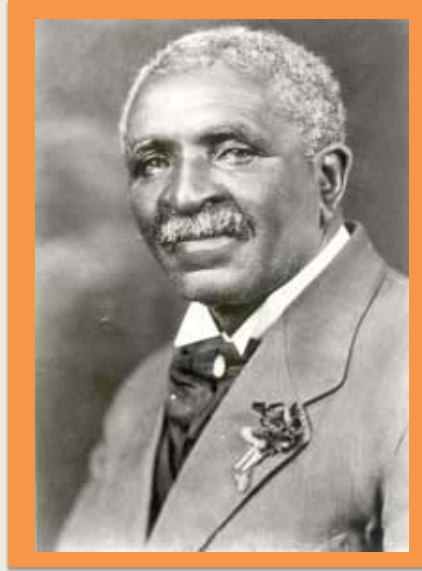
Procedure Step 5

Q1 - Percy Lavon Jackson was a researcher and a physician. Describe the duties of a researcher and a physician.

Scientific researcher: someone that proposes hypothesis as explanations of phenomena, and design experimental studies to test these hypothesis via predictions.

Physician: a person trained in the art of healing, such as a doctor of medicine.

George Washington Carver



http://shs.umsystem.edu/famousmissourians/scientists/carver/images/12_007806_thumb.jpg

3.1 Procedure Step 5

Q2 - *George Washington Carver* was an agricultural scientist (or an agriscientist for short). What do you think an agriscientist studies?

Agriscientist (agricultural scientist): a scientist researching the science of agriculture.

Theme 4

Can the Golden Bean be "Green"?

How do advancements in technology afford us different choices about the environment?



LESSONS

Fulfilled Grade Level
Content Expectations

Beans Give Gas: Soy Biodiesel Fuel

3-G5.0.2, 3-P3.1.1, S.RS.03.16, S.RS.03.17, S.RS.03.18,
E.ES.03.41, E.ES.03.41, E.ES.03.42, E.ES.03.43,
E.SE.03.32, 4-G5.0.1, 4-P3.1.1, S.RS.04.16, S.RS.04.17,
S.RS.04.18

Growing a Car

E.SE.03.31, E.ES.03.41, E.ES.03.42, S.RS.03.16,
S.RS.03.17, S.RS.03.18, S.RS.03.19, 3-H3.0.1,
3-H3.0.8, 3-G4.0.1, 3-G5.0.1, 3-G5.0.2, 3-E1.0.3,
S.RS.04.16, S.RS.04.17, S.RS.04.18, S.RS.04.19,
4-H3.0.3, S.RS.05.17, S.RS.05.19

A Line Up For Henry Ford's Assembly Line

3-H3.0.1, 3-H3.0.8, 3-G4.0.1, 3-G5.0.2,
3-E1.0.3, 3-E1.0.4, 3-E1.0.5, S.RS.03.19,
E.ES.03.41, E.ES.03.42, 4-E1.0.2, 4-E1.0.5,
4-E1.0.6, S.RS.05.19

Beans Give Gas: Soy Biodiesel Fuel

Purpose

1. Stimulate awareness for the need to use renewable fuels.
2. Observe technology's role in helping to reduce dependence on non-renewable resources.
3. Understand the pros and cons of utilizing natural resources.
4. Understand the economic choice of supporting biodiesel and the impact of support in relation to Michigan's economy.

GLCEs

3rd Grade

- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.
- 3-P3.1.1 Identify public issues in Michigan that influence the daily lives of its citizens.
- S.RS.03.16 Identify technology used in everyday life.
- S.RS.03.17 Identify current problems that may be solved through the use of technology.
- S.RS.03.18 Describe the effect humans and other organisms have on the balance of the natural world.
- E.ES.03.41 Identify natural resources (metals, fuels, fresh water, fertile soil and forests).
- E.ES.03.42 Classify renewable (fresh water, fertile soil, forests) and non-renewable (fuels, metals) resources.
- E.ES.03.43 Describe ways humans are protecting, extending and restoring resources (recycle, reuse, reduce, renewable).
- E.SE.03.32 Describe how materials taken from the Earth can be used as fuels for heating and transportation.

4th Grade

- 4-G5.0.1 Assess the positive and negative effects of human activities on the physical environment of the United States.
- 4-P3.1.1 Identify public issues in the United States that influence the daily lives of its citizens.
- S.RS.04.16 Identify technology used in everyday life.
- S.RS.04.17 Identify current problems that may be solved through the use of technology.
- S.RS.04.18 Describe the effect humans and other organisms have on the balance of the natural world.

Background

Most trucks, buses and tractors burn diesel fuel, a petroleum-based, non-renewable resource. Using a petroleum-based fuel means tapping into a limited supply of fossil fuels that have taken millions of years to develop. Other consequences of using diesel fuel include: it's toxic, it adds pollutants to the air, it can be dangerous to the environment if spilled and it can be costly to import the necessary oil to make fuel.

Many commercial producers are offering biodiesel as an alternative to diesel. Biodiesel is a fuel made from vegetable oils and animal fats, the most common of which is soy biodiesel. Soy biodiesel produces less air pollution than diesel, is non-toxic, is a renewable resource, and is biodegradable. In Michigan, soybeans are the second most produced commodity, therefore, supporting soy biodiesel helps these producers and Michigan's economy. Vehicles that have diesel engines can use soy biodiesel without modifications. There are variants as to the extent that biodiesel can be used: one can use a blend with regular diesel or 100% soy biodiesel (B100). Some school districts are using B20 (soy biodiesel that consists of 20% soy biodiesel and 80% diesel) to fuel their bus fleets.

Activity
Examine
alternatives
to petroleum-
based fuels.

30
min.

Materials provided

- *SoyNews*
- Worksheets HO #4.1A-B
- Theme 4 Power Point

Materials provided

- Yarn
- 3"x5" index cards
(11 per group)
- Markers/crayons
- Tape

Vocabulary/Definitions

- **Biodiesel:** it is a renewable resource that is vegetable oil - or animal fat - based diesel.
- **Diesel fuel:** a fuel made from petroleum.
- **Fossil fuel:** a material that we can use for energy (like oil or coal) that is the remains of a once-living plant or animal.
- **Fuel:** a material that produces heat or power by burning.
- **Natural resource:** available raw material in the Earth that can be drawn on by need.
- **Non-renewable resource:** raw material that cannot be replaced.
- **Petroleum:** an oil found underground; it's a fossil fuel.
- **Renewable resource:** raw material that can be replaced.

Procedure 4.1

Objective		Activity	Possible Responses/Notes
1	Establish baseline knowledge about gasoline	<p>Ask questions, write answers on the board and solicit feedback:</p> <p>Q1 - Has anyone pumped gas into their parent's car before? Describe what you are putting into the car and why.</p> <p>Q2 - What is gasoline? How is gasoline made?</p>	<p>Q1 Notes: Gasoline - to keep the engine of the car operating.</p> <p>Q2 Notes: Gasoline is a petroleum-based fuel.</p>
2	Foster new vocabulary	<p>Pass around worksheet HO #4.1A and instruct students to fill it out as they hear the vocab words in the discussion. Also write these definitions on the board for them as they come up.</p>	
3	Introduce concept of natural resource	<p>Define fuel. Acknowledge gasoline as a fuel.</p> <p>Ask questions, solicit responses:</p> <p>Q1 - Where does gasoline come from? Can we get it here in Michigan or the U.S.?</p> <p>Define natural resource. Link natural resource concept with fuel.</p>	<p>Fuel: a material that produces heat or power by burning.</p> <p>Q1 Notes: Out of the ground as oil; we mostly buy it from other countries.</p> <p>Natural resources: available raw materials in the Earth that can be drawn on when needed.</p>

