

# Training Guide

for *The Power  
of the Wind*

90-Minute  
Engineering  
Design  
Process



# Acknowledgements



## Training Guide for *The Power of the Wind*

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**The Power of the Wind Training Guide would not have been possible without The Power of the Wind Youth and Facilitator Guides.**

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# Welcome



### Purpose:

- To identify the purpose of the training.
- To identify key components of the 90-minute training.

### Time:

5 minutes

### Materials:

#### Trainer

#### Resource:

- Agenda on Flipchart

### Trainer Notes:

#### STEP 1: Welcome

Welcome to *The Power of the Wind* 90-Minute Engineering Design Process. Some of you may have more experience than others in facilitating groups of youth in their learning. The overarching goal of this workshop is to enhance your ability to successfully work with youth using *The Power of the Wind* Youth and Facilitator Guides. This training is dependent on *The Power of the Wind* Youth and Facilitator Guides and is designed to deepen your knowledge and skills on how to use those guides most effectively.

#### STEP 2: Review Agenda

*Go over the 90-minute training agenda with the participants:*

- I. Opening and Context Setting – 5 minutes:** *Explain that this will give them a brief taste of two of the activities in the curriculum and increase their knowledge of the Engineering Design Process which is the core framework for the curriculum.*
- II. How Does a Pinwheel Use Wind Power? – 30 minutes:** *With some of the discussion and processing of the activity, point out key pieces of the way the curriculum is organized.*
- III. Examining the Engineering Design Process – 15 minutes:** *Provides an overview of the Engineering Design Process that participants will use during the next activity.*
- IV. Designing a “Better” Pinwheel – 35 minutes:** *Participants have an opportunity to re-design and think through the steps of the Engineering Design Process that they are using.*
- V. Closure – 5 minutes**

*Mention that participants will have an opportunity to experience two activities and become familiar with how the curriculum is set up.*





## How Does a Pinwheel Use Power?

### Purpose:

- To become familiar with a new activity from the curriculum.
- To become competent in completing an engineering-based lesson.

### Time:

30 minutes

### Materials:

- Scissors, straight pins, pencils with erasers, pinwheel pattern from Appendix A or B,
- Pages 14 – 15 from Youth Guide

### Trainer Notes:

#### STEP 1: Context

*Explain to participants that they will complete investigations using the engineering design process, learn about the process itself, and redesign a “product.” This is the first of three workshop segments that will scaffold and help them become competent in leading this curriculum based on engineering design principles.*

#### STEP 2: Activity

Let’s get going! You will have an opportunity to create a pinwheel, a form of a turbine. You will have 30 minutes to complete the activity “How Does a Pinwheel Use Wind Power?” on pages 14 – 15 in the Youth Guide. Please work with someone who you have not yet worked with. Materials are located \_\_\_\_\_ *(tell participants where materials are located)*.



*As participants are doing the activity, the facilitator should move around the room and check in with groups to identify progress and challenges they are having. The activity can take about 30 minutes but if the majority of participants are done early or need extra time, the length of time spent on the activity can be adjusted. Notify participants when they have 5 minutes left. This cue will help them wrap up the activity.*





## STEP 3: Discussion

*Have participants walk around and see what each group did. Have each group share a little about their process. As groups are sharing, choose some of the following questions.*

- When the wind blows straight into the front of the pinwheel, it turns. What happens when the wind blows into the back of the pinwheel or if it blows into the sides? Try both sides and see what happens.
- What adjustments can you make in the design to make your pinwheel turn better?
- How does the pinwheel use the power of the wind?
- The pinwheel and your boat both use wind power. How are they similar? How are they different?<sup>1</sup>

## STEP 4: Transition

*Explain that through this process participants just completed a portion of the engineering design process. They have also just begun sharing and a little processing and generalizing of what they are learning. In the next couple of activities they will not only learn more about the engineering design process, but have a chance to apply some of what they have learned as they build a "better" pinwheel.*

*Tell participants that they will now spend some time working through the engineering design process and reflect on the pieces they've completed. When done explaining, they will have an opportunity to complete the process by redesigning their pinwheel.*



<sup>1</sup> Sebestick, J. *The Power of the Wind Youth Guide*. University of Illinois, 2008, p. 15.





