



# 10 BUILDINGS THAT CHANGED AMERICA™

COMPANION TO THE  PBS SPECIAL WRITTEN BY **DAN PROTESS** WITH **GEOFFREY BAER**

**wttw**  
CHICAGO

# 10 BUILDINGS THAT CHANGED AMERICA™

## Curriculum for grades 6 through 12

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# Overview

## Attention, students!

Design a building that would make your community better! Explore the history of a place and shape its future through your own designs. Test structural design ideas and create scale drawings of your architectural ideas. Become an architect for your community – get started today!

## Attention, teachers!

The PBS television program, *10 Buildings that Changed America*, can be used as an interdisciplinary teaching tool for grades 6-12. Lesson plans are provided that support academic standards in the core subjects of English Language Arts, Social Studies, Art, Mathematics, and Science. Each lesson plan can be used as a complete stand-alone lesson or can be combined with other subjects to create an interdisciplinary architecture-themed unit. Each lesson plan contains recommendations for interdisciplinary connections with other core subjects. For a truly multidisciplinary unit, all five lessons are combined into One Building to Change My Community.

- PBS reminds teachers to preview all video clips before showing clips to students.
- PBS provides educational resources for teachers ([pbs.org/teachers](http://pbs.org/teachers)).

# Lesson Plans

## English Language Arts: Historic Landmarks: Research and Writing

Students will research and write about a historic landmark, the Seagram Building, describing why the building is considered a landmark and discussing its positive and negative influence on the local community and/or the community at large.

## Social Studies: Build Something Better: Economic Impacts of Development

Students will propose an architectural solution (e.g., new building, renovation, plaza, courtyard) for their community. Proposals will consider the impact of new economic development on communities using Southdale Center in Minnesota, the first regional shopping mall, as a case study. This lesson focuses on critical thinking skills, enabling students to understand the consequences, both intended and unintended, of economic development.

## Art: Make Your Mark: Design with a Purpose

Students will design a new building for their community, explaining how their ideas influenced their artistic decisions. The Vanna Venturi house provides a case study of how one architect designed with a purpose, demonstrating how design decisions can be evidence of the architect's intentions.

## Mathematics: It's in the Details: Math and Scale

Students will learn the concept of scale and why it is important for architects. Using a scale drawing of the Wainwright Building, students will take measurements and make calculations, culminating in the creation of a scale detail drawing of the building.

## **Science: Catenary Curves: Scientific Investigations**

Students will design and conduct an experiment about catenary curves and their structural qualities. Using Dulles International Airport as a case study, students will investigate how catenary curves are important to the structure of the building.

**Note: the PBS television program, *10 Buildings That Changed America*, contains the following content, which some teachers may consider inappropriate for younger or more sensitive students:**

- **In the Dulles Airport segment (used in the Science unit), Reed Kroloff says, “Damn right.”**
- **In the Vanna Venturi House segment (used in the Art unit), Robert Venturi makes an obscene gesture. It is electronically masked, but in a way that makes his intention clear.**
- **In the Southdale Mall segment (used in the Social Studies unit), Victor Gruen is quoted calling later shopping malls “bastard developments.”**



# ENGLISH

# ENGLISH



## Introduction

### Historic Landmarks: Research and Writing

#### Overview

In this lesson, students will research and write about a historic landmark, the Seagram Building, describing why the building is considered a landmark and discussing its positive and negative influence on the local community and/or the community at large.

**Grades:** 6-12

**Time:** 3 class sessions, plus independent student work

#### Standards & Objectives

This lesson addresses selected standards from the Common Core State Standards for English Language Arts. These can be found in the section titled “ENGLISH STANDARDS.”

In addition to the English Language Arts Standards, students will be able to:

- Define the characteristics of a historic landmark.
- Justify the decision to call a building a landmark or not.
- Analyze the impact of a landmark building on the local community and/or the community at large.

#### Teach This Lesson

Preparation and resources for teaching this lesson are found in the section titled “ENGLISH PREPARATION AND RESOURCES.”

Instructions for teaching this lesson are found in the section titled “ENGLISH INSTRUCTION.”

#### Interdisciplinary Connections

The PBS television program, *10 Buildings that Changed America*, provides lesson plans in four additional subjects: Art, Mathematics, Science, and Social Studies. All five lessons are combined in an interdisciplinary unit: One Building to Change My Community.

This English Language Arts lesson can be paired with another *10 Buildings that Changed America* lesson plan to create interdisciplinary connections.

- **Art:** After researching how historic buildings have influenced communities and culture, students should consider positive and negative impacts of the buildings they design in the Art lesson.

- **Science:** During student research on the Seagram Building, ensure they learn about the structure and materials of the building. As an extension of the Science lesson, explore steel framing or reinforced concrete.
- **Social Studies:** The research process is similar in the Social Studies and English Language Arts lessons. The influence of zoning and financial incentives can also be considered with the Seagram Building.

# ENGLISH

## Preparation and Resources

### Historic Landmarks: Research and Writing

#### Preparation

To prepare to teach this lesson, teachers should:

- Watch the Seagram Building segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings).
- Review the section titled “ENGLISH INSTRUCTION.”
- Review the worksheet titled “ENGLISH WORKSHEET.”
- Review resources below to be familiar with the Seagram Building and its impact on the local community and/or the community at large.

Additionally, teachers may consider identifying a select number of resources for students to use during the lesson based on the needs of their students. Providing students with a limited number of preselected sources or passages can reduce research time and focus on the reading level of students.

#### Resources

##### Books

*Building Seagram* by Phyllis Lambert

*Mies van der Rohe: A Critical Biography* by Franz Schulze

*The Seagram Building: Building Blocks Series* by Ezra Stoller

##### Online Sources

Neighborhood Preservation Center: Historic Designation Report

([neighborhoodpreservationcenter.org/db/bb\\_files/Seagram-Building--Including-The-Plaza.pdf](http://neighborhoodpreservationcenter.org/db/bb_files/Seagram-Building--Including-The-Plaza.pdf))

# ENGLISH

## Standards

### Historic Landmarks: Research and Writing

#### Academic Standards

This lesson is aligned with the Common Core State Standards for English Language Arts.

#### Reading Informational Text

RI.7.1: Cite several pieces of textual evidence to support analysis of what the text says explicitly, as well as inferences drawn from the text.

RI.7.3: Analyze the interactions between individuals, events, and ideas in a text.

RI.7.8: Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.

#### Common Core: Writing

W.7.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

W.7.6: Use technology, including the Internet, to produce and publish writing and link to and cite sources, as well as to interact and collaborate with others, including linking to and citing sources.

W.7.8: Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

# ENGLISH

## Instruction

### Historic Landmarks: Research and Writing

#### Instruction

Students will research and write about a historic landmark, the Seagram Building in New York City. This lesson builds research and writing skills, enabling students to describe why the Seagram Building is considered a landmark and to discuss its positive and negative influence on the local community and/or the community at large.