4	<p>Introduce new concepts</p> <p>Link fuels currently in use to petroleum and fossil fuels</p>	<p>Discuss that there are different types of fuels used. Most buses, trucks and tractors use diesel.</p> <p>Introduce petroleum as a fossil fuel.</p> <p>Instruct the class that even though America is only 5% of the population of the world, we use about 25% of the petroleum that's available.</p>	<p>Discussion Notes:</p> <p>In the U.S., we mostly use diesel and gasoline - both are petroleum based.</p> <p>Diesel: a fuel made from petroleum.</p> <p>Petroleum: an oil found underground.</p> <p>Fossil fuel: a material that we can use for energy (like oil or coal) that is the remains of a once-living plant or animal.</p>
5	<p>Introduce new concepts</p>	<p>Introduce non-renewable vs. renewable resources.</p>	<p>Non-renewable: raw material that cannot be replaced.</p> <p>Renewable: raw material that can be replaced.</p>
6	<p>Label petroleum-based fuels as non-renewable</p> <p>Brainstorm consequences of common use of these fuels in Michigan</p> <p>Brainstorm consequences of common use of these fuels worldwide</p>	<p>Ask students and solicit responses:</p> <p>Q1 - What type of resource are diesel fuel and gasoline?</p> <p>Q2 - What are some consequences of using gasoline or diesel fuels in Michigan?</p> <p>Q3 - What are global consequences of using gasoline or diesel fuels?</p>	<p>Q1 Notes: Non-renewable</p> <p>Q2 Notes:</p> <ul style="list-style-type: none"> • Air pollution • High cost to import and use <p>Q3 Notes: It is non-renewable and may someday run out.</p>

7	Identify renewable resources in Michigan	<p>Ask questions, write answers on board and solicit responses:</p> <p>Q1 - What are some renewable resources located in Michigan?</p> <p>*If students are having difficulty, rephrase question:</p> <p>Q2 - What kinds of resources are abundant in Michigan that could be used to make energy?</p> <p>Q3 - What are some renewable resources in Michigan that can be used to fuel our automobiles?</p> <p>Summarize students' responses.</p>	<p>Q1 Notes: Answers will vary.</p> <p>Agriculture (e.g., soybeans, corn, etc.), trees (if replanted), wind power, water power.</p> <p>Q2 Notes: Wind, water, even woody biomass</p> <p>Q3 Notes: Soybeans, corn</p>
8	Build on new vocabulary	Instruct students to read "Beans Give Gas" in <i>SoyNews</i> .	
9	<p>Summarize learning about biodiesel</p> <p>Personalize learning about biodiesel</p>	<p>Ask students, write answers on board, and solicit responses:</p> <p>Q1 - What did you find interesting about this article?</p> <p>Q2 - What did you learn about biodiesel?</p>	<p>Q1 Notes: Answer will vary.</p> <p>Q2 Notes: Biodiesel fuel is a renewable resource made from vegetable oils or animal fats that can be sourced in Michigan that runs very clean and can be cost effective.</p>
10	Expand on new knowledge with sensory support	<p>Pass around the biodiesel vial, ask questions, and solicit responses:</p> <p>Q1 - Who can guess what this is?</p> <p>Q2 - How come more people aren't using biodiesel fuel?</p>	<p>Q1 Notes: Biodiesel</p> <p>Q2 Notes: Don't know about it, its benefits or logistics. Most cars do not have an engine that can run on biodiesel.</p>

11	Understand concept of choice-making in regards to using natural resources	Link idea that using fuel or biodiesel is about choices and there are costs and benefits of both.	
12		<p>Pass out yarn, markers and index cards.</p> <p>Instruct students to get in groups of three to create a mobile following the directions on HO #4.1A.</p>	

Extended Activity

1. Find out if your school district is burning soy biodiesel, gather information for them to learn about the costs and benefits and present it at a school board meeting.
2. Inform any local trucking or fleet companies who may not be aware of the costs and benefits of burning biodiesel.



Extended Online Activities

1. *What is the closest gas station to your school that sells SOY biodiesel and how much soy blend (B100, B20, B10, B5, etc.)?*

Students should be able to find area gas stations online using a search engine. The types of fuel may or may not be available. If not listed online, students could call (the gas station phone number should be listed online). You can call in advance to let the station know to expect calls and explain the purpose of the activity.

2. *How many bushels of soybeans does it take to make a gallon of soy biodiesel?*

"According to the U.S. Department of Agriculture's (USDA) Farm Service Agency, one bushel of soybeans yields approximately 1.4 gallons of biodiesel. Soybeans contain about 20% oil, so it takes almost 7.3 pounds of soybean oil to produce a gallon of biodiesel. U.S. soybean production reached about 2.5 billion bushels in 2003, according to the USDA National Agriculture Statistics Service. The U.S. produces about 20 million gallons of biodiesel per year using soybeans and other feedstock."

<http://www.biog-3000.com/Pages/FAQ%20Biodiesel.htm>

3. *Describe the history of biodiesel.*

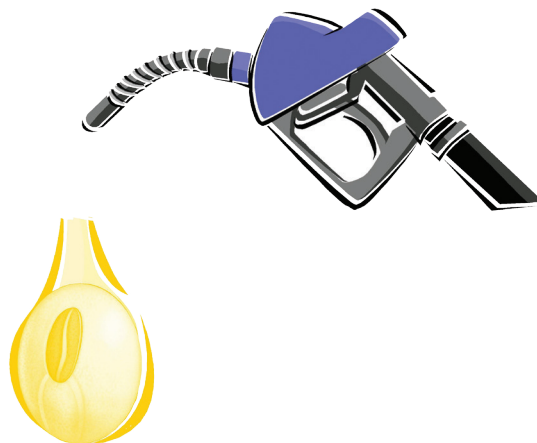
Early experiments on vegetable fuel were done by Dr. Rudolph Diesel and the French government. A 1937 Belgian inventor proposed process for converting vegetable oils into fatty acid alkyl esters to replace diesel fuels. Work continued in Europe and South Africa until 1990's when the first biodiesel plant was built in the U.S.

Other history links:

<http://auto.howstuffworks.com/fuel-efficiency/alternative-fuels/biodiesel2.htm>

<http://www.mybiodiesel.com/biodiesel-history.php>

http://www.biodiesel.com/index.php/biodiesel/history_of_biodiesel_fuel



HO #4.1A

Name: _____ Date: _____

Fuel:

Natural resource:

Diesel fuel:

Petroleum:

Fossil fuel:

Renewable resource:

Non-renewable resource:

Biodiesel:

HO #4.1B

Making a Mobile: Making Choices About Natural Resources

Using natural resources is all about making choices; sometimes they are difficult ones.

Pick a topic below and pretend you are in charge of making decisions about how these vehicles are going to be fueled.

