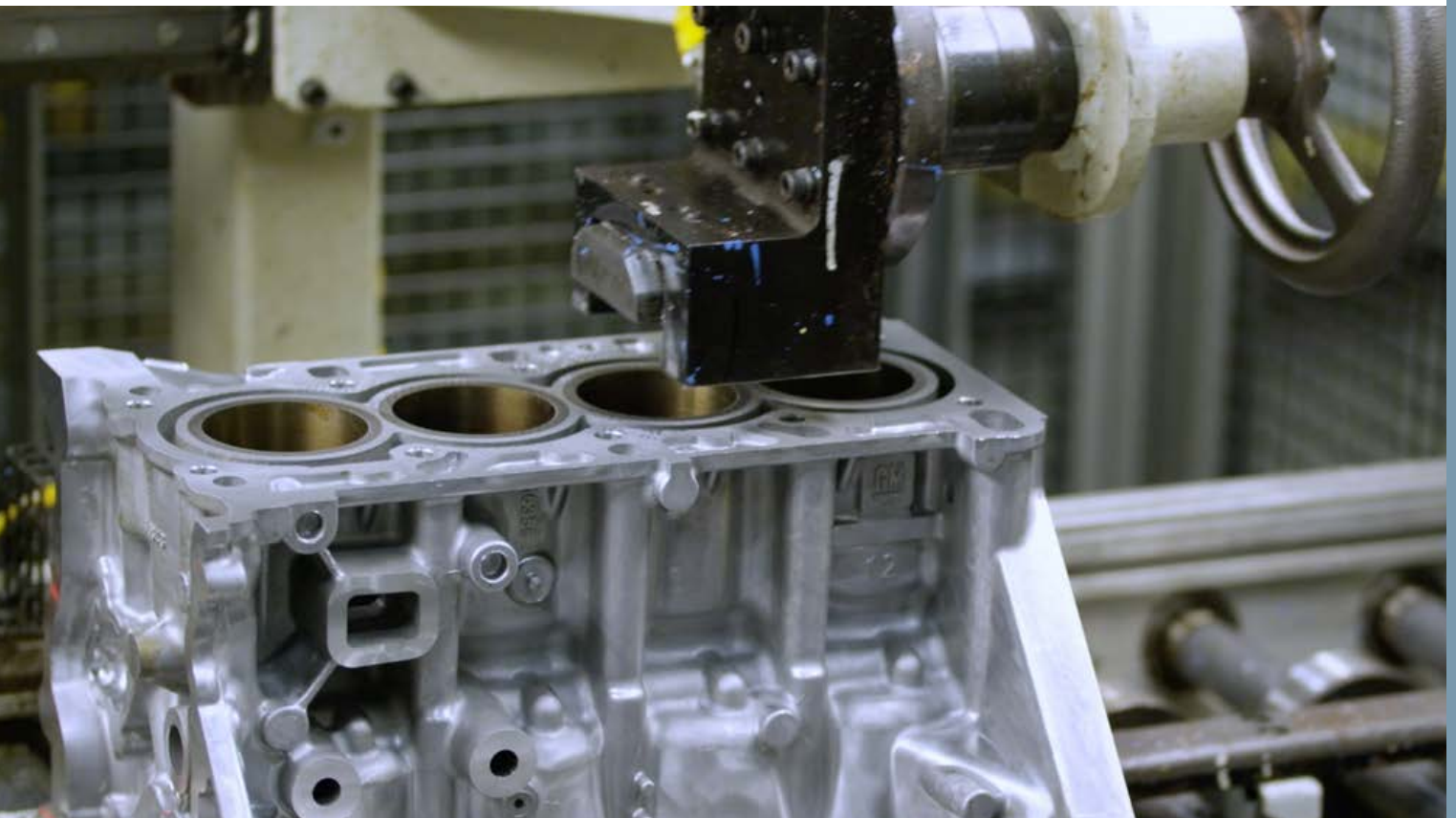




Grade 3-5 STEM Challenge

# Conveyor Engineering

Inspired by Yolanda, an Industrial Engineer in in the  
Indiana Uplands.