**Activity 1:** The Seagram Building

**Activity 2:** The Research Assignment

**Activity 3:** Evaluating and Editing

**Assessment**

#### Activity 1: The Seagram Building

1. Facilitate student discussion about landmarks, so students are able to:
  - Differentiate between local landmarks with significance to the local community and landmarks that are recognized by a broader audience.
  - Understand that landmarks can be significant for a variety of reasons.
  - Understand that the National Register of Historic Places ([nps.gov/nr](https://www.nps.gov/nr)) is not a comprehensive list of American landmarks.



Two views of The Seagram Building

- Understand that other, often local, organizations designate and document landmarks. In New York, landmark organizations include the New York City Landmarks Preservation Commission ([nyc.gov/html/lpc/html/home/home.shtml](http://nyc.gov/html/lpc/html/home/home.shtml)) and the Neighborhood Preservation Center ([neighborhoodpreservationcenter.org](http://neighborhoodpreservationcenter.org)).
2. Based on discussion, have students write their own definition of a landmark or create a class definition.
  3. Introduce assignment to students. Explain they will be researching and writing about a historic landmark, the Seagram Building, describing why the building is considered a landmark and discussing its positive and negative influence on the local community and/or the community at large.
  4. Watch the Seagram Building segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). Prompt students to take notes during the segment.
  5. Facilitate discussion about the Seagram Building segment. Note opportunities for further research. Questions to prompt discussion may include:
    - What makes the Seagram Building a landmark (or not a landmark, if they can support the argument)?
    - How did the Seagram Building affect the neighborhood surrounding it? Consider both positive and negative aspects.
    - How did the Seagram Building impact future development? Consider zoning ordinances and similar architectural designs by Mies van der Rohe and other architects.
  6. In small groups, use ideas from discussion to create thesis statements to share with the class.

## Activity 2: The Research Assignment

1. Review or introduce research techniques appropriate for grade level (ask your librarian!).
2. Explain the assignment: Students will write a research paper (length TBD by teacher) about the Seagram Building describing why the Seagram Building is considered a landmark and discussing its positive and negative influence on the local community and/or the community at large.
3. Individually, have students prepare to research and write by completing the worksheet titled “ENGLISH WORKSHEET.” Provide time for students to research.
4. In small groups, have students trade thesis statements and discuss:
  - How does the thesis statement address the assignment?
  - Describe three arguments you could make to support the thesis statement.
5. Individually, have students revise their thesis and arguments based on peer discussion. Collect and provide feedback to students.
6. Review assignment expectations and provide time for students to do independent research and writing. Provide additional research and writing guidance as needed.

### Activity 3: Evaluating and Editing

1. After students create a thesis statement and find resources to support it, create small groups to discuss what resources they found and which are the most and least reliable. Have the groups share their reasoning with the class. Students should use this list as a guide for finalizing their selection of sources.
2. After students have written a draft of their paper, have peers review the paper and answer the following questions:
  - What is the thesis statement?
  - Identify the key arguments supporting the thesis. Explain how these arguments work together (or don't work together) to support the thesis.
  - What else could be added to support the thesis?
  - Are citations provided for every supporting argument? If not, identify what should be cited.
  - What counterarguments could be made in opposition to the thesis? What support do you have for these?
  - Note any grammatical or spelling errors you find.
3. Collect draft papers and peer feedback. Evaluate peer feedback and provide additional comments on drafts before returning to students for revisions.

### Assessment

Assignments are designed to address the standards and learning goals of the lesson. Each assignment is mapped to the appropriate standards and learning goals.

1. Evaluate and comment on student theses and arguments before they write their first draft.
  - RI.7.1: Cite several pieces of textual evidence to support analysis of what the text says explicitly, as well as inferences drawn from the text.
2. Review and comment on students' first draft.
  - W.7.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
3. Review and comment on students' peer analysis.
  - RI.7.3: Analyze the interactions between individuals, events, and ideas in a text.
  - RI.7.8: Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.
4. Assess students' final papers based on their ability to:
  - W.7.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
  - W.7.6: Use technology, including the Internet, to produce and publish writing and link to and cite sources, as well as to interact and collaborate with others, including linking to and citing sources.
  - W.7.8: Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

# English Worksheet - Historic Landmarks: Research and Writing

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## Preparing to Research and Write

Read the paragraph below and answer the following questions.

While the design of the Seagram Building may seem ordinary, at the time of its construction, it was visionary. It was built between 1956 and 1958 in the minimalist “International Style” by the famous architect Mies van der Rohe and is widely recognized as his most famous building. It is a modular design of bronze and glass. Where a typical building would have begun at the edge of the sidewalk, the Seagram Building is set back from the street by a large plaza. As a result of the plaza, the building becomes a focal point and a public space is created – features that transformed future design of public space in cities.

## Questions

1. Underline the thesis statement.
2. Explain how the thesis addresses the assignment.

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3. What information in the paragraph should be cited?

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4. Describe three arguments you could make to support the thesis statement. (May require some research.)

a. 

---

b. 

---

c. 

---

## Prepare ideas for your paper about the Seagram Building.

Write your thesis:

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Describe three arguments to support your thesis (include citations).

1. 

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Citation(s): 

---

2. 

---

Citations(s): 

---

3. 

---

Citation(s): 

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# **SOCIAL STUDIES**

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# SOCIAL STUDIES



## Introduction

### Build Something Better: Economic Impacts of Development

#### Overview

Students will propose an architectural solution (e.g., new building, renovation, plaza, courtyard) for their community. Proposals will consider the impact of new economic development on communities using Southdale Center in Minnesota, the first regional shopping mall, as a case study. This lesson focuses on critical thinking skills, enabling students to understand the consequences, both intended and unintended, of economic development.

**Grades:** 6-12

**Time:** 2 class sessions, plus independent student work

#### Standards & Objectives

This lesson addresses selected standards from the McRel Standards for Economics. These can be found in the section titled “SOCIAL STUDIES STANDARDS.”

#### Teach This Lesson

Preparation and resources for teaching this lesson are found in the section titled “SOCIAL STUDIES PREPARATION AND RESOURCES.”

Instructions for teaching this lesson are found in the section titled “SOCIAL STUDIES INSTRUCTION.”

#### Interdisciplinary Connections

The PBS television program, *10 Buildings that Changed America*, provides lesson plans in four additional subjects: Art, English Language Arts, Science, and Mathematics. All five lessons are combined in an interdisciplinary unit: One Building to Change My Community.

This Social Studies lesson can be paired with another *10 Buildings that Changed America* lesson plan to create interdisciplinary connections.

- **Art:** The built structure proposed in the Social Studies lesson can become the building designed and modeled in the Art lesson. Students can set their design intentions to be similar to their expected outcome of their Social Studies proposal, and determine their design strategy so that their expected outcome is more realistic.
- **English Language Arts:** Students can look into how zoning/financial incentives influenced the Seagram Building. Additionally, students can think about how their own design could be a landmark in their community.

# **SOCIAL STUDIES**

## **Preparation and Resources**

### **Build Something Better: Economic Impacts of Development**

#### **Preparation**

To prepare to teach this lesson, teachers should:

- Watch the Southdale Center segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). **CONTENT NOTE: In this segment, Victor Gruen is quoted as calling later shopping malls “bastard developments.”**
- Review the section titled “SOCIAL STUDIES INSTRUCTION.”
- Review the worksheet titled “SOCIAL STUDIES WORKSHEET.”
- Review resources below to be familiar with the Southdale Center and its impact on the local community and/or the community at large.

