

**COOPER  
HEWITT  
DESIGN  
K-12**

# **PROBLEM SOLVING THROUGH DESIGN**

## **TEACHER RESOURCE PACKET**



## TABLE OF CONTENTS

<b>WELCOME LETTER</b>	<b>3</b>
<b>PREPARING FOR DESIGN FIELD TRIPS</b>	<b>4</b>
<b>DESIGN THINKING RESOURCES</b>	<b>5</b>
<b>PRE-VISIT ACTIVITIES</b>	<b>5</b>
<b>DIGEST THE LANGUAGE   ALL GRADES</b> <i>SUBJECTS: English, Art, Science</i> <i>DESIGN PROCESS: Getting Ideas</i>	
<b>BRUSH UP YOUR SKILLS   K-5</b> <i>SUBJECTS: English, Science</i> <i>DESIGN PROCESS: Getting Ideas</i>	
<b>BRIDGE COMBO   6-12</b> <i>SUBJECTS: English, Science</i> <i>DESIGN PROCESS: Getting Ideas</i>	
<b>POST-VISIT ACTIVITIES</b>	<b>9</b>
<b>THE SPAGHETTI BRIDGE   ALL GRADES</b> <i>SUBJECTS: Science, Social Studies</i> <i>DESIGN PROCESS: Prototyping, Testing &amp; Evaluating</i>	
<b>ROUND AND ROUND THE MULBERRY BUSH   K-5</b> <i>SUBJECTS: Social Studies, Science, Math</i> <i>DESIGN PROCESS: Prototyping, Testing &amp; Evaluating</i>	
<b>A SEAT FOR EVERYONE   6-12</b> <i>SUBJECTS: Social Studies, Science, Math</i> <i>DESIGN PROCESS: Prototyping, Testing &amp; Evaluating</i>	
<b>VOCABULARY AND HEATHERWICK PROVOCATIONS</b>	<b>13</b>

# COOPER HEWITT DESIGN K-12

September 16, 2015

Dear Educator,

Thank you for registering for Design Field Trips! This exciting program is designed to present Cooper Hewitt, Smithsonian Design Museum's compelling content to your class(es) through an interactive tour and workshop.

Problem solving through design Design Field Trip explores our temporary exhibition *Provocations: The Architecture and Design of the Heatherwick Studio*. During this 90-minute inquiry tour and workshop, students will explore how designers use the design process solve a variety of problems, including how to improve public spaces and everyday products we use. The Heatherwick Studio, known for their unique design concepts ranging from products to finished projects, illustrates how designers problem solve. In the workshop, students apply the design process explored in the galleries to their own challenges as they work in teams to design solutions.

This packet provides several resource activities to help your students prepare for the program and ideas to continue integrating design thinking connections into your classroom. We enjoy receiving feedback from teachers about their experience with the program. Within a month of your museum visit you will be e-mailed a brief survey. Thank you in advance for taking time to provide your feedback so that we can continue to offer a high-quality program for all K-12 schools.

Sincerely,

*Kimberly Cisneros-Gill*

Kimberly Cisneros-Gill

School Programs Manager

*Schuyler Schuler*

Schuyler Schuler

Education Assistant

Activities in collaboration with 2015 Smithsonian-Queensland Fellows, Dawn Boland and Silas Middleton.

## PREPARING FOR YOUR DESIGN FIELD TRIP

During your Design Field Trip, the Design Educator assigned to your group will need your support in helping students stay on task. You must remain with the group at all times with the Design Educator. Please review the following museum guidelines and share them with your chaperones and students.