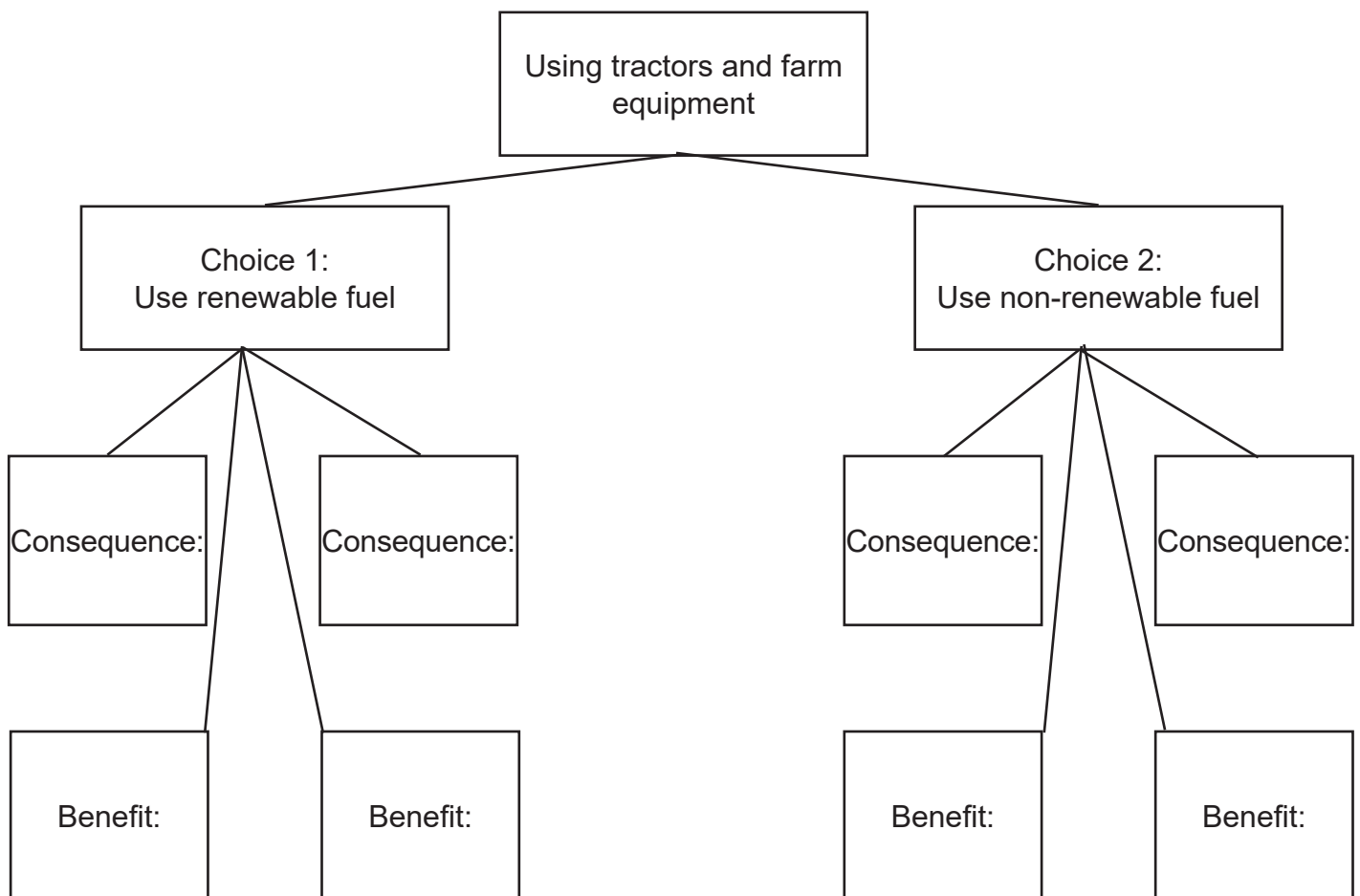
Think of *TWO* choices to make: one is a choice using biodiesel which is a renewable fuel and the other is a choice about using a non-renewable fuel. Think about at least two consequences and two benefits of each choice.

Write everything on 3"x5" cards and attach to make a mobile with yarn and tape.

Pick a topic:

- The school buses at your school district.
- A trucking company's fleet of trucks.
- A farmer's tractor and other fuel-powered farm equipment.

Your mobile will look like this in the end (but filled it in with your ideas):



Purpose

1. Develop an awareness of Henry Ford's contribution to the soybean industry in Michigan and on its economy.
2. Stimulate an interest in the soybean and its versatility.
3. Understand the different types of resources our society utilizes especially in regards with technology.
4. Explain how advancements in technology affect soybean production and use. Link these choices to environmental advocacy and awareness.

GLCEs

3rd Grade

- 3-G4.0.1 Describe major kinds of economic activity in Michigan today (e.g., agriculture) and explain the factors influencing the location of these economic activities.
- 3-G5.0.1 Locate natural resources in Michigan and explain the consequences of their use.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.
- 3-E1.0.3 Analyze how Michigan's location and natural resources influenced its economic development.
- 3-H3.0.1 Identify questions historians ask in examining the past in Michigan.
- 3-H3.0.8 Use case studies or stories to describe how the ideas or actions of individuals affected the history of Michigan.
- E.SE.03.31 Identify Earth materials used to construct some common objects.
- E.ES.03.41 Identify natural resources (metals, fuels, fresh water, fertile soil and forests).
- E.ES.03.42 Classify renewable (fertile soil, forests) and non-renewable (fuels) resources.

3rd - 4th Grade (Science)

- S.RS.XX.16 Identify technology used in everyday life.
- S.RS.XX.17 Identify current problems that may be solved through the use of technology.
- S.RS.XX.18 Describe the effect humans and other organisms have on the balance of the natural world.
- S.RS.XX.19 Describe how people have contributed to science throughout history and across cultures.

4th Grade

- 4-H3.0.3 Describe how the relationship between the locations of natural resources and industries (post-1837) affected and continues to affect the location and growth of Michigan cities.

5th Grade (Social Science)

- S.RS.05.17 Describe the effect humans and other organisms have on the natural world's balance.
- S.RS.05.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

Background

Henry Ford was one of America's pioneers in the automobile industry, leading the way for production-line assembly to be replicated in many of today's modern marvels. Ford hoped to see a time when industry would conserve the non-renewable resources (e.g., coal, oil, natural gas) by using renewable farm products (timber, corn, soybeans). In trying to bridge farm crops and industry, he coined the term "chemurgy" (KEM-ur-jee). He had scientists experiment with various crops to discover crop viability in the industrial market. Ford wanted to assist farmers by discovering ways in which their crops could be used as renewable resources to support the industrial boom, thereby making farming profitable. Link to a video about Henry Ford and soy in vehicles: <https://www.youtube.com/watch?v=hu3B4t0to6A>.

There are many different types of resources affecting human production, distribution, consumption and disposal. The different kinds of resources available to use are: natural resources, renewable resources, non-renewable resources, human resources and capital resources.

Activity

Create a commercial highlighting Henry Ford and his contribution to the soybean industry.

60
min.

Materials

- *SoyNews*
- Worksheets HO #4.2A-B
- Theme 4 Power Point

Vocabulary/Definitions

- **Capital resource:** a good produced for and used to make other goods or services (such as buildings, equipment, tools or cash).
- **Chemurgy:** the development of new industrial chemical products from raw materials, especially agricultural products.
- **Human resource:** the amount of labor/work people put into making a product (such as a cashier, a teacher or even a student).
- **Natural resource:** available raw material in the Earth that can be drawn on when wanted.
- **Non-renewable resource:** raw material from the Earth that cannot be replaced.
- **Renewable resource:** raw material from the Earth that can be replaced.