## GRADE 3-5 STEM CHALLENGE

# Conveyor Engineering

Inspired by Yolanda, an Industrial Engineer in the Indiana Uplands. Students will design and build a conveyor system that can move an object from one place to another.



## CAREER CONNECTION AND LESSON OVERVIEW

Yolanda is an industrial engineer for General Motors in Bedford, Indiana. She designs systems that check automotive components for mistakes and scrap any defective parts before they're assembled into vehicles. Yolanda's work helps GM know their production line is making high-quality products as efficiently as possible.

Industrial engineers create systems that help people, machines, materials, and plans work together to create a product. They use mathematics and data analysis to create solutions for assembly line design, worker safety strategies, or, like Yolanda, ensure that the line is producing quality components. In this activity, students will design a conveyor belt to move objects from one place to another.

## LESSON TIMELINE

DAY 75 Minutes

# 1

- Show the inspiration video, "[Yolanda - Industrial Engineer](#)"
- Read "What is a Conveyor Belt?"
- Create conveyor design

DAY 60 Minutes

# 2

- Build and test prototype
- Improve conveyor design

DAY 60 Minutes

# 3

- Share conveyor design
- Communicate successes and challenges

## Recommended Supplies

- Tubes (paper towel rolls, PVC piping, soda bottles, pencils, or similar materials)
- Balls, marbles, ball bearings or similar
- Fabric sheets or rolls of paper
- Plastic wrap
- Paper or plastic cups
- Foil
- String
- Paperclips
- Tape
- Scissors
- Scrap cardboard
- Additional assorted supplies to encourage experimentation
- Small material to be moved for prototype testing (pennies, candy, cotton balls)



## IN THIS CHALLENGE, STUDENTS WILL:

- Read the Student Resource article ‘What is a Conveyor Belt?’ to build background knowledge about conveyors and how they are used in producing goods.
- Design and build a conveyor that moves an object from one place to another.
- Share their prototype and Engineering Design Process by documenting the steps they took to get to the finished conveyor.

## Standards

### Science & Engineering Process Standards

SEPS.1 Posing Questions (for science) and defining problems (for engineering)

SEPS.2 Developing and using models and tools

SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)

SEPS.8 Obtaining, evaluating, and communicating information

### Engineering Standards

3-5.E.1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.

3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

### English/Language Arts

3.RN.2.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.

4.RN.2.2 Determine the main idea of a text and explain how it is supported by key details; summarize the text.

5.RN.2.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

### Computer Science Standards

3-5.PA.1 Use technology resources for problem solving and self-directed learning, general-purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, facilitate learning, and individual/collaborative writing, communication and publishing materials.

3-5.NC.2- Use productivity technology tools for individual and collaborative writing, communication and publishing activities.

### Science Standards

3.PS.2 Identify types of simple machines and their uses. Investigate and build simple machines to understand how they are used.

4.PS.3 Investigate how multiple simple machines work together to perform everyday tasks.

### Employability Skills Standards

3-5.WE.4 Complete tasks or activities with prompting and guidance from adult educators.

3-5.WE.5 Demonstrate perseverance to complete tasks and activities.

3-5.LS.2 Communicate with others by applying a variety of speaking skills.

3-5.LS.3 Communicate with others using a variety of technology.

3-5.LS.4 Relate personal interests, abilities, and leisure time activities to possible occupational choices without stereotyping.

3-5.LS.8 Develop criteria for making decisions and predict results of choices to find the best solution.

3-5.LS.10 Identify a short-term goal and develop a plan of action.

3-5.LS.13 Utilize effective questioning and brainstorming techniques.