#### **Resources**

##### **Books**

*Mall Maker: Victor Gruen, Architect of an American Dream* by M. Jeffrey Hardwick

*Centers for the Urban Environment: Survival of the Cities* by Victor Gruen

*Shopping Towns USA: The Planning of Shopping Centers* by Victor Gruen and Larry Smith

##### **Online Sources**

Minnesota Historical Society

([mnhs.org/library/tips/history\\_topics/72southdale.html](http://mnhs.org/library/tips/history_topics/72southdale.html))

# **SOCIAL STUDIES**

## **Standards**

### **Build Something Better: Economic Impacts of Development**

#### **Academic Standards**

This lesson is aligned with the McRel Learning Standards for Economics.

#### **McRel Economics:**

##### **Level III (Grades 6-8)**

Standard 2: Understands characteristics of different economic systems, economic institutions, and economic incentives.

9. Understands that many non-economic factors (e.g., cultural traditions and customs, values, interests, abilities) influence patterns of economic behavior and decision-making.

##### **Level IV (Grades 9-12)**

Standard 4: Understands basic features of market structures and exchanges.

4. Understands that the introduction of new products and production methods by entrepreneurs is an important form of competition and source of technological progress and economic growth.
5. Understands that externalities are unintended positive or negative side effects that result when the production or consumption of a good or service affects the welfare of people who are not the parties directly involved in the market exchange.

# **SOCIAL STUDIES**

## **Instruction**

### **Build Something Better: Economic Impacts of Development**

#### **Instruction**

Students will propose an architectural solution (e.g., new building, renovation, plaza, courtyard) for their community. Proposals will consider the impact of new economic development on communities using Southdale Center in Minnesota, the first regional shopping mall, as a case study. This lesson focuses on critical thinking skills, enabling students to understand the consequences, both intended and unintended, of economic development.

**Activity 1:** The Southdale Center

**Activity 2:** Brainstorming

**Activity 3:** Creating a Poster

**Assessment**

#### **Activity 1: The Southdale Center**

1. With the entire class, brainstorm a list of where students shop and where they do not, focusing on location, not individual stores. Once a list is created, ask students why some locations are more successful than others.



**The Southdale Center**

2. Introduce assignment to students. Explain that they will be proposing their own new economic/commercial center for their communities.
3. Watch the Southdale Center segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). Prompt students to take notes during the segment. **CONTENT NOTE: In this segment, Victor Gruen is quoted calling later shopping malls “bastard developments.”**
4. Facilitate discussion about the Southdale Center segment. Questions to prompt discussion may include:
  - What were Victor Gruen’s intentions for the Southdale Shopping Center?
  - What were some of the economic outcomes of the shopping center?
  - In what ways did the Southdale Shopping Center not meet Gruen’s design intentions?
  - Thinking about Gruen’s intended consequences and the Southdale Center’s unintended consequences, what factors should be considered when proposing new economic development in a community? Consider both economic factors and non-economic factors (e.g., cultural traditions and customs, values, interests, abilities).

## Activity 2: Brainstorming

1. Ask students to think about development that has been made in their own communities and the effects it has had (positive or negative). Teachers should be familiar with a few local instances of economic change, ideally with at least one current example. For example, instances of economic change could be a new construction or renovation project in the community or a recent loss (e.g., department store closing). On a larger scale, this could be a new industry (e.g., wind, Marcellus shale) or a declining one (e.g., auto, manufacturing).
2. Brainstorm list of development ideas with students.
3. Select one item from the list and identify its economic and non-economic impacts on the community. Identify each impact as positive or negative (or both) and explain why. Hypothesize whether or not each impact was intended or unintended and explain why. Have students document this example on worksheet titled “SOCIAL STUDIES WORKSHEET.”
4. Students should select three more items and complete the worksheet individually. Encourage them to talk with adults about the economic impact of the examples they have selected.

## Activity 3: Creating a Poster

1. Introduce the assignment in greater depth. Explain that students will be creating a poster of an architectural solution (e.g., new building, renovation, plaza, courtyard) for their community. Posters should be designed to convince local government officials that the new project is essential to improving the community, explaining the potential economic and non-economic impacts of the project.
2. As a class, brainstorm ideas for new community development. Discuss ideas, considering the benefits to the community, feasibility, and cost-effectiveness.
3. Each student should propose a project (e.g., new building, renovation, plaza, courtyard) and write an overview of why they selected it and what impact it would have on their community. Proposals should include a ranked list of positive impacts to demonstrate the value of the project to government officials. Additionally, potential negative impacts should be discussed in the proposal.

4. In small groups, students should discuss proposals. Peers should discuss the ranked list and propose ideas to modify the project to alleviate the negative impacts.
5. Using text and images, students will design a poster that clearly illustrates their proposal to their community. Consider inviting local government officials to view the posters.

## **Assessment**

Assignments are designed to address the standards and learning goals of the lesson. Each assignment is mapped to the appropriate standards and learning goals.

1. Evaluate and comment on both lists that the students created before they design their final proposal.
  - Level III Standard 2.9: Understands that many non-economic factors (e.g., cultural traditions and customs, values, interest, abilities) influence patterns of economic behavior and decision-making.
2. Assess the students' final poster proposals, evaluating their ability to clearly represent their ideas and having a clear understanding of its potential effects.
  - Level IV Standard 4.4: Understands that the introduction of new products and production methods by entrepreneurs is an important form of competition and source of technological progress and economic growth.
  - Level IV Standard 4.5: Understands the externalities are unintended positive or negative side effects that result when the production or consumption of a good or service affects the welfare of people who are not the parties directly involved in the market exchange.

**Social Studies Worksheet - Build Something Better: Economic Impacts of Development**

| Development | Consequences | Positive or Negative, and Why? | Intended Consequence? Why or why not? |
|-------------|--------------|--------------------------------|---------------------------------------|
|             |              |                                |                                       |
|             |              |                                |                                       |
|             |              |                                |                                       |
|             |              |                                |                                       |



# ART

# ART



## Introduction

### Make Your Mark: Design with a Purpose

#### Overview

Students will design a new building for their community, explaining how their ideas influenced their artistic decisions. The Vanna Venturi House provides a case study of how one architect designed with a purpose, demonstrating how design decisions can be evidence of the architect's intentions.

**Grades:** 6-12

**Time:** 3 class sessions, plus optional independent student work

#### Standards & Objectives

This lesson addresses selected standards from the McRel Visual Arts Standards. These can be found in the section titled "ART STANDARDS."

In addition to the Visual Arts Standards, students will be able to:

- Identify Venturi's design intentions for the Vanna Venturi House
- Understand the general process of design for architects

#### Teach This Lesson

Preparation and resources for teaching this lesson are found in the section titled "ART PREPARATION AND RESOURCES."

Instructions for teaching this lesson are found in the section titled "ART INSTRUCTION."