Procedure 4.2

	Objective	Activity	Possible Responses/Notes
1	Review concepts of natural, renewable and non-renewable resources	<p>Ask questions, write some answers on board and solicit responses:</p> <p>Q1 - What are some examples of natural resources that we use in our daily life?</p> <p>Q2 - What are some examples of renewable and non-renewable resources?</p> <p>Q3 - What is the difference between a renewable and non-renewable resource?</p> <p>Q4 - Why does it matter that we use one or the other?</p> <p>Q5 - What are capital resources?</p> <p>Q6 - What are human resources?</p> <p>Summarize students' responses.</p>	<p>Q1 Notes: Answers will vary but could include: coal, oil, water, soybeans, gold, etc.</p> <p>Q2 Notes: Renewable: soybeans, trees (if we keep replanting them), solar energy, wind energy. Non-renewable: coal, oil, water, gold.</p> <p>Q3 Notes: Non-renewable resources can't be replaced or at least it would take a long time.</p> <p>Q4 Notes: Since there is a limited supply of non-renewable resources, if the demand is too high, we will soon deplete these sources and they will no longer be available.</p> <p>Q5 Notes: Capital resource: a good produced for and used to make other goods or services (such as buildings, equipment, tools or cash).</p> <p>Q6 Notes: Human resource: the amount of labor/work people put into making a product (such as a cashier, a teacher or even a student).</p>

2	<p>Establish baseline knowledge of Henry Ford and his legacy</p>	<p>Ask questions, write some answers on board and solicit responses:</p> <p>Q1 - What do you know about Henry Ford?</p> <p>Q2 - Why was his work such an important contribution to the industrialization of America?</p>	<p>Q1-2 Notes:</p> <ul style="list-style-type: none"> • Made an affordable automobile (Model T). • Most successful early car manufacturer. Created Ford Motor Company. • Didn't invent the assembly line, but responsible for making the assembly line concept in production a key component in American industry.
3		<p>Divide the class into smaller groups (approximately 3-5 students).</p> <p>Instruct class they are going to be making a commercial in their groups today, but they're going to need to collect background information first.</p>	
4	<p>Introduce students to Henry Ford's vision</p> <p>Recognize his vision as including uniting agriculture and industry to make different choices about impacts on the environment</p>	<p>Direct students in their groups to read <i>SoyNews</i> "Henry Ford's Vision" (pg. 4).</p> <p>Write on board and instruct students on the following:</p> <p>Q1 - What do you think Ford thought about preserving the environment? How do you know? What types of things did he do that illustrate this?</p> <p>Q2 - What do you think Henry Ford thought about the growth of the agriculture industry in Michigan? How do you know? What types of things did he do that illustrate this?</p>	<p>Q1-2 Notes:</p> <p>Ford envisioned agriculture and industry having a special relationship to support each other's businesses. Ford was passionate about the soybean and using this renewable resource in his automobile industry. Ford had numerous things created out of soybeans for his industry ("a bushel of soybeans went into every Ford").</p>
5	<p>Refine new knowledge about types of resources</p>	<p>Prior to starting commercial, instruct students to individually fill out <i>Linking Activity</i> on <i>SoyNews</i> (pg. 5) about resources and their definitions.</p>	

6	<p>Solidify understanding about Henry Ford's vision</p> <p>Foster positive group work</p>	<p>Instruct groups to come up with a 2-3 minute commercial about Henry Ford advertising his beliefs about the environment and agriculture in Michigan.</p> <p>Instruct students if they'd like more information they can read <i>SoyNews</i> (pg. 5) or use the internet if available (search: Henry Ford AND soybean).</p>	<p>Instructional Notes:</p> <p>Their commercial should convince viewers to think like Henry Ford did about the environment and agriculture in Michigan (early 1900's).</p>
7	Brainstorming	Give groups 15-20 minutes to prepare.	<p>Allow them to use props if they wish.</p> <p>Allow them to use whatever they need to help them feel more comfortable in front of the classroom (e.g., scripts, note cards, etc.).</p>
8	Peer share	<p>Have groups perform their commercials one group at a time.</p> <p>If desired, commercials could be videotaped and posted to You Tube and/or Michigan Soybean Promotion Committee's Facebook page.</p>	
9	Summarize concepts learned	<p>Ask questions, write some answers on board and solicit responses:</p> <p>Q1 - What did you learn about Henry Ford and his vision?</p> <p>Q2 - What did you find to be most interesting? What was the biggest surprise?</p>	<p>Answers will vary:</p> <p>He wanted to make different choices about how industry affected the environment, and how to unite industry with the strength of Michigan's agriculture industry.</p>



10	<p>Connect new knowledge and apply to Michigan's current economic situation</p> <p>Foster creative thinking about how the industry can boost Michigan's economic future</p>	<p>Ask questions, write some answers on board and solicit responses:</p> <p>Q1 - What does Michigan's automobile industry look like right now? Is it thriving?</p> <p>Q2 - What about Michigan's economy, how is it doing?</p> <p>Q3 - What about Michigan's agriculture industry, like soybean production, how is that doing?</p> <p>Q4 - Thinking about Henry Ford and his vision, do you have some ideas about how soybean production in Michigan could help our economy?</p>	Answers will vary.
11		Additional review: You can have students complete assignment on HO #4.2A.	

Searchable Internet Questions:

1. What other car companies are using soy?
2. In which vehicles are these companies using soy?
3. How are these companies using soy (soy foam seats, soy foam insulation, soy steering fluid, etc.)?

Name: _____ Date: _____

**Answer the following in complete sentences
in reference to the article "Growing a Car".**

1. What is the main idea of the article "Growing a Car"?

2. Give two reasons that Henry Ford was famous?

3. What does the word "chemurgy" mean?

4. What did Ford want to see industry do?

5. Name some products from the article that soybeans are found in.

6. Write an interesting fact that you learned about Henry Ford.

HO #4.2B

Rubric: Answer the following in complete sentences in reference to the article "Growing a Car".

1. What is the main idea of the article "Growing a Car"?

The main idea of "Growing a Car" article is that Henry Ford developed a laboratory in which he hoped to produce a car from farm products and thereby found many other uses for soybeans.

2. Give two reasons that Henry Ford was famous?

Henry Ford was famous for inventing a car, starting the Ford Motor Company and researching the soybean.

3. What does the word "chemurgy" mean?

Chemurgy means to develop new industrial chemical products from natural resources, but especially from agricultural products.

4. What did Ford want to see industry do?

Ford hoped to see a time when industry would conserve the non-renewable resources by using farm products.

5. Name some products from the article that soybeans are found in.

Soy products mentioned were: base for paint, plastic buttons for horns, milk, ice cream, whipped topping and molded plastic.

6. Write an interesting fact that you learned about Henry Ford.

Answers will vary.

A Line-up for Henry Ford's Assembly Line

Purpose

1. Experience an assembly line as a mode of production.
2. Weigh the pros and cons of assembly lines.
3. Understand how innovating with resources (like the assembly line and using renewable natural resources) placed Henry Ford at an economic advantage.
4. Understand Ford Motor Company's impact on Michigan.

GLCEs

3rd Grade

- 3-G4.0.1 Describe major kinds of economic activity in Michigan today (e.g., agriculture) and explain the factors influencing the location of these economic activities.
- 3-G5.0.2 Describe how people adapt to, use and modify the natural resources of Michigan.
- 3-E1.0.3 Analyze how Michigan's location and natural resources influenced its economic development.
- 3-E1.0.4 Describe how entrepreneurs combine natural, human and capital resources to produce goods and services in Michigan.
- 3-E1.0.5 Explain the role of business development in Michigan's economic future.
- 3-H3.0.1 Identify questions historians ask in examining the past in Michigan.
- 3-H3.0.8 Use case studies or stories to describe how the ideas or actions of individuals affected the history of Michigan.
- E.ES.03.41 Identify natural resources (metals, fuels, fresh water, fertile soil and forests).
- E.ES.03.42 Classify renewable (fertile soil, forests) and non-renewable (fuels) resources.
- S.RS.03.19 Describe how people have contributed to science throughout history and across cultures.

4th Grade

- 4-E1.0.2 Describe some characteristics of a market economy (e.g., private property rights, voluntary exchange, competition, consumer sovereignty, incentives, specialization).
- 4-E1.0.5 Explain how specialization and division of labor increase productivity (e.g., assembly line).
- 4-E1.0.6 Explain how competition among buyers results in higher prices and competition among sellers results in lower prices (e.g., supply, demand).

5th Grade (Social Science)

- S.RS.05.19 Describe how science and technology have advanced because of the contributions of people throughout history and across cultures.