### ARRIVAL & DEPARTURE

- Please arrive 10 minutes before your scheduled start time to check in; you will be greeted at the main entrance (91<sup>st</sup> Street between Fifth and Madison Avenues)
- Non-NYC teachers with a cash payment, please remit to the Visitor Experience Desk
- Coat check will provide large bins to quickly store and retrieve coats and backpacks
- Please call your bus in advance to meet you in front of the main entrance, and exit through the main entrance

## MUSEUM RULES AND POLICIES

- Please do not touch the objects or lean on the walls; view the objects at a safe distance
- Use only pencils for taking notes or sketching; pens are not permitted
- Food, drinks, and chewing gum are NOT permitted in the museum
- All items entering and leaving the museum are subject to inspection
- Please remain with your assigned group at all times
- Please leave all backpacks and large purses on the bus or at the coat check
- Photography without flash is welcomed; no tripods or selfie-sticks, please

## TAKE AN ACTIVE ROLE

### TEACHER & CHAPERONES

The classroom teacher and chaperones are essential to the success of a group's visit; they can enhance the success of the tour and the amount of learning that can take place by showing active interest in the objects while supervising student behavior.

- Please ensure that you and your group of students (10 students or fewer per chaperone) stay together during your time in the museum (this includes the Shop)
- You and the group chaperones are responsible for keeping track of each student in your group, and for students' proper behavior (including their respect of museum rules and policies)
- If you have questions, ask a museum staff member for help

### STUDENTS

- Students will be encouraged to share their ideas and work in teams
- Students must stay with their chaperones at all times while in the museum and Shop
- Please do not allow students to touch anything unless signs, museum staff members, or designated volunteers let you know it's okay

## DESIGN THINKING CONNECTION

The following pages include pre- and post-Design Field Trip activities. The pre-visit activities are suggestions for how to help your students prepare for their trip; they are designed to introduce students to concepts that will be discussed during the program. The post-visit activities are suggestions for how to extend your students' thinking beyond the program and reinforce your classroom curriculum. For teachers who would like additional ideas, we recommend our free Educator Resource Center (ERC), which offers 400 design-focused lesson plans (available at: <http://dx.cooperhewitt.org/lesson-plans/>).

## PRE-VISIT ACTIVITIES

### DIGEST THE LANGUAGE | ALL GRADES

*SUBJECTS: English, Art, Science | DESIGN PROCESS: Getting Ideas*

*ACTIVITY TYPE: Slideshow and discussion | 30 mins.*

Prior to visiting the museum, it would be helpful to familiarize students with design vocabulary. Using our “Digest the Language” slideshow as a guide, introduce students to the idea that everything we see and touch was made by a designer for specific functions and users. Each slide presents vocabulary and questions to help you lead a discussion around the selected examples. After discussing objects in the classroom, examine what their purposes are and interpret how they are intended to be used.

#### GUIDING QUESTIONS

- What do you think of when you hear the word “design?”
- Who are the users for each of these objects? What are their needs?
- What were the designers' solutions to those needs?

#### VARIATIONS AND EXTENSIONS

Take an informal or formal assessment and compare to final assessments after the post-visit activities.

#### MATERIALS AND RESOURCES NEEDED

If available, a projector and internet connection

Our “Digest the Language” slideshow at [www.cooperhewitt.org/education/school-programs](http://www.cooperhewitt.org/education/school-programs)

#### VOCABULARY

See Cooper Hewitt's design vocabulary on Page 13 of the Teacher Resource Packet

#### STANDARDS

Common Core

English Language Arts R.1, 7, 9; SL.1, 2, 4; L.4, 6

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## BRUSH UP YOUR SKILLS | K-5

*SUBJECTS: English Science | DESIGN PROCESS: Getting Ideas*

*ACTIVITY TYPE: Discussion & Presentation | 45 mins.*

Designers sometimes work organically and sometimes systematically to gather ideas and inspiration. They often borrow ideas from nature or combine existing object and ideas. Using an everyday item, the toothbrush, we will show how the design process can be utilized to improve existing objects. Designers are often inspired by other objects, and sometimes combine them in order to create a new “mashup” design.

### THE DESIGN CHALLENGE

How might we combine one or more objects or ideas to create a new and improved toothbrush? Using the guiding questions below, students will brainstorm an idea for a prototype that combines two or more objects or ideas in an attempt to improve the design of an ordinary toothbrush.