#### Interdisciplinary Connections

The PBS television program, *10 Buildings that Changed America*, provides lesson plans in four additional subjects: English Language Arts, Mathematics, Science, and Social Studies. All five lessons are combined in an interdisciplinary unit: One Building to Change My Community.

This Art lesson can be paired with another *10 Buildings that Changed America* lesson plan to create interdisciplinary connections.

- **English Language Arts:** After researching how historic buildings have influenced communities and culture, students should consider positive and negative impacts of the buildings they design in the Art lesson.
- **Mathematics:** After understanding how to properly draw a building at a particular scale, students should think about using this as a way to draw the buildings they design in the Art lesson.
- **Science:** After experimenting with different ways to build a curved structure, students can apply this knowledge to their design in the Art lesson to make a model.

- **Social Studies:** The built structure proposed in the Social Studies unit can become the building designed and modeled in the Art unit. Students can set their design intentions to be similar to the expected outcome of their Social Studies proposal, and determine their design strategy so that their expected outcome is more realistic.

# ART

## Preparation and Resources

### Make Your Mark: Design with a Purpose

#### Preparation

To prepare to teach this lesson, teachers should:

- Watch the Vanna Venturi House segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). **CONTENT NOTE: In this segment, Robert Venturi makes an obscene gesture. It is electronically masked, but in a way that makes his intention clear.**
- Review the section titled “ART INSTRUCTION.”
- Review resources below to be familiar with the Vanna Venturi House.
- Review resources below to be familiar with model-making techniques.

#### Resources

##### Books

*Key Houses of the Twentieth Century: Plans, Sections and Elevations* by Colin Davies

*The Architecture of Robert Venturi* by Christopher Mead

*Architectural Modelmaking* by Nick Dunn

*Model Making* by Megan Werner

##### Online Sources

ArchDaily

([archdaily.com/62743/ad-classics-vanna-venturi-house-robert-venturi](http://archdaily.com/62743/ad-classics-vanna-venturi-house-robert-venturi))

Vanna Venturi House on Wikipedia

([en.wikipedia.org/wiki/Vanna\\_Venturi\\_House](http://en.wikipedia.org/wiki/Vanna_Venturi_House))

# ART

## Standards

### Make Your Mark: Design with a Purpose

#### Academic Standards

This lesson is aligned with the McRel Visual Arts Standards.

#### McRel Visual Arts

##### Level III (Grades 5-8)

Standard 1: Understands and applies media, techniques, and processes related to the visual arts.

1. Understands what makes different art media, techniques, and processes effective (or ineffective) in communicating various ideas.
2. Knows how the qualities and characteristics of art media, techniques, and processes can be used to enhance communication of experiences and ideas.

##### Level IV (Grades 9-12)

Standard 1: Understands and applies media, techniques, and processes related to the visual arts.

1. Applies media, techniques, and processes with sufficient skill, confidence, and sensitivity that one's intentions are carried out in artworks.
2. Understands how the communication of ideas relates to the media, techniques, and processes one uses.

# ART

## Instruction

### Make Your Mark: Design with a Purpose

#### Instruction

Students will design a new building for their community, explaining how their ideas influenced their artistic decisions. The Vanna Venturi House provides a case study of how one architect designed with a purpose, demonstrating how design decisions can be evidence of the architect's intentions.

**Activity 1:** The Vanna Venturi House

**Activity 2:** Design Development

**Activity 3:** Model Building

**Assessment**

#### Activity 1: The Vanna Venturi House

1. Introduce assignment to students. Explain that they will be designing a new building for their community.
2. Watch the Vanna Venturi House segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). Prompt students to take notes during the segment about Robert Venturi's design intentions – the reason behind his design decisions. **CONTENT NOTE: In this segment, Robert Venturi makes an obscene gesture. It is electronically masked, but in a way that makes his intention clear.**



**The Vanna Venturi House**

3. Facilitate discussion about the Vanna Venturi House segment. Questions to prompt discussion may include:
  - What were Robert Venturi's design intentions?
  - How are these intentions evident in the design of the house?
4. Brainstorm ideas for what may play a role in determining the students' design intentions. Consider sustainability, weather, social engagement, and history as starting points. For example, creating a sustainable building may change how the building is oriented or the materials used. Students may want to encourage specific social behaviors, such as spending more time outdoors. Ideas for design intentions can be reactions against something the students dislike, as in Venturi's reaction to Modernism. Consider responses that are based on stylistic reactions such as Venturi's – or any other reaction, such as a cultural reaction to the lack of in-person contact in the digital age. Some students may find it easier to brainstorm problems or concerns and create their design intentions as a reaction to them.
5. Individually, have students identify three ideas that they are interested in using to inform their design intentions.

## **Activity 2: Design Development**

1. In small groups, have students discuss how their design intentions could be made evident in architectural designs.
2. Students should sketch ideas for their buildings.
3. In small groups or as a class, have students present their design intentions and sketches. Encourage peer discussion about student projects. Pair students to take notes for one another during peer discussion. Consider the following questions as prompts:
  - What about the design best exemplifies the intentions?
  - How would you revise the design to make the intentions more evident?

## **Activity 3: Model Building**

1. Using the feedback from the peer discussion, students should revise their designs and build models of their designs. Model-building techniques and suggested materials can be found in the two books listed in the section titled "ART PREPARATION AND RESOURCES."
2. If time permits, have students create sketch models (rough draft models) so they can see how their designs transform into three dimensions. Sketch models provide students with experience building models and an opportunity to see their designs in three dimensions. Lead a peer review of sketch models before students build final models. Revisit discussion about design intentions and introduce discussion about making well-crafted models.

## Assessment

Assignments are designed to address the standards and learning goals of the lesson. Each assignment is mapped to the appropriate standards and learning goals.

1. Evaluate written design intentions and models.
  - Level III Standard 1.1: Understands what makes different art media, techniques, and processes effective (or ineffective) in communicating various ideas.
  - Level III Standard 1.2: Knows how the qualities and characteristics of art media, techniques, and processes can be used to enhance communication of experiences and ideas.
  - Level IV Standard 1.1: Applies media, techniques, and processes with sufficient skill, confidence, and sensitivity that one's intentions are carried out in artworks.
  - Level IV Standard 1.2: Understands how the communication of ideas relates to the media, techniques, and processes one uses.



# MATHEMATICS

# MATHEMATICS



## Introduction

### It's in the Details: Math and Scale

#### Overview

Students will learn the concept of scale and why it is important for architects.

Using a scale drawing of the Wainwright Building, students will take measurements and make calculations, culminating in the creation of a scale detail drawing of the building.

**Grades:** 6-12

**Time:** 2 class sessions

#### Standards & Objectives

This lesson addresses selected standards from the Common Core State Standards for Mathematics. These can be found in the section titled “MATHEMATICS STANDARDS.”

In addition to the Mathematic Standards, students will be able to:

- Understand why architects use scale drawings
- Explain why different scales are used for different drawings

#### Teach This Lesson

Preparation and resources for teaching this lesson are found in the section titled “MATHEMATICS PREPARATION AND RESOURCES.”