Background

Henry Ford was a successful entrepreneur who was very innovative in how he utilized his resources. This mentality shaped his interest in using renewable resources like soybeans, which were grown in Michigan. His innovative way of thinking fostered an increase in human capital with the employees in his plants. He was known to inspire workers to establish a team mentality and even suggested that employees share ideas with him. Henry Ford was not the originator of the assembly line concept; however, he revolutionized production methods, helping to establish its widespread use in the early 1900's to the present. The assembly line has noted benefits and consequences. One benefit includes an increase in even quality production at a cheaper price than competitors. One consequence would be the loss of trade skills among the workforce. For instance, if one man knows how to build a car from start to finish, he has a complete trade skill. However, in an assembly line, each line worker focuses entirely on only one aspect of the trade, perhaps shaping a bumper or installing a door, etc.

Activity

Create an assembly line.

Day One
(30-45 min.)

Day Two
(45 min.)

Materials

- *SoyNews*
- Scrap paper of good quality - lots
- Full roll of wrapping paper (any type)
- Empty wrapping paper tube
- Masking tape
- 10 feet of continuous flat surface (e.g., desks pushed together)
- HO #4.3A "Henry Ford and the Moving Assembly Line" article
- HO #4.3B, C, D Worksheets
- Theme 4 Power Point

Vocabulary/Definitions

- **Assembly line:** a manufacturing process where the product being assembled passes consecutively from operation to operation until completed.
- **Division of labor:** a production process in which a worker or group of workers is assigned a specialized task in order to increase efficiency.
- **Law of demand:** as the cost of something increases, people will demand (or buy) less. The opposite is also true, if the cost of something decreases, people will demand (or buy) more.
- **Law of supply:** as the price of something increases, producers will produce or offer more. The opposite is also true, if the price of something decreases, producers will produce or offer less.
- **Production:** the way that something is made.
- **Specialization:** being allowed to do only one specific task.
- **Wage:** payment for labor or services to a worker.

Procedure 4.3

Objective	Activity	Possible Responses/Notes
DAY ONE		
1	Establish baseline knowledge about Henry Ford from Theme 4.2	Ask questions, write some on the board and solicit responses: Q1 - What are some things we remember about Henry Ford's contribution to the soybean industry? Q2 - What do we remember about the types of resources that one has control over in running a business? Q3 - What are some examples of these resources?
2	Identifying Henry Ford's use of resources Foster idea that Ford's use of his resources was well thought out	Hand out <i>SoyNews</i> to each student. Ask questions, write down some responses on board and solicit responses: Q1 - Looking back at Henry Ford's vision, what examples do you find in the resources he used creating his business in Michigan? Q2 - Why do you think he decided to use these particular resources? Why not something else? Why soybeans?

2 continued.....			<p>Ford felt very strongly that agriculture and industry should not just be partners but have a mutually supportive relationship including being consumers of one another's products. This ties into the concept "chemurgy" from 4.2. He supposedly also had countless ideas for how to use soybean oil and eventually the soy protein in the meal in his inventions. He apparently saw quite a bit of teasing for his firm belief in the versatility of the soybean.</p>
3	<p>Establish baseline knowledge of assembly lines as mode of production</p>	<p>Ask questions, write some answers on the board and solicit responses:</p> <p>Q1 - How does an assembly line in a company function?</p> <p>Define division of labor.</p> <p>Link concepts of assembly line with division of labor.</p>	<p>Q1 Notes: Workers each doing one task, side-by-side, progressively building something bigger than each of their tasks.</p> <p>Assembly line: a manufacturing process where the product being assembled passes consecutively from operation to operation until completed.</p> <p>Division of labor: a production process in which a worker or group of workers is assigned a specialized task in order to increase efficiency.</p>

4	<p>Foster thinking about benefits of assembly line</p> <p>Introduce law of supply and demand</p>	<p>Ask question, write some answers on the board and solicit responses:</p> <p>Q1 - Why do companies use assembly lines?</p> <p>Define laws of supply and demand.</p> <p>Summarize that by law of demand, if assembly lines mean Ford can produce automobile faster and at a lower cost, people will buy more of it.</p>	<p>Q1 Notes:</p> <p>To help produce products faster and at the same level of quality; makes products cheaper and can sell them cheaper, allowing company to be more competitive with other businesses.</p> <p>Law of supply: as the price of something increases, producers will produce or offer more. The opposite is also true, if the price of something decreases, producers will produce or offer less.</p> <p>Law of demand: as the cost of something increases, people will demand (or buy) less. The opposite is also true, if the cost of something decreases, people will demand (or buy) more.</p>
5	<p>Foster thinking about consequences of assembly line</p>	<p>Ask question, write some answers on the board and solicit responses:</p> <p>Q1 - Even though he wasn't the first one to use the assembly line, Henry Ford decided to use it to help his company make cars and other things faster. What kinds of problems do you think Henry Ford might have faced with workers on the assembly line?</p>	<p>Q1 Notes:</p> <p>They are only experienced with one aspect of a larger trade. This can make them less marketable if they try to get another job. Also, the monotony of one task may have been a boring profession for some of his employees. In addition, the worker doesn't have a complete skill-set (e.g., putting together an entire car), they only have a very specific task mastered.</p>
6	<p>Demonstrate concept of different types of production</p> <p>Experience level of individual productivity without assembly line</p>	<p>Instruct students that they are going to make paper airplanes. Instruct them that they are going to do it the way a company might have before the use of assembly lines.</p> <p>Instruct students to make their own paper airplanes from start to finish. Give them 5 minutes. Allow some brief flight-testing.</p>	<p>*Note - Ford did have an airplane division of his company starting in World War I that even created the first passenger airplane.</p>

7	Process experience	<p>Ask questions, write some answers on the board, write the number of planes made as a group on the board and solicit responses:</p> <p>Q1 - What were your experiences making the airplane from start to finish on your own?</p> <p>Q2 - How well did the planes fly that you made?</p>	Answers will vary.
8		<p>Instruct students that Henry Ford used a different approach, he was very innovative in how he used resources in his production methods.</p> <p>Define production.</p>	Production: the process of making or manufacturing products from components or raw materials.
9	Homework or out-of-class assignment	Have students read Part 1 of HO #4.3A "Henry Ford and the Moving Assembly Line" article produced by The Henry Ford.	
<p>DAY TWO</p> <p>**Set-up the assembly line ahead of time for ease.**</p> <p><i>Tape the end of the full roll of wrapping paper to an empty roll of wrapping paper in a few places along the end.</i></p> <p><i>You will need ten feet of continuous flat surface; you might line up desks or tables to achieve this.</i></p> <p><i>Place the wrapping paper at one end of the surface; unwind it so that the empty roll-end reaches the other end of the flat surface to form the "conveyor belt".</i></p> <p><i>Place a stack of scrap paper (in good condition) at the end of the full roll. This will be Station 1 on the assembly line.</i></p>			
10	Review content of previous day	Review concepts and ideas of previous day.	