### GUIDING QUESTIONS

- What would you recommend needs changing in a toothbrush?
- Is the toothbrush as comfortable as it can be?
- How could we make the experience more comfortable?
- How could we make a toothbrush more environmentally friendly?
- How could we make a toothbrush represent our personality?
- How can we make the experience of brushing teeth fun?
- How can we ensure people brush their teeth for the correct amount of time?
- How could a toothbrush be designed for a young child?
- How could we make a toothbrush without a handle?
- How could we know when to best change our toothbrush?

### VARIATIONS AND EXTENSIONS

Sometimes when looking at the design we can ‘reverse engineer’ what the designer was possibly thinking and identify the need they were addressing for the user. Reverse engineering involves looking at a finished product and working out how they did it by assessing the parts. Using our “Brush Up Your Skills” slideshow explore the following questions:

1. What purpose or goal can you identify for each toothbrush?
2. What combination of ideas do you think they used for each toothbrush?

### MATERIALS AND RESOURCES NEEDED

If available, a projector and internet connection

Our “Brush Up Your Skills” slideshow at [www.cooperhewitt.org/education/school-programs](http://www.cooperhewitt.org/education/school-programs)

### VOCABULARY

See Cooper Hewitt’s design vocabulary on Page 13 of the Teacher Resource Packet

## STANDARDS

Common Core

English Language Arts: R.1, 7

Learning Standards for New York State

Mathematics, Science, and Technology Standards 1, 4, 6, 7

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## BRIDGE COMBO | 6-12

*SUBJECTS: English Science | DESIGN PROCESS: Getting Ideas*

*ACTIVITY TYPE: Discussion & Presentation | 45 mins.*

Designers are inspired by nature or combining existing objects and ideas. Bridges serve a clear purpose to help connect between two things. However, good designers think beyond just one function, and are creatively embedding multi-purpose functionality and aesthetics into their design. Functionality can be improved by combining objects, ideas, and purposes. Aesthetics can be improved by incorporating inspiration from nature.

### THE DESIGN CHALLENGE

Utilizing drawing and key words, design a bridge concept that combines multiple objects, ideas or purposes to make it both multi-functional and aesthetically appealing.

To assist with this, please choose some random words. Even professional designers sometimes get stuck with ideas, and will often use random words to ignite a starting point. This can easily be done using the web site <http://creativitygames.net/random-word-generator>.

### GUIDING QUESTIONS

- What everyday items have you used where the designer has clearly ‘combined’ functionality?
- Why should considerations be given to combining the functionality of public spaces?
- Aesthetically speaking, what benefits are there in looking at nature for inspiration?
- Functionally speaking, what benefits are there in looking at nature for inspiration?
- Using random words is one method that we introduced to help spark ideas. What other methods would you use, or believe designers would use to spark ideation?

### VARIATIONS AND EXTENSIONS

Sometimes when looking at the design we can ‘reverse engineer’ what the designer was possibly thinking and identify the need they were addressing for the user. Reverse engineering involves looking at a finished product and work out how they did it by looking at the parts. Using our “Bridge Combo” slideshow explore the following questions:

1. What purpose or goal can you identify for each bridge?
2. What combination of ideas do you think they used for each bridge?

### MATERIALS AND RESOURCES NEEDED

If available, a projector and internet connection

Our “Bridge Combo” slideshow at [www.cooperhewitt.org/education/education/school-programs](http://www.cooperhewitt.org/education/education/school-programs)

**VOCABULARY**

See Cooper Hewitt’s design vocabulary on Page 13 of the Teacher Resource Packet

**STANDARDS**

Common Core

English Language Arts: R.1, 7

Learning Standards for New York State

Mathematics, Science, and Technology Standards 1, 4, 6, 7



## POST-VISIT ACTIVITIES

### THE SPAGHETTI BRIDGE | ALL GRADES

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*SUBJECTS: MATHEMATICS, SCIENCE AND SOCIAL STUDIES | DESIGN PROCESS: Prototyping and Testing & Evaluating*

*ACTIVITY TYPE: Hands on building and testing | 45 mins.*

#### THE DESIGN CHALLENGE

How might we design and build a bridge from spaghetti that can have a toy car move across it without breaking?