Instructions for teaching this lesson are found in the section titled “MATHEMATICS INSTRUCTION.”

#### Interdisciplinary Connections

The PBS television program, *10 Buildings that Changed America*, provides lesson plans in four additional subjects: Art, English Language Arts, Science, and Social Studies. All five lessons are combined in an interdisciplinary unit: One Building to Change My Community.

This Mathematics lesson can be paired with another *10 Buildings that Changed America* lesson plan to create interdisciplinary connections.

- **Science:** During student research on the Wainwright Building, ensure they learn about the structure and materials of the building. As an extension of the Science lesson, explore the invention of the elevator and how it allowed for buildings to grow taller.
- **Art:** After understanding how to properly draw a building at a particular scale, students should think about using this as a way to draw the buildings they design in the Art lesson.

# MATHEMATICS

## Preparation and Resources

### It's in the Details: Math and Scale

#### Preparation

To prepare to teach this lesson, teachers should:

- Watch the Wainwright Building segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings).
- Review the section titled “MATHEMATICS INSTRUCTION.”
- Review the worksheets titled “MATHEMATICS WORKSHEET #1” and “MATHEMATICS WORKSHEET #2.”
- Review resources below to be familiar with the Wainwright Building.

#### Resources

##### Books

*Skyscrapers: A History of the World's Most Extraordinary Buildings* by Judith Dupre

*The Autobiography of an Idea* by Louis H. Sullivan

*Louis Sullivan: The Function of Ornament* by David Van Zanten

##### Online Sources

Missouri State Historical Preservation Office

([stlcin.missouri.org/history/structdetail.cfm?Master\\_ID=1361](http://stlcin.missouri.org/history/structdetail.cfm?Master_ID=1361))

# MATHEMATICS

## Standards

### It's in the Details: Math and Scale

#### Academic Standards

This lesson is aligned with the Common Core State Standards for Mathematics.

#### Common Core: Geometry

7.G.1: Solve the problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing in a different scale.

7.G.6: Solve real-world and mathematical problems involving area, surface area, and volume.

Modeling with Geometry G-MG: Apply geometric concepts in modeling situations.

# MATHEMATICS

## Instruction

### It's in the Details: Math and Scale

#### Instruction

Students will learn the concept of scale and why it is important for architects.

Using a scale drawing of the Wainwright Building, students will take measurements and make calculations, culminating in the creation of their own detail drawing of the building.

**Activity 1:** The Wainwright Building

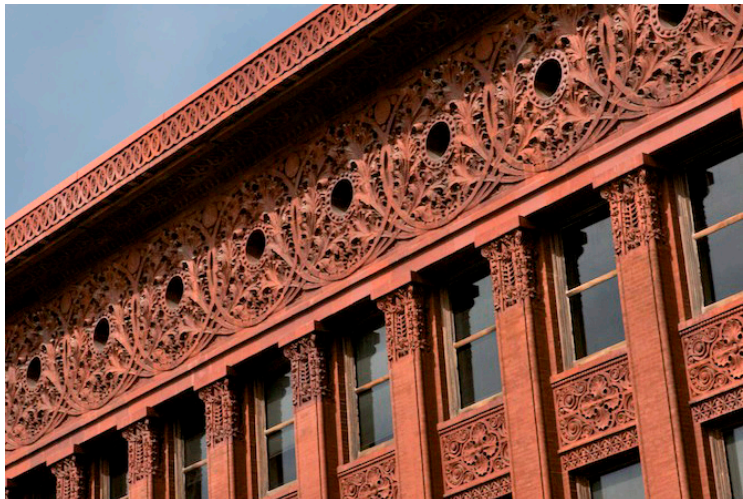
**Activity 2:** The Scale Façade

**Activity 3:** Detail Drawing

**Assessment**

## Activity 1: The Wainwright Building

1. Facilitate a student discussion about scale, so students are able to:
  - Understand that a scale drawing has dimensions at a specific ratio with respect to an actual (existing or planned) object.
  - Understand that mathematical calculations are used to determine the dimensions of a drawing based on an actual object or vice versa.
  - Understand that more detail can be shown on larger scale drawings, as these are “close-ups” of a part of the building.
2. Introduce the assignment to students. Explain they will be redrawing a part of the façade of the Wainwright Building to scale.
3. Watch the Wainwright Building segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). Prompt students to take notes during the segment.
4. Facilitate discussion about the Wainwright Building segment. Questions to prompt discussion may include:
  - What are some significant things about the Wainwright Building?
  - Based on the discussion of scale, what details on the Wainwright Building might be left off a drawing of the entire building?
  - Discuss the level of detail that can be seen from a distance (i.e., imagine looking up at the top of the Wainwright Building from the sidewalk). Consider how this compares to what is shown on drawings of different scales (i.e., a drawing of the entire building and a detail showing the entrance).



Two views of the Wainwright Building

## Activity 2: The Scale Façade

1. Explain the assignment: Students will solve measurement and scale problems based on a façade drawing of the Wainwright Building on the worksheet titled “MATHEMATICS WORKSHEET #1.”
  - A façade is the “face” or one side, often the front, of a building.
  - A pilaster is a rectangular protrusion from a wall that resembles a column.
2. Guide the class through the first few questions on page one of the worksheet “MATHEMATICS WORKSHEET #1,” demonstrating how to measure the pilaster and convert to 1/32-inch scale. It is approximately 2.5 inches tall (on paper), yielding an actual height of approximately 80 feet (2.5 inches x 32 feet/inch = 80 feet).
3. Individually, have students complete the window calculations. If students finish quickly, have them do more measurements and calculations based on the façade – providing slower students with more time to complete the window calculations. This provides students with practice converting scale drawing dimensions into actual measurements.
4. Guide the class through calculating scale dimensions from actual measurements on page two of the worksheet “MATHEMATICS WORKSHEET #1.”
5. Individually, have students complete the calculations and explanations.
6. Explain how knowing the scale of one drawing and the scale of another drawing establishes a multiplier for determining how to transform the length or area of an object in one scale to another scale. In this case, from 1/32-inch scale to 1/8-inch scale, a multiplier of 4 converts the length of an object; because area is length times width, a multiplier of 16 (4 times 4) converts the area of an object. For example, an eight-foot-tall window would be represented by a rectangle 1/4-inch-tall in 1/32-inch scale; using the multiplier, this would be 1/4 inch x 4 = 1 inch in 1/8-inch scale. Multipliers vary based on which scales are being used.

## Activity 3: Detail Drawing

1. Explain that students will be creating detail drawings that show more information about the building than can be seen when the drawing is a small scale (such as 1/32-inch scale). The drawings will be created on the graph paper area of the worksheet titled “MATHEMATICS WORKSHEET #2.”
2. Review the steps of the drawing assignment and check for understanding.
3. Individually, have students complete the worksheet.

## Assessment

Assignments are designed to address the standards and learning goals of the lesson. Each assignment is mapped to the appropriate standards and learning goals.