11		<p>Explain that each station on the assembly line is one person's job. The paper airplane should move on the "conveyor belt" between stations.</p> <p>Choose 10 students to work on the assembly line and two students to run the conveyor belt.</p>	
12		<p>Instruct the two students running the conveyor belt that one must hold the full tube and one will wind the paper around the empty tube. The second student (called the winder) will also be the belt-controller, meaning this student will control the speed of the assembly line.</p>	
13	Foster observation skills	<p>Instruct students not working on the assembly line to closely observe one of the workers. Let the observers know that they'll be asked to comment on what they observed.</p>	
14		<p>Explain that the speed of production is controlled by how fast the conveyor belt is moving.</p>	
15		<p>Remind the workers to pay close attention to what their thoughts and feelings are as they work.</p>	



16		<p>Review each of the jobs with students.</p> <p>Assembly line stations:</p> <ul style="list-style-type: none"> -Station 1: take one piece of paper from the stack and place it on the conveyor belt. -Station 2: make a center vertical fold in the piece of paper. -Station 3: open the folded paper. -Station 4: fold the top right corner of the unfolded paper into the fold line. -Station 5: fold the top left corner of the paper into the fold line. -Station 6: fold the center to create the nose. -Station 7: fold one side down to create one wing. -Station 8: fold other side down to create the other wing. -Station 9: adjust the folds so that the wings are horizontal. -Station 10: test-fly the airplane. <p>Link to concept of specialization.</p>	<p>Specialization: being allowed to do only one specific task.</p>
17		<p>Explain how the moving assembly line will work.</p> <p>Allow conveyor belt students to test out the belt briefly, but not all the way. Have them reset it.</p> <p>Explain to the conveyor belt students to start out moving the assembly line slowly.</p>	
18	Experience of productivity in an assembly line	Instruct students to begin.	Continue this process until the belt gets to the other end of the roll.

19	Process students' experiences	<p>Ask students and solicit responses:</p> <p>Q1 - Station workers: How do you describe your experience working on the assembly line? What were you thinking when the product came to your station?</p> <p>Q2 - What did you all find challenging about this experience?</p> <p>Q3 - What was successful about producing planes on the assembly line?</p>	Answers will vary.
20		Repeat the process with another 12 students; however, this time have the conveyor belt move faster.	
21	<p>Process students' experiences</p> <p>Contrast two different sets of experiences on assembly line</p>	<p>Ask students and solicit responses:</p> <p>Q1 - Station workers: How do you describe your experience working on the assembly line? What were you thinking when the product came to your station?</p> <p>Q2 - What did you all find challenging about this experience?</p> <p>Q3 - What was successful about producing planes on the assembly line?</p> <p>Q4 - How were the two assembly line experiences different?</p>	
22	Compare experiences in two modes of production (day one and day two)	<p>Refer back to questions asked DAY ONE.</p> <p>Ask questions, write answers on the board, and solicit responses:</p> <p>Q1 - What were your experiences making the airplane from start to finish on the assembly line?</p> <p>Q2 - How well did the planes fly that the group made?</p>	Answers will vary.

23	Understand assembly line's impact on quality	<p>Ask students, write some answers on the board and solicit responses:</p> <p>Q1 - How well were the airplanes made between the different types of production (alone, assembly line with slow belt, assembly line with fast belt)?</p> <p>Q2 - Many people consider Henry Ford and the Ford Motor Company very successful. Reflecting on this lesson and the previous one (4.2), why do you think he was successful?</p> <p>Q3 - What did Henry Ford and the Ford Motor Company do for Michigan's economy?</p>	<p>Answers will vary:</p> <p>Q1 Notes: The planes produced in the assembly line were probably more uniform.</p> <p>Q2 Notes: He innovated about how to use resources in creating his entire empire from automobiles to planes, etc. This was especially so in how he used human resources (such as revolutionizing the use of the assembly line), but he also made smart decisions about using renewable natural resources like soybeans that were available to him locally in Michigan in his automobile production (the tie in from 4.2 lesson). These decisions helped him to create a cheaper product like automobiles that many people started to purchase.</p> <p>Q3 Notes: He helped establish a strong automotive industry and created job opportunities for many Michigan locals.</p>
24		Instruct students to fill out HO #4.3B	

*Adapted from The Henry Ford at www.thehenryford.org.

The section of the 2-plane paper airplane workshop was adapted from *The Power In Our Hands: A Curriculum on the History of Work and Workers in the United States*, by William Bigelow and Norman Diamond. New York: Monthly Review Press, 1988.

Name _____

Henry Ford and the moving assembly line

Part I

Have you ever wondered how the items you use every day, such as the shoes you wear and the pen with which you write, were made? They were probably made by workers on a moving assembly line in a factory. Products have been made on moving assembly lines for almost 100 years. But in 1908, when Henry Ford began producing automobiles on the first moving assembly line, it was a major innovation in the way workers did their jobs.

Producing anything requires people. The people who play a part in producing a product are human resources. Henry Ford used **human resources** very well in his company, as “teammates” who helped him run the company and as workers who made the cars.

Henry Ford was a great team builder. He knew how to choose good workers and how to inspire them to make the business better. Ford employed engineers and business people to help plan the **production**, or building, of vehicles and the sales of cars. Members of his team started Henry Ford on his way to the moving assembly line. In 1906, a new production overseer rearranged the tools in Ford’s factory. Now the tools were in the same order of the steps needed to produce an automobile part! But it took seven more years for Henry Ford and his team to fully develop the moving assembly line.

In 1908, Henry Ford began building a new factory in Highland Park, Michigan. This factory is where the moving assembly line came to life.



Women Workers Assembling Magnetos at Ford Highland Park Plant, circa 1913 ID# THF23810

There are many different stories about what inspired the moving assembly line, which Ford started using in 1913. Henry Ford once said that he had observed the processes in a meatpacking plant. In a meatpacking plant, the animal’s body was attached to a moving conveyor belt and moved from worker to worker, who each cut off a particular piece of meat. One of Henry’s top engineers, Charles Sorenson, said that he and some of his assistants developed the assembly line by pulling an automobile chassis along on a rope past piles of parts, adding one part at each new spot. Historians think all of the stories probably have a bit of truth. It is certain that a variety of influences, many people and lots of

Continued...

experimentation led to the development of the moving assembly line. Henry Ford encouraged his workers to try new ways of doing things. He was a great example for them, too, as he was always tinkering with his machines and automobiles.



Swift & Company's Meatpacking House, Chicago, Illinois, Splitting Backbones and Final Inspection of Hogs, 1910-1915 ID# THF32081

This type of “disassembly” line inspired Henry Ford’s [moving assembly line](#). In the moving assembly line, the work moves from worker to worker. Each worker puts on a new piece of the part; then the part moves along to the next worker. Each worker does one step of the bigger job; this is called [division of labor](#). Also, each worker only has to learn and perform one step; this is called [specialization](#). At first, Ford Motor Company used the moving assembly to make the individual parts of cars. It was so efficient, allowing workers to make parts so quickly, that eventually it spread to all aspects of the assembly process. Even the chassis (the bottom of the car to which the wheels attach) moved on a conveyor belt from worker to worker.



Workers Assembling Car Bodies at Ford Rouge Plant, 1932 ID# THF23466

Part II

This new method of production changed the way that people worked. Instead of being involved in the whole process of building a car, workers just completed one small part of the process. This was faster and made it easier to train workers. However, doing a small task over and over again was boring. Also, workers had to work at the same speed the conveyor belt moved; if one worker slowed down or got behind, the rest of the process would be held up. In 1914, in order to convince workers to do this unpleasant work, Henry Ford began paying his

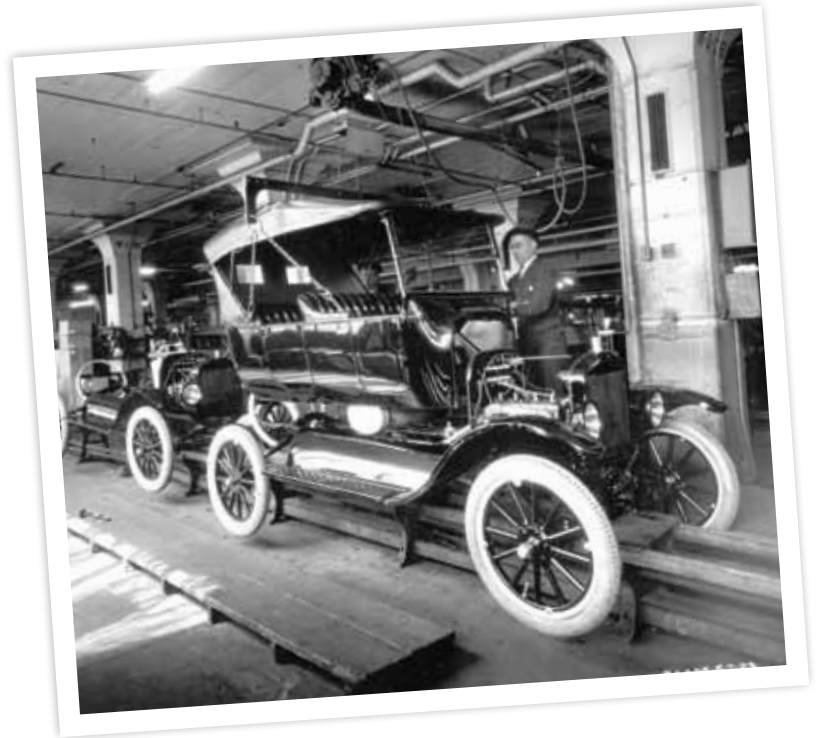
Continued...