Students are given 100 spaghetti sticks, 6 ft. of masking tape and 2 balls of playdough or model magic. Students create a drawing (low fidelity) with annotations to help guide their group in the allocation of materials, delegation of jobs within the group, and joining of materials for the final build. Students are then given a time limit within which to build. All groups begin and finish together, with no extra time allowed. Groups then view each other's work and give feedback, and testing begins. Successful groups are able to have the toy car pushed over the bridge without the bridge falling apart or breaking. Student should keep the user of the bridge in their minds throughout the process i.e. the safety of the driver, passengers and cargo. Students then discuss the group work and design process.

#### GUIDING QUESTIONS

- How can we make the spaghetti stronger to withstand more force?
- How can we ensure the safety of the passengers and cargo in the car as it travels across the bridge?
- How can we communicate with others towards a common outcome?
- How might we give feedback in a constructive way so that the creative process can continue?
- What can we do differently in the future to ensure a successful outcome?

#### VARIATIONS AND EXTENSIONS

- Try the online 'Marshmallow Challenge' with students at <http://marshmallowchallenge.com/Welcome.html>
- Try using different materials to construct the bridge and discuss the hypothesis and outcomes of the testing. Compare results (suggestions include popsicle or match sticks and string).
- Try other bridge designs and discuss their strengths and weaknesses.

#### MATERIALS AND RESOURCES NEEDED

- Spaghetti (raw)
- Masking tape (6 ft. per group)
- Playdough or Model Magic - 2 balls per group

## VOCABULARY

Vocabulary may need to be extended depending on the age level.

Prototype, feedback, process, fidelity, evaluation, testing

## STANDARDS

Common Core

CCSS.ELA-LITERACY.CCRA.R.1; CCSS.ELA-LITERACY.CCRA.SL1-6

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## ROUND AND ROUND THE MULBERRY BUSH | K-5

*SUBJECTS: SOCIAL STUDIES, SCIENCE AND MATHEMATICS | DESIGN PROCESS: PROTOTYPING AND TESTING*

*ACTIVITY TYPE: Hands on building and testing | 45 mins.*

### THE DESIGN CHALLENGE

How might we design a way for students to get down the hill that is safe, fun, and keeps them from getting muddy?

There is a hill in your playground where students have worn a pathway down because they do not want to walk around. The hill is 6 ft. long and has an incline of 45 degrees.

Students work in groups to develop drawings (low fidelity) that build on their ideas and that also meet the design challenge. Students then build prototypes of their ideas using a Lego or toy person as the scale for the challenge.

Students present their ideas and share their feedback with other groups. The idea must function as a method to move down the hill i.e. the Lego or toy person can travel down from top to bottom safely, and it must also be part of the landscape of the school.

### GUIDING QUESTIONS

- What are suitable materials for the prototype and for the finished product?
- How can we ensure the safety of the Lego or toy person as they use the product?
- How can we communicate with others towards a common outcome?
- How might we give feedback in a constructive way so that the creative process can continue?
- What can we do differently in the future to ensure a successful outcome?

### VARIATIONS AND EXTENSIONS

- Students design different types of playground equipment.
- Students design a playground for the future.
- Invite experts such as landscape or playground designers to discuss ideas with students.

## **MATERIALS AND RESOURCES NEEDED**

Prototyping materials such as cardboard, cardboard tubes, glue, hot glue, paper clips, matchsticks, material and other repurposed items.

## **VOCABULARY**

Prototype, feedback, testing and evaluation

## **STANDARDS**

Common Core

CCSS.ELA-LITERACY.CCRA.R.1; CCSS.ELA-LITERACY.CCRA.SL1-6

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## **A SEAT FOR EVERYONE | 6-12**

*SUBJECTS: SOCIAL STUDIES, SCIENCE, MATHEMATICS | DESIGN PROCESS: PROTOTYPING AND TESTING*

*ACTIVITY TYPE: hands on building and testing | 45 mins.*

## **THE DESIGN CHALLENGE**

How might we design a perfect outside seat for a multi-purpose area?

Design Brief: Outside at lunch time there is an increasing need for seating where students can charge their devices. Users need these seats to be both collaborative but also have the ability to create solitude should the need arise. Students may wish to work or eat in these seats so the design must be flexible to suit these needs.