# Planning and Implementation

## CONVEYOR ENGINEERING

### Essential Vocabulary

- **ENGINEERING:** The branch of science and technology concerned with the design, building, and use of engines, machines, and structures.
- **INDUSTRIAL ENGINEERING:** The branch of engineering dealing with the study, design, and improvement of systems to help companies make a product or provide a service.
- **PROTOTYPE:** A first model of something from which other models are developed or copied.
- **CONVEYOR SYSTEM (or CONVEYOR BELT):** Mechanical system that moves materials from one location to another, usually through a moving surface, or "belt".

### In this challenge, students will:

- View the job shadow video "Yolanda- Quality Engineer" to learn more about industrial engineering.
- Read the Student Resource article "What is a Conveyor Belt?" to build background knowledge about conveyors and how they are used in producing goods.
- Design and build a conveyor that moves an object from one place to another.
- Document their process and share their prototype.

### Day 1

#### Introduction (10 minutes)

Guide a conversation that introduces the career of engineering. Pose the question to students, "What do you know about engineering or being an engineer?"

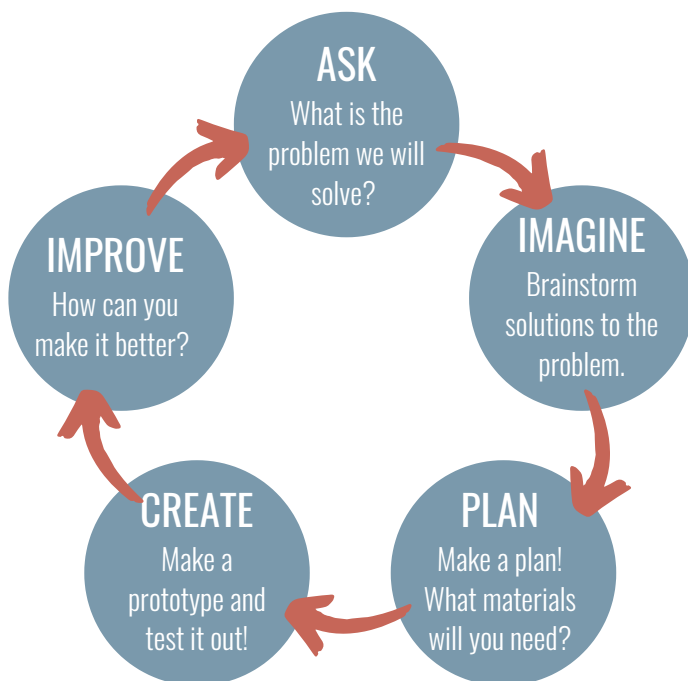
*"The person in the video we will watch today is an industrial engineer. She works for the General Motors plant located in Bedford, Indiana."*

Explain that industrial engineering is the branch of engineering dealing with the study, design, and improvement of systems to help companies make a product or provide a service. Yolanda is an industrial engineer although her official title at General Motors is Quality Engineer. To introduce these careers, either project the Industrial Engineering career profile or give a copy to each student. Here they can read more about Yolanda's work. Show students the video "Yolanda- Industrial Engineer" available at <https://regionalsoportunityinc.org/yolanda/>.

## Introduce the Challenge (30 minutes)

Group students (3-4 students per group) and assign the following roles:

- The Building Lead will make sure that every group member's ideas are heard and that each group member contributes to constructing the conveyor. The Building Lead will also handle the conveyor when it is time to test the prototype.
- The Materials Manager will gather and organize materials the group has chosen for construction. The Materials Manager will observe during prototype testing.
- The Recorder will make sure that the group's ideas are recorded during the IMAGINE stage and will observe and record details of what takes place during prototype testing. These observations will help the group when making improvements.



Explain that you will begin exploring what it means to be an industrial engineer by using the Engineering Design Process. The students will create a conveyor system to move a 'product' from one place to another. The conveyor must be able to move 4 Unifix cubes or other small, light-weight objects, at least 12 inches in a straight line.

*Optional modification: Include a requirement that the conveyor must make a 90° turn for added challenge.*

To build background knowledge about conveyor systems, have students read the "What is a Conveyor Belt?" article, courtesy of [www.TryEngineering.org](http://www.TryEngineering.org) (included at the end of this lesson plan.) It would be appropriate for students to read either the first page or the whole article depending on lesson timing, age, and reading level of students.