## Examining the Engineering Design Process

### Purpose:

- To identify the components of the engineering design process.
- To identify how the engineering design process works and how it is implemented with *The Power of the Wind*

**Time:** 15 minutes

### Materials:

#### Trainer Resource:

- Engineering design process
- Flip chart with engineering design process

#### Handout:

- Engineering design process chart
- Page 8 from *The Power of the Wind* Youth Guide

### Trainer Notes:

#### STEP 1: Context

*The Power of the Wind* includes the engineering design process and it is important for you to know about this process as you are working with youth. As you built an initial pinwheel, tested, and are now thinking about redesign, you are going through the engineering design process. Please turn to page eight in the Youth Guide. Let's apply the engineering design process to the activity you did.

#### STEP 2: Discussion of Process

*With the chart on the wall and participants referring to it in their books, walk through it briefly so they think about each component. As you do, ask participants about each step and whether they used this in their pinwheel design. Use the trainer resource sheet to discuss the components. If time allows, ask the following questions:*

- What do you notice on this chart?
- How many of you have used something like this with youth already?
- How might this help young people think through their design and their role as engineers?





## STEP 3: Discuss Applying with Youth

The engineering design process really is about identifying a challenge or problem, identifying solutions, testing them, getting results, and making the product better. Think about new products coming out all of the time. One product may have several models or versions. Engineers are continually improving their products.

- How would you go about making this a focal point of the lessons?
- How do you think youth will benefit from using this model?

## STEP 4: Transition

In the next activity, we will use the engineering design process again, but, this time, instead of thinking about it after you have done the activity, I want you to complete the chart as you are doing each step. This is a way for you to become more familiar with the process and to make decisions as a group. Working as “teams” is another important part of how engineers design and an exciting part of this career.

*Hand out the engineering design process chart and say that in the next activity they will have a chance to complete this chart for how they make the pinwheel “better”.*



**STEP 1: What is the challenge?**

Engineering work is based on “challenges” or “problems.” There must be a problem for engineers to solve. Clearly identifying the problem or challenge is the first step to thinking like an engineer.

**STEP 2: How have others solved this?**

Engineers don’t think only by themselves. In order to be efficient in their work, before they attempt to find a solution, they gather information. They might look at similar problems, geography, or a multiple of projects. They may ask other engineers or researchers, or tap into their prior experiences.

**STEP 3: What are the design criteria and constraints?  
Brainstorm possible solutions.**

Before engineers can identify possible solutions, they need to know what is available to them. What is their budget? What are the materials? How much time is available? After identifying these, they can begin to brainstorm possible solutions.

**STEP 4: Which of the possible solutions do you choose?**

Engineers don’t identify only one possible solution. They brainstorm several solutions and identify the pros and cons of each. During their identification of pros and cons, they take into consideration what they know from steps two and three. After careful thought, they can select the best solution for the problem.

# **TRAINER RESOURCE Engineering Design Process**

## **STEP 5: Build a prototype.**

A prototype is a first design of the solution. Engineers know that their work will be refined and the product made better, but they always need to start with an initial design.

## **STEP 6: How does it work? Try it and test again.**

After the prototype is built, it must be tried and tested. Engineers will do several tests to ensure reliability. During the testing phase they will note what works well and what parts of the product need to be improved. They observe and record carefully.

## **STEP 7: How do you learn from the designs of others?**

It is likely that others are working on similar problems or challenges. By sharing those problems and challenges with other engineers, they can get additional ideas for their design and products.

## **STEP 8: How can you use your new ideas to improve your design?**

Looking closely at the initial prototype, data records from initial trials, and learning from others, engineers will redesign and refine to make their products better.





# HANDOUT Engineering Design Process Chart

Remember that the engineering design process is always a circular process like the chart in the Facilitator Guide. This handout merely gives you a place to record your thoughts and progress.