1. Assess the students' "WORKSHEET #1" for accuracy.
  - 7.G.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
2. Assess the students' process of problem-solving to identify how students solved calculation problems or where they made mistakes.
  - 7.G.6: Solve real-world and mathematical problems involving area, surface area, and volume.
  - Modeling with Geometry G-MG: Apply geometric concepts in modeling situations.

# Mathematics Worksheet #1 (page 1) - It's in the Details: Math and Scale

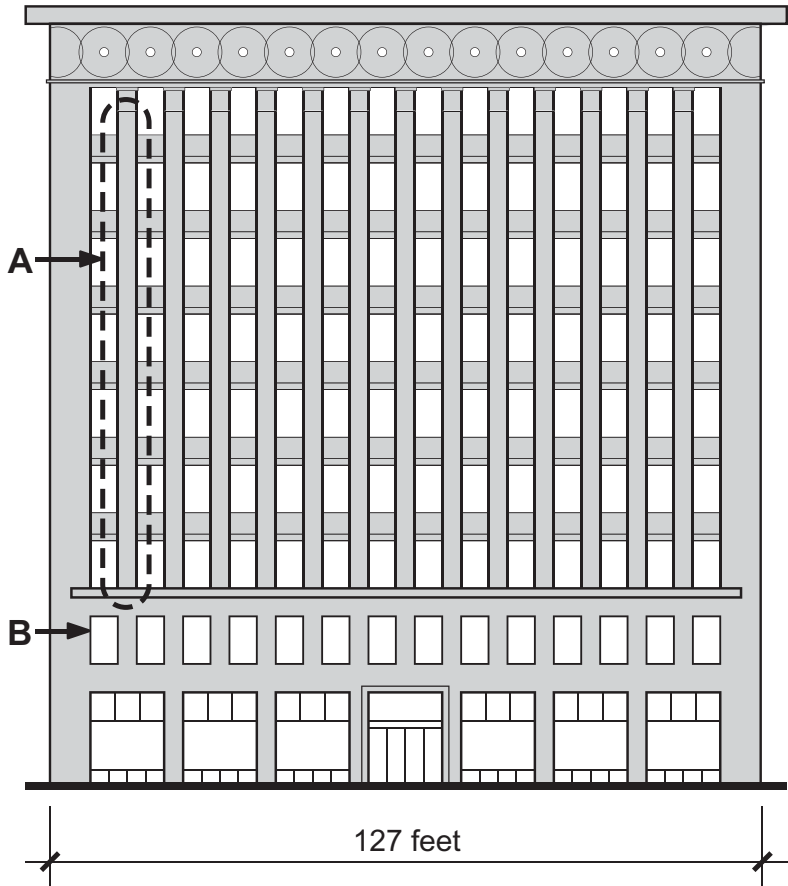
This facade drawing of the Wainwright Building in St. Louis, Missouri is at 1/32 scale - meaning that 1/32" equals one foot, which can also be stated as 1" = 32'. Use the drawing to answer the following questions.

How wide is the **actual building** in feet? \_\_\_\_\_

How wide is the **drawing** of the building in inches? \_\_\_\_\_

Explain how you can use this scale drawing to determine how big a window is on the Wainwright Building.

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Estimate the height of the pilaster (rectangle within the dotted oval) labeled "A." Show your work.

Estimate the size of the window (width and height) labeled "B." Show your work.

Calculate the area of the actual window in sq. feet and the area of the drawing of the window in sq. inches.

What else can you measure? Label items on the drawing and estimate the sizes on the back of this sheet.

## Mathematics Worksheet #1 (page 2) - It's in the Details: Math and Scale

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Based on your estimations for the actual sizes of the pilaster and the window, calculate the dimensions they would be if drawn at the scale of 1" = 8'.

At 1/8" scale, how tall should the drawing of the pilaster be? \_\_\_\_\_

At 1/8" scale, what is the size of the drawing of the window? width: \_\_\_\_\_ height: \_\_\_\_\_

At 1/8" scale, what is the area of the drawing of the window in square inches? \_\_\_\_\_

Solve for X:

$$\frac{\text{height of window at 1/8" scale (sq. inches)}}{\text{height of window at 1/32" scale (sq. inches)}} = X$$

Explain how X can be used to convert the length of any object drawn at 1/32" scale to the correct length when drawn at 1/8" scale.

Solve for Y:

$$\frac{\text{area of window at 1/8" scale (sq. inches)}}{\text{area of window at 1/32" scale (sq.inches)}} = Y$$

Explain how Y can be used to convert the area of any object drawn at 1/32" scale to the correct area when drawn at 1/8" scale.

Explain the relationship between X and Y.

## Mathematics Worksheet #2 - It's in the Details: Math and Scale

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Using the 1/32" drawing to estimate measurements, enlarge a portion of the Wainwright Building to show more detail at 1" = 8'.

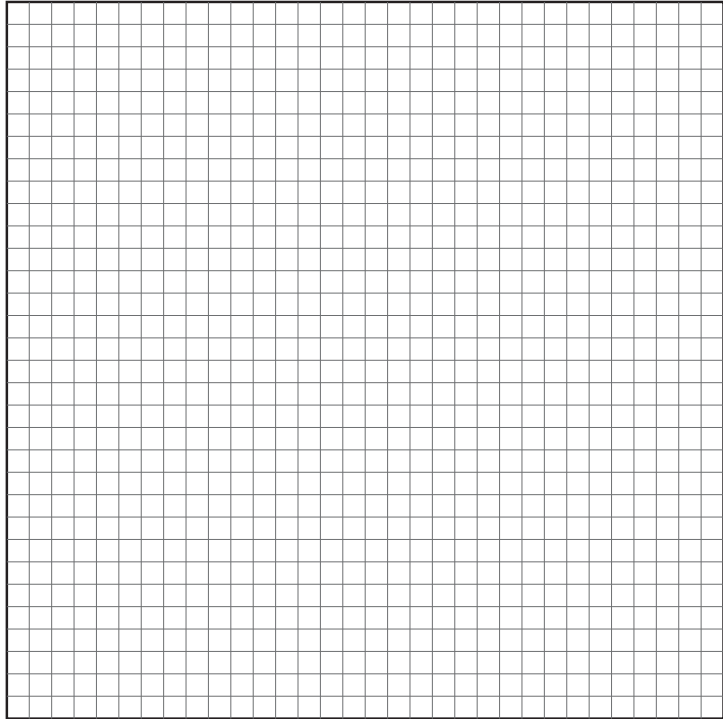
STEP 1: Create a 1" square box over a portion of the 1/32" scale façade drawing on page one of Math Worksheet #1. This is the area you will enlarge to create your detail drawing.

STEP 2: Convert the 1/32" scale dimensions to 1/8" scale dimensions.

STEP 3: At 1/8" scale, draw the portion of the façade in the box using the 1/8" grid at right.

STEP 4: Add more detail to the enlarged drawing based on information in the photos.

STEP 5: Explain why it is important for architects to create drawings at different scales.





# SCIENCE

# SCIENCE



## Introduction

### Catenary Curves: Scientific Experimentation

#### Overview

Students will design and conduct an experiment about catenary curves and their structural qualities. Using Dulles International Airport as a case study, students will investigate how catenary curves are important to the structure of the building.