Alternatively, this article may be read aloud.

After reading the article, have students write down the main idea and a few key facts they should keep in mind when creating their own conveyor system. Use the graphic organizer provided or the students' science notebooks to collect their ideas. Help students think through the criteria and constraints for their conveyor system.

### Ask, Imagine, & Plan (30 minutes)

Once students understand the challenge and are grouped appropriately, pose the question to the class:

*“How can we design a conveyor system to move a ‘product’ from one place to another?”*

Have the students write this question (or something like it in their own words) in the ASK box of their Engineering Design Process handout.

Introduce the building materials that will be available to the students. As mentioned in the materials list, a wide variety of options should be available to encourage creativity. Allow students time individually to sketch a few designs of their conveyor system in the IMAGINE box on their Engineering Design Process handout.

Once students have developed a few ideas on their own, invite students to share their ideas in their groups. As a group, the students should use their brainstormed ideas to create a plan they all agree with. Have students record their final ideas in the PLAN section of their Engineering Design Process handout.





## Day 2

### Create and Improve (60 minutes)

Using their plans from Day 1, each group will build out their conveyor systems using the materials provided. As each group assembles their conveyor design, they should describe their conveyor in the CREATE box of the Engineering Design Process handout.

Once complete, students will test their design, troubleshooting any problems and finding ways to improve their approach. Students should continue the test/improve cycle until they have a model that carries the objects and satisfies the criteria described by the teacher on day 1.

As students work, you will want to prompt them to brainstorm solutions to issues they may run into. For example, what might happen if a part breaks? How would using different materials for the conveying surface affect the outcome? Students may also want to look at pictures of conveyors to get inspiration for this step. Students will reflect on the improvement process by completing the IMPROVE box on the Engineering Design Process handout.

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## Day 3

### Communicate (60 Minutes)

Students will work in their small groups or individually to complete the COMMUNICATE section of the Engineering Design Process handout. Have students use available technology (slides, videos, or another mode of presentation) to summarize their STEM challenge and share their designs.

Presentations should include:

- a summary of what students learned about the history of manufacturing and conveyor systems.
- a summary of the information in the CREATE and IMPROVE boxes.
- a description of the testing and revisions they did on their conveyor.
- an explanation of the most successful and the most difficult part of this STEM challenge.

## Career Exploration and Extension

Prompt students to think about and research what a career as an industrial engineer might involve.

- What does an industrial engineer do all day? What does Yolanda do?
- What kind of training would a student need to become an engineer? What kind of training would they need to become the scientist who designs these systems?
- What kind of education is needed to be an engineer? What types of classes are important?