Part II Continued

workers \$5 a day – almost twice as much as what they had been earning. Workers came to expect these high wages from Ford Motor Company and other automobile companies. When companies decreased wages during the Great Depression, workers formed a union, or group of workers with shared interests, so auto companies would always have to pay them good wages.

While the work was tedious, items could be produced faster and more cheaply than ever. Also, with workers being paid so well, they could afford to buy more. Soon, **consumption** – buying things – became a way of life for Americans. While Henry Ford did want all people to be able to get around with a Model T, Henry did not like unnecessary consumption, which increased partly because of his innovation of the moving assembly line.

By the 1920s, making, selling and buying automobiles became very important, especially in Michigan, where many automobile companies were located. Today, automobile companies selling cars in the United States are located all over the world. Michigan now faces the challenge of developing other economic activities, since the automobile industry is no longer as strong. However, the innovations of Henry Ford can be an example for the present and future of the Michigan economy.



1924 Ford Model T Cars on Assembly Line at Highland Park Plant, October 1923 ID# THF23577

<http://www.thehenryford.org/education/erb/YouCanBeAnInnovatorUnitPlanLesson4.pdf>

Name: _____ Date: _____

Questions for Reflection on the Assembly Line Lesson

1. What are 2-3 advantages of the moving assembly line?

2. What are 2-3 disadvantages of the moving assembly line?

3. How is the moving assembly line important to Michigan's history?

4. If you were giving advice to a business person just starting a new business, what would you tell them about using their resources so they do well in Michigan's economy (such as capital, human, renewable, non-renewable)?

Resource Classification

Below is a list of items that would be needed to make biodiesel.
Write each Resource in the category where it belongs:

Trucks	Diesel Engine	Water
Truck Drivers	Roads	Processing Plant
Soybeans	Farm Equipment	Factory Workers
Farmers	Soil	Sunshine

Renewable: _____

Capital Resources: _____

Non-renewable: _____

Human Resources: _____

**Rubric for Reflections on the Assembly Line Lesson
and Resource Classification Worksheet:**

1. What are 2-3 advantages of the moving assembly line?

Increases number of products produced; creates an even level of quality; should hopefully have a high level of quality; allows for the products to be sold cheaper which will in theory increase demand.

2. What are 2-3 disadvantages of the moving assembly line?

People get bored; if the line is moving quickly, quality can decrease or numbers can decrease; if the line is moving quickly, people may not want to work there and may require being paid more money to remain.

3. How is the moving assembly line important to Michigan's history?

Henry Ford revolutionized the use of the assembly line and helped establish cheap cars that more people could buy and he did so in Michigan where he helped establish the auto industry and support Michigan's economy.

4. If you were giving advice to a business person just starting a new business, what would you tell them about using their resources so they do well in Michigan's economy (such as capital, human, renewable, non-renewable)?

Answers will vary.

Resource Classification

Renewable: Soybeans

Capital Resources: Diesel Engines, Trucks, Roads, Farm Equipment, Processing Plant

Human Resources: Truck Drivers, Farmers, Factory Workers

Non-renewable: Soil, Water, Sunshine

SOY Word Search List

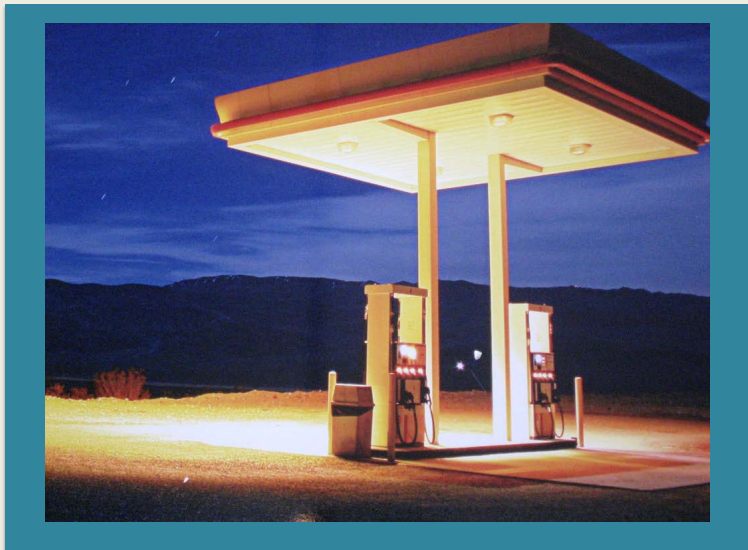
BIODIESEL	SOY SAUCE
BABY FOOD	CANDY
CRAYONS	SOY INK
PIE CRUST	PLYWOOD
CANDLES	PET FOOD
MAKEUP	CEREAL
NOODLES	FISH FOOD

Can the Golden Bean Be “Green”?



*How do advancements in
technology afford us different
choices about the environment?*

Gasoline



http://www.afaceaface.org/blog/home/a4038513/public_html/blog/wp-content/uploads/2011/07/Gas-Station.jpg

4.1 Procedure Step 1

Q1 - Has anyone pumped gas into their parent's car before?
Describe what you are putting into the car and why.

Q2 - What is gasoline? How is gasoline made?

Q1 Notes:

To keep the engine of the car operating.

Q2 Notes:

Gasoline: a petroleum-based fuel

Fuel



<http://fleetfuelph.com/wp-content/uploads/2010/02/Fuel-Economy11.jpg>

4.1 Procedure Steps 3-4

Q1 - Where does gasoline come from? Can we get it here in Michigan or the U.S.? Define natural resource. Link natural resource concept with fuel.

Q1 Notes:

Out of the ground as oil, we mostly buy it from other countries.

Natural resource: available raw material in the Earth that can be drawn on when needed.

In U.S., we mostly use diesel and gasoline - both are petroleum based.

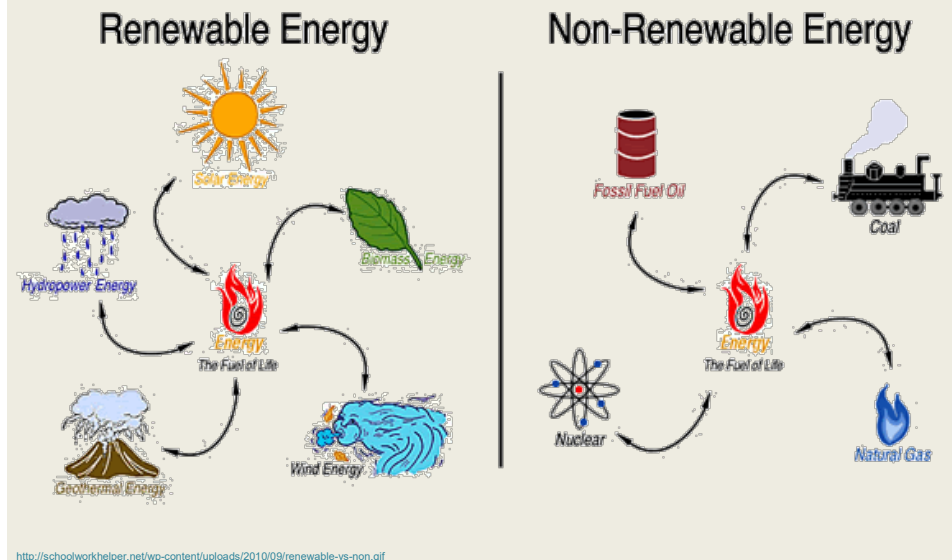
Diesel: a fuel made from petroleum.