<b>Engineering Design Process</b>	<b>Pinwheel</b>
What was the challenge?	
How have others solved this same challenge?	
What were the design criteria and constraints? How did you brainstorm possible solutions?	
What possible solutions did you choose?	
How did you go about building your prototype?	
How did it work? How did you test it and try it again?	
What did you learn from the design of others?	
How can you use your new ideas to improve your design? <sup>2</sup>	

2. Sebestick, J. *The Power of the Wind Youth Guide*. University of Illinois, 2008, p. 8.





# Designing a “Better” Pinwheel

## Purpose:

- To become competent in completing an engineering-based lesson.
- To become skilled at leading engineering based lessons.
- To increase ability to lead an activity from *The Power of the Wind*.

**Time:** 35 minutes

## Materials:

- Scissors
- Straight pins, pencils with erasers, paper (various weights), pinwheel patterns, paper plates, aluminum pie plates, paper clips, coffee stirrers, popsicle sticks
- Pages 16 – 17 from Youth Guide and Facilitator Guide

## Trainer Notes:

### STEP 1: Context and Introduction

Now that you have constructed an initial pinwheel, and talked about the engineering design process, I have one more challenge for you. In the business world, scientists and engineers are always trying to find ways to improve products and refine their work. Now you will have a chance to make your pinwheel even “better” than we did the first time. Your challenge is to design and construct a “better” pinwheel than your current one.

*Someone may ask what “better” means. In this case, groups can decide HOW they want to make their pinwheel better. Possible ideas include: turn faster, turn for a longer period of time, bigger, smaller, etc. You may want to ask: What are ways you can think of to define better? What would make it better for your team?*

Using the handout for the engineering design process, I want your groups to document what it is they are doing. Take each step and think as a group about how you want to proceed and what it is you want to be able to accomplish. Not unlike other things we have done, this is the intentional aspect of the engineering design process—what do you want to accomplish and how will you figure that out?





## STEP 2: Activity

You will have 15 minutes to design and construct a “better” pinwheel. Materials are located \_\_\_\_\_ *(tell participants where materials are located)*.

*As participants are doing the activity, the facilitator should move around the room and check in with groups to identify progress and challenges they are having. This may be a time when the facilitator encourages the learning with open-ended questions about what is happening, what they have done, what they want to do. Remind people about the handout of the engineering design process. Ask them to make notes on each step of the process as they build a “better” pinwheel.*

## STEP 3: Discussion

Now that you have each completed the activity, let’s share with the group. Each small group needs to describe their design and redesign to the large group.

*Ask the following questions of each group after they share about their model:*

- What element of the design did you choose to to make “better”?
- How did you go about doing it (what was the process)?
- What did you learn through doing this?

## STEP 4: Review as Facilitators

It is now time to put on your “facilitator” or “group leader hats.” Let’s spend some time thinking about what you did and consider what it means to you as a leader working with youth.





Please turn to pages 16 – 17 in *The Power of the Wind Youth Guide*. The activity “How Can We Design a Better Pinwheel?” is essentially the same activity you completed. Let’s look closely at the lesson and see what additional ideas are included that might help you as a leader or a youth complete this activity.

*Have participants look at the lesson in both Youth and Facilitator Guides.  
Have them share additional items that they had not thought about in their activity.*

## **STEP 5: Review the Process**

We had you document what you were doing at each step of the engineering design process so you could become familiar with the steps.

- Why do you think we had you use that tool?
- In what ways did it help you become familiar with the steps in the process?
- What was it like to document what you were doing?
- How might this work with the youth you work with?
- How might you want to do this differently?



# Closure



### Purpose:

- To bring a sense of closure to the training.

### Time:

5 minutes

### Trainer Notes:

#### STEP 1: Closing

During the last 90 minutes you were able to experience two of the activities and become more familiar with how the curriculum is organized.

As a closure for this workshop, please describe in one phrase or sentence how you plan to use this information.





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# 4-H Pledge

I Pledge my **Head**  
to clearer thinking,

my **Heart** to greater loyalty,

my **Hands** to larger  
service,

and my **Health** to  
better living,

for my club, my community, my country, and my world.

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