**Grade:** 6-12

**Time:** 3 class sessions

#### Standards & Objectives

This lesson addresses selected standards from the McRel Standards for Science. These can be found in the section titled “SCIENCE STANDARDS.”

In addition to the Science Standards, students will be able to:

- Understand how a catenary curve is formed.
- Understand how a catenary curve is used at Dulles International Airport.
- Understand the materials used to form the catenary curve at Dulles.
- Hypothesize how the Dulles roof could have looked different while still using catenary curves (e.g., longer or shorter cables would have changed the shape).

#### Teach This Lesson

Preparation and resources for teaching this lesson are found in the section titled “SCIENCE PREPARATION AND RESOURCES.”

Instructions for teaching this lesson are found in the section titled “SCIENCE INSTRUCTION.”

#### Interdisciplinary Connections

The PBS television program, *10 Buildings that Changed America*, provides lesson plans in four additional subjects: Art, English Language Arts, Mathematics, and Social Studies. All five lessons are combined in an interdisciplinary unit: One Building to Change My Community.

This Science lesson can be paired with another *10 Buildings that Changed America* lesson plan to create interdisciplinary connections.

- **Art:** After experimenting with different ways to build a curved structure, students can apply this knowledge to their design in the Art lesson to make a model.
- **Mathematics:** Students can use the concept of scale, taught in the Mathematics lesson, to draw the structure that they designed in the Science lesson. This gives students the opportunity to understand how big their models are in real life.

- **English Language Arts:** During student research on the Seagram Building, ensure they learn about the structure and materials of the building. As an extension of the Science lesson, students can design and conduct an experiment to explore steel framing.

# SCIENCE

## Preparation and Resources

### Catenary Curves: Scientific Experimentation

#### Preparation

To prepare to teach this lesson, teachers should:

- Watch the Dulles International Airport segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). **CONTENT NOTE: In this segment, Reed Kroloff says, “Damn right.”**
- Review the section titled “SCIENCE INSTRUCTION.”
- Review the worksheet titled “SCIENCE WORKSHEET.”
- Review resources below to be familiar with Dulles International Airport and its structural significance.

#### Resources

##### Books

*Washington Dulles International Airport (VA) (Images of America)* by Margaret C. Peck

*Eero Saarinen: An Architecture of Multiplicity* by Antonio Roman

*Eero Saarinen, 1910-1961: A Structural Expressionist* by Pierluigi Serraino

*Eero Saarinen: Shaping the Future* by Eero Saarinen, Eeva-Liisa Pelkonen, and Donald Albrecht

##### Online Sources

Metropolitan Washington Airports Authority

([mwaa.com/dulles/661.htm](http://mwaa.com/dulles/661.htm))

Catenary Curves on Wikipedia

([en.wikipedia.org/wiki/Catenary](http://en.wikipedia.org/wiki/Catenary))

# SCIENCE

## Standards

### Catenary Curve: Material Investigation

#### Academic Standards

This lesson is aligned with the McRel Standards for Science.

#### McRel Science:

##### Level III (Grades 6-8)

Standard 12: Understands the nature of scientific inquiry.

3. Designs and conducts a scientific investigation.
4. Identifies variables (independent, dependent, control) in a scientific investigation.
5. Understands why only one variable can be manipulated at a time and that all other variables must be controlled during the investigation.
6. Uses appropriate tools and techniques to gather, analyze, and interpret scientific data.
8. Evaluates the results of scientific investigation, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists.
9. Knows possible outcomes of scientific investigation.

##### Level IV (Grades 9-12)

Standard 12: Understands the nature of scientific inquiry.

2. Designs and conducts scientific investigation.
3. Evaluates the results of scientific investigation, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists.
5. Knows that conceptual principles and knowledge guide scientific inquiries; historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.

# SCIENCE

## Instruction

### Catenary Curves: Scientific Experimentation

#### Instruction

Students will design and conduct an experiment about catenary curves and their structural qualities. Using Dulles International Airport as a case study, students will investigate how catenary curves are important to the structure of the building. (A catenary curve is the shape that is formed when a cable, string, or other flexible strand is suspended from two points.)

**Activity 1:** Dulles International Airport

**Activity 2:** Materials Investigation – Select One

**Activity 2a: Drawings:** Requires pencils, paper (large preferred), string (at least two types preferred), and paper clips. A camera is recommended.

**Activity 2b: Models:** Requires pencils, string, cardboard, tape, school or all-purpose glue, and water – plus space to store projects while drying.

**Activity 3:** Experiment Report

**Assessment**

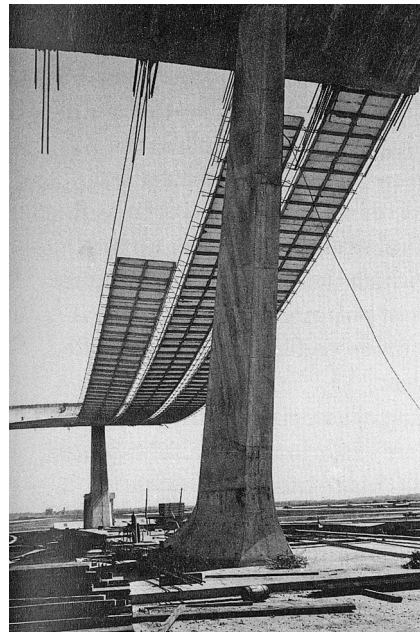
#### Activity 1: Dulles International Airport

1. Review or introduce scientific investigation principles as appropriate for your students.
2. Introduce the assignment to students, explaining that they will be designing and conducting a scientific experiment based on the Dulles International Airport roof design.



Two views of Dulles International Airport

3. Watch the Dulles International Airport segment from the PBS special, *10 Buildings that Changed America*, on DVD or at [wttw.com/10buildings](http://wttw.com/10buildings). Prompt students to take notes during the segment, paying particular attention to the roof design and to scientific inquiry. **CONTENT NOTE: In this segment, Reed Kroloff says, "Damn right."**
4. Facilitate a brief discussion about what the architect investigated before designing the airport. Questions to prompt discussion may include:
  - What questions did the architect ask about how people used existing airports?
  - How did he acquire his information? What else could he have done?
  - What did he find out? What other information could be sought?
  - How did this inform the design of Dulles International Airport?
5. Introduce the assignment in greater depth. Explain that using scientific inquiry, students will hypothesize and test catenary curves, explaining what a catenary curve is and that it is the shape of the roof at Dulles International Airport. (A catenary curve is the shape that is formed when a cable, string, or other flexible strand is suspended from two points.) The roof was constructed by attaching precast panels to cables that had been hung in a catenary curve (**See PHOTO 1**). To explain this in terms that may be more understandable to students, use an analogy of a rope bridge with a walkway of wooden planks. The ropes are analogous to the cables at Dulles, the planks to the precast concrete panels.
6. Facilitate student discussion about catenary curves and the materials used to construct the roof of Dulles International Airport, so students are able to:
  - Understand how a catenary curve is formed.
  - Understand how a catenary curve is used at Dulles International Airport.
  - Understand the materials used to form the catenary curve at Dulles.
  - Hypothesize how the Dulles roof could have looked different while still using catenary curves (e.g., longer or shorter cables would have changed the shape).
7. Explain that the students will be constructing catenary curves through drawings or models (depending on teacher's selection of Activity 2a or 2b of the Materials Investigation).
8. Based on class discussion, have students create hypotheses about catenary curves to share with the class. Suggestions for hypotheses: curve shape may vary based on string type or length, and curve shape may be impacted by additional supports, additional weight, or by changing the height of one of the anchor points.
9. Discuss what the variables would be for each student hypothesis.
10. Based on this information, ask students to select hypotheses from the class list that seem testable with the selected materials investigation approach.