Petroleum: an oil found underground.

Fossil fuel: a material that we can use for energy (like oil or coal) that is the remains of a once living plant or animal.

Fuel: a material that produces heat or power by burning.

Resources



4.1 Procedure Steps 5-6

- Q1 - What type of resource are diesel fuel and gasoline?
Q2 - What are some consequences of using gasoline or diesel fuels in Michigan?
Q3 - What are global consequences of using gasoline or diesel fuels?

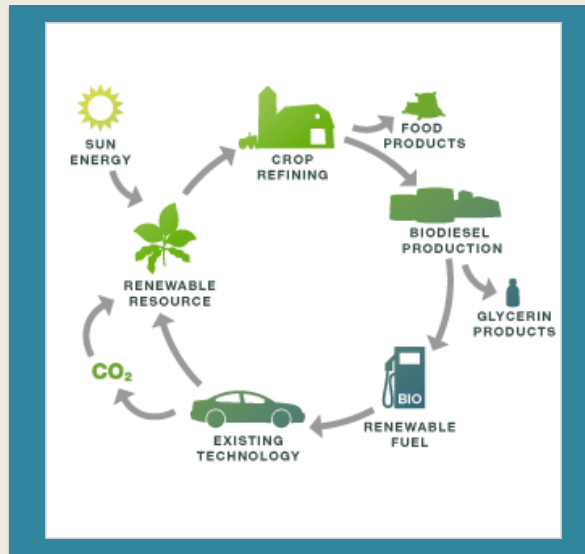
Q1 Notes:

Non-renewable: raw material that cannot be replaced.
Renewable: raw material that can be replaced.

Q2 Notes:
Air pollution
High cost to import and use.

Q3 Notes:
It is non-renewable and may some day run out.

Biodiesel



<http://charityfundraising.autographstore.com/wp-content/uploads/2011/03/The-National-Biodiesel-Foundations-annual-charity-auction-helps-promote-renewable-energy-sources.gif>

4.1

Procedure Steps 9-10

After reading article:

Q1 - What did you learn about biodiesel?

Q1 Notes:

Biodiesel fuel is a renewable resource made from vegetable oils or animal fats that can be sourced in Michigan that runs very clean and can be cost effective.

Pass around the biodiesel vial, ask questions and solicit responses:

Q2 - Who can guess what this is?

Q3 - How come more people aren't using biodiesel fuel?

Q2 Notes:

Biodiesel

Q3 Notes:

Don't know about it, its benefits or logistics. Most cars do not have an engine that can run on biodiesel.

Other kinds of resources

Capital Resources



<http://www.glickmorganstern.com/img/venture-capital.jpg>

Human Resources



http://s3.hubimg.com/u/4035070_f520.jpg

4.2

Procedure Step 1

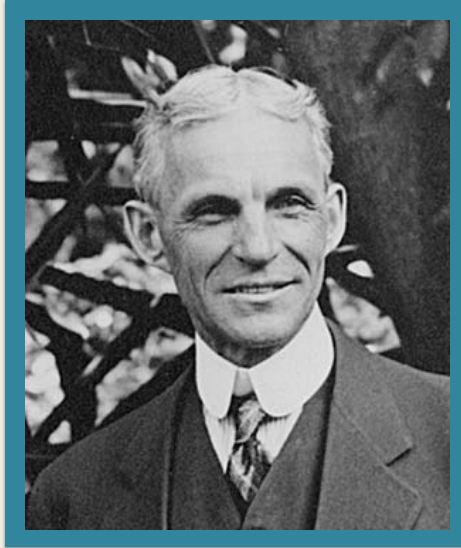
Q1 - What are capital resources?

Q2 - What are human resources?

Capital resource: a good produced for and used to make other goods or services (such as buildings, equipment, tools or cash).

Human resource: the amount of labor/work people put into making a product (such as a cashier, a teacher or even a student).

Henry Ford



http://im.in.com/connect/images/profile/b_profile2/Henry_Ford_300.jpg

4.2 Procedure Step 2

Q1 - What do you know about Henry Ford?

Q2 - Why was his work such an important contribution to the industrialization of America?

Q1-2 Notes:

- Made an affordable automobile (Model T).
- Most successful early car manufacturer.
- Created Ford Motor Company.
- Didn't invent the assembly line, but responsible for making the assembly line concept in production a key component in American industry.

Soy & Cars



http://images.hemmings.com/wp-content/uploads/2007/01/plasticford_resized.jpg

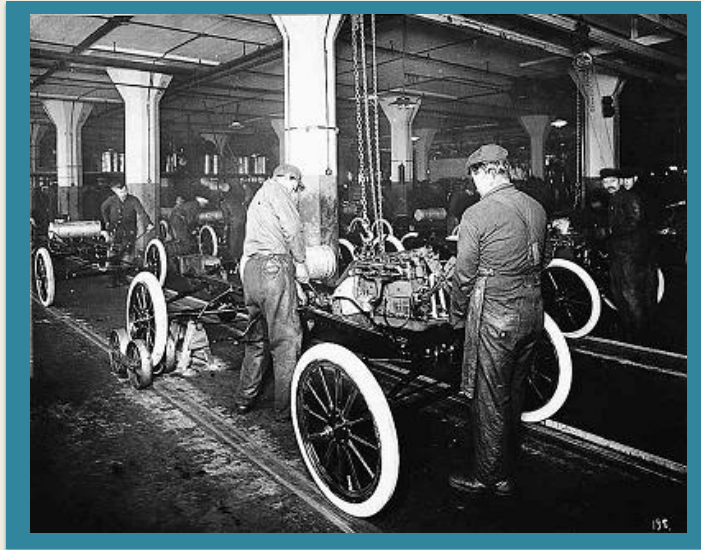
4.3 Procedure Step 2

Q1 - Why do you think he decided to use these particular resources? Why not something else? Why soybeans?

Q1 Notes:

He tapped into what was available locally - soybeans. Ford felt very strongly that agriculture and industry should not just be partners but have a mutually supportive relationship including being consumers of one another's products. This ties into the concept "chemurgy" from 4.2. He supposedly also had countless ideas for how to use soybean oil and eventually the soy protein in the meal in his inventions. He apparently received quite a bit of teasing for his firm belief in the versatility of the soybean.

Assembly Lines



<http://www.johndclare.net/images/Ford%20Assembly%20line.JPG>

4.3

Procedure Step 3

Q1 - How does an assembly line in a company function?

Define division of labor.

Link concepts of assembly line with division of labor.

Q1 Notes:

Workers each doing one task, side-by-side, progressively building something bigger than each of their tasks.

Assembly line: a manufacturing process where the product being assembled passes consecutively from operation to operation until completed.

Division of labor: a production process in which a worker or group of workers is assigned a specialized task in order to increase efficiency.

Procedure Step 4

Q1 - Why do companies use assembly lines?

To help produce products faster and at the same level of quality; makes products cheaper and can sell them cheaper, allowing companies to be more competitive with other companies.