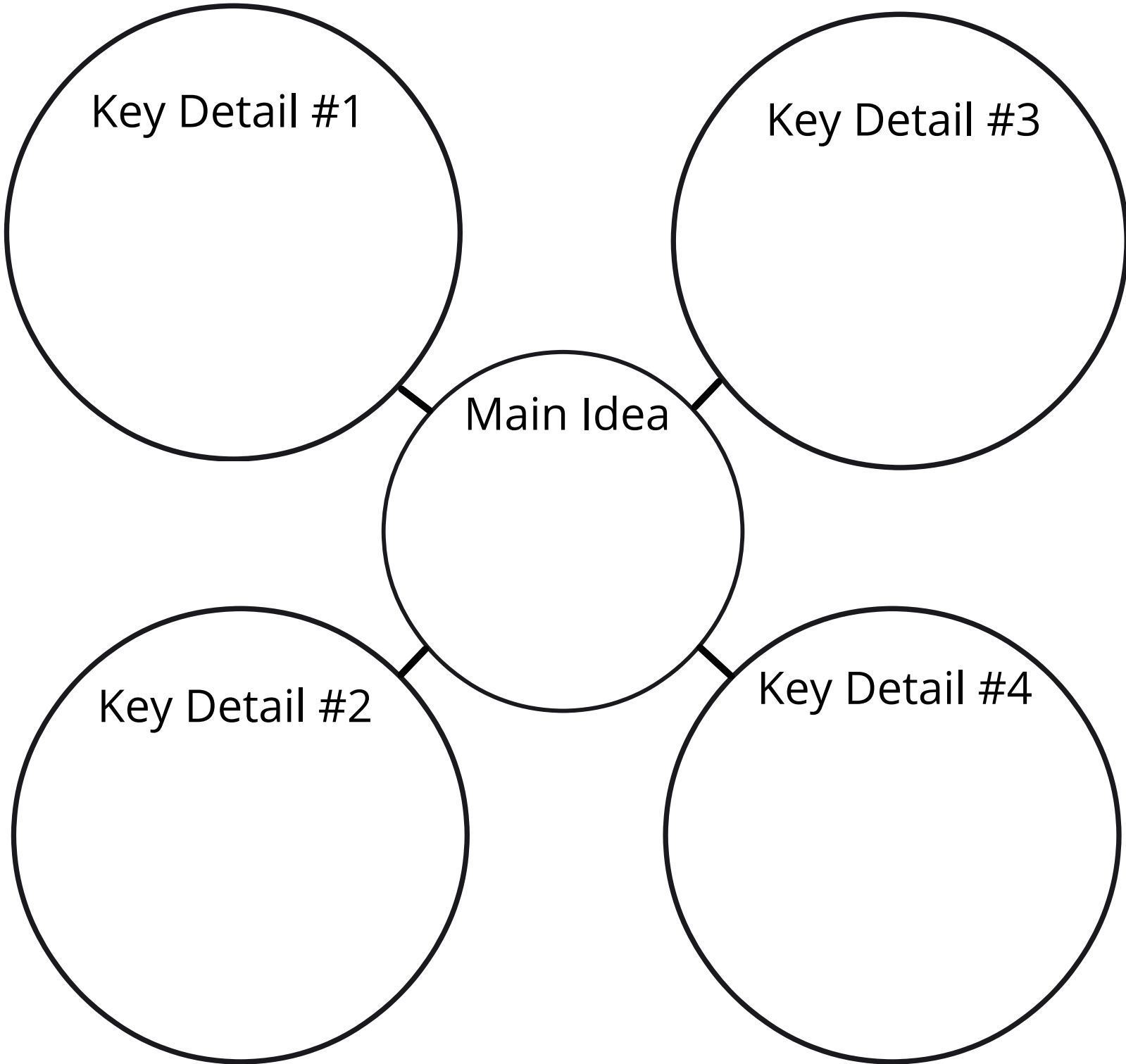




Name: \_\_\_\_\_

# Conveyor Engineering

Graphic Organizer



Name: \_\_\_\_\_

# Conveyor Engineering

## *Engineering Design Process Sheet*

### ASK

What is the problem we are going to solve?

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### IMAGINE

Brainstorm solutions to the problem above.  
Record your ideas in words or pictures.

Name: \_\_\_\_\_

## PLAN

Create a blueprint of the prototype you will build.  
What materials will you use?

## CREATE

You will have \_\_\_\_\_minutes.  
Use this time to build the prototype you planned.

Name: \_\_\_\_\_

## IMPROVE

Edit the prototype that your group made.

Explain the changes that your group made to your model.

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Why did your group make these changes?

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## COMMUNICATE

Share your prototype with the class or another group.

What was the most difficult part of this challenge?

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What was the most successful part of this challenge for your group?

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Washington Community Schools

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## IMAGE AND CONTENT CREDITS

### Images

Stock photography courtesy of Canva.com  
Still video images from "Yolanda - Industrial Engineer," available at <https://regionalsoportunityinc.org/yolanda>

### Content

"Conveyor Engineering," (2020, February 12). Retrieved from <https://tryengineering.org/wp-content/uploads/conveyor.pdf>



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