Students design and build prototypes for these seats and test and give feedback in regards to their work.

## **GUIDING QUESTIONS**

- What are suitable materials for the prototype and for the finished product?
- How can we ensure the safety of the user outside with electricity?
- How might we create a seating space that blends into the surrounding environment?
- How can we communicate with others towards a common outcome?
- How might we give feedback in a constructive way so that the creative process can continue?
- What can we do differently in the future to ensure a successful outcome?

## **VARIATIONS AND EXTENSIONS**

Students may wish to identify other design challenges around their school and create prototypes

## **MATERIALS AND RESOURCES NEEDED**

A selection of cardboard, glue, hot glue and materials for building.

# COOPER HEWITT DESIGN K-12

## VOCABULARY

Prototype, feedback, testing and evaluation

## STANDARDS

Common Core

CCSS.ELA-LITERACY.CCRA.R.1; CCSS.ELA-LITERACY.CCRA.SL1-6

## VOCABULARY

<b>Color</b>	Color can convey a message. Designers must understand their audiences' perception of color as part of effective design plans.
<b>Design</b>	To make an object that solves a problem
<b>Design challenge</b>	A difficulty or challenge that can be solved through design
<b>Design process</b>	<p>The steps that you take to solve your challenge:</p> <ol style="list-style-type: none"> <li>1. Defining problem</li> <li>2. Getting ideas</li> <li>3. Prototyping and making</li> <li>4. Testing and evaluating</li> </ol>
<b>Design solution</b>	The way, idea, or answer to a design challenge or problem
<b>Designer</b>	A person who creates a new object, idea, or plan
<b>Form</b>	The shape and structure of any three dimensional object that can be defined by light and dark.
<b>Function</b>	The way something works, or a purpose of an object <i>e.g., the function of a paper clip is to fasten things together</i>
<b>Graphic design</b>	The visual communication of messages through images and words
<b>Line</b>	An element of art used to define shape, contours, and outlines. Also to suggest mass and volume. It may be a continuous mark made on a surface with a pointed tool or implied by the edges of shapes and forms.
<b>Materials</b>	The items you are using to represent your ideas
<b>Needs</b>	What the user must have in order to use the design successfully
<b>Pattern</b>	Uses the art elements in planned or random repetitions to enhance surfaces. Patterns often occur in nature.
<b>Prototype</b>	An original model on which something is patterned
<b>Solution</b>	The way, idea, or answer to a problem. There can be more than one
<b>System</b>	A group of related parts that work together
<b>Texture</b>	The surface quality of an object; roughness or smoothness.



# COOPER HEWITT DESIGN K-12

<b>Typography</b>	The design or process of working with type; the general character or appearance of type.
<b>Team</b>	A group working together on a common goal or activity
<b>User</b>	A person who operates or experiences the design
<b>Fidelity (Low/Medium/High)</b>	The level of detail and/or functionality within a prototype

## HEATHERWICK STUDIO'S PROVOCATIONS

PROJECT	PROVOCATION
<b>Autumn Intrusions</b>	How can a shop's window display relate to its architecture?
<b>B of the Bang</b>	What shape should a monument make against the sky?
<b>Spun Chair</b>	Can a rotationally symmetrical form make a comfortable chair?
<b>Olympic Cauldron</b>	How can every country in the Olympic games take part in making and lighting the Olympic cauldron?
<b>Glass Bridge</b>	Is it possible to make a bridge out of glass?
<b>Rolling Bridge</b>	Can a drawbridge open without breaking?
<b>Large Span Rolling Bridge</b>	Is it possible to make a rolling bridge long enough to span the Thames River?
<b>Nanyang Learning Hub</b>	Can a building help change the way we learn?
<b>Garden Bridge</b>	How can you create a garden over the Thames River?
<b>Pier 55</b>	How do you build a public park and performance space that is suspended above water?

\*These projects can be viewed on the web site <http://www.cooperhewitt.org/events/current-exhibitions/provocations-the-architecture-and-design-of-Heatherwick-studio/>

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