**PHOTO 1:** Dulles International Airport under construction showing precast concrete panels being attached to cables hanging in a catenary curve.

10. Assign students to write an individual hypothesis for catenary curves, list of variables, and how they will test it. Enter this information in the first section of the worksheet “SCIENCE WORKSHEET,” which should be used throughout the project.

## Activity 2: Materials Investigation – Select One

### 2a: Drawings

### 2b: Models

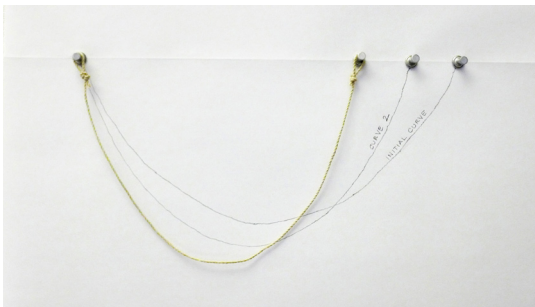
## Activity 2a: Materials Investigation through Drawings

### 2a Materials List:

- String (at least two types)
- Pushpins and/or tape
- Paper clips
- Paper (preferably large)
- Pencils
- Camera (optional)

### 2a Instruction:

1. Teachers will demonstrate the following instructions before asking students to attempt individually or in pairs.
2. Use two pushpins to hang a large piece of paper at the upper corners. Make sure pushpins are approximately level with one another (i.e., the same height from the floor). Tape can be used as an alternate to pushpins.
3. With a lightweight string, approximately two feet long, tie a small loop at each end and hang one loop over each push pin. Ensure that when the string is hanging, it is entirely on the paper. Shorten the string, if necessary.
4. Carefully trace the resulting catenary curve onto the paper (**See PHOTO 2**). Note on drawing that this is their initial curve.



**PHOTO 2:** Variations in catenary curve shapes using push pins and string



**PHOTO 3:** Testing how weight from paper clips changes the shape of a catenary curve

5. Once all students have their initial catenary curve drawn on their paper, let them begin their scientific investigations. Suggested investigations include:
  - Testing varied lengths of string to see how the shape of the catenary curves changes.
  - Testing varied types of string to see how the shape of the catenary curves changes.
  - Testing how weight (e.g., paper clips) could be added to the string to see how the shape of the catenary curves changes (**see PHOTO 3**). Can the original curve be maintained? How is this achieved (i.e., what spacing and how many points approximate the curve)? Does this hold for varied lengths/string types?
  - Testing how changing the location of one endpoint changes the shape of the catenary curve.
6. For each variation, students should document the resulting shape of the string on the paper and note which variables were modified. Note: another option is to document each result separately with a camera, permitting the images to be compiled digitally. Document this in the second section of the worksheet titled “SCIENCE WORKSHEET,” which should be used throughout the project.

## Activity 2b: Materials Investigation through Models

### 2b Materials List:

- Cardboard (recommended: each student or group should have one piece of cardboard that ranges in size from 6 to 10 inches square)
- String
- Scissors
- Tape
- Water
- School or All-Purpose Glue
- Hair Dryers (optional)

### 2b Instruction:

1. Teachers will demonstrate the following instructions before asking students to attempt. Access to a sink is helpful for the glue and water necessary in this project. If the classroom does not have one, teachers may want to provide hand wipes or a bucket of soapy water for hand washing. The workstations may get messy from the glue; consider covering tables/ desks with paper before using glue.
2. Create small groups of three to four students. Student groups should discuss what they want to investigate as a group. The group will test a hypothesis by each student creating different models demonstrating different values for the variable(s) critical to the hypothesis. Document this in the second section of the worksheet titled “SCIENCE WORKSHEET,” which should be used throughout the project.
3. To construct the models:
  - Attach ends of string to cardboard base; multiple strings will be needed. For a linear design like Dulles International Airport, create small slits (approximately 1/4 inch) evenly spaced on two opposite sides of the cardboard base. Slide string into slits and tape onto back of cardboard. For a radial design like a dome, draw a circle on the cardboard base. Tape ends of string on opposite sides (180 degrees apart) of the circle.

- Verify resulting catenary curve by flipping the cardboard upside down so the strings hang toward the ground. Curves can be modified by rearranging strings.
  - When strings are complete, find a location where each model can rest upside down with strings hanging in a catenary curve. Models can be set between desks by creating a small gap between the desks or yardsticks can be slid through the more open projects and set between desks.
  - Use hands to coat the strings with watered-down school or all-purpose glue. The mixture should be approximately 30% water and 70% glue.
  - Let glue dry overnight or use hair dryer to quicken the drying process. Once the strings are completely dry, the cardboard is ready to be flipped over. Drying time will vary by project.
4. Have the entire class place their models together, so the class can see all of the different models made. Students can discuss what differences they see. Why are some more successful than others? What variables are different that may have led to a difference in the final product? Tie this discussion back into the topics of scientific inquiry and investigation.

### Activity 3: Experiment Report

1. The experiment report (“SCIENCE WORKSHEET”) should be a documentation of the process and should be started during the first two activities. Encourage students to revise their writing of the first two activities to make their report more clear, concise, and thorough.
2. Individually, have students complete the Experiment Report using the worksheet titled “SCIENCE WORKSHEET.” It is recommended that the Experiment Report be reviewed after each activity.

### Assessment

Assignments are designed to address the standards and learning goals of the lesson. Each assignment is mapped to the appropriate standards and learning goals.

1. Evaluate the drawings/models for a systematic approach to the hypothesis.
  - Level III Standard 12.5: Understands why only one variable can be manipulated at a time and that all other variables must be controlled during the investigation.
  - Level IV Standard 12.3: Evaluates the results of scientific investigations, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists.
2. Evaluate the Experiment Report for understanding of scientific investigation.
  - Level III Standard 12.3: Designs and conducts a scientific investigation.
  - Level III Standard 12.4: Identifies variables (independent, dependent, control) in a scientific investigation.
  - Level III Standard 12.5: Understands why only one variable can be manipulated at a time and that all other variables must be controlled during the investigation.
  - Level III Standard 12.6: Uses appropriate tools and techniques to gather, analyze, and interpret scientific data.
  - Level III Standard 12.8: Evaluates the results of scientific investigation, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists.
  - Level IV Standard 12.2: Designs and conducts a scientific investigation.

- Level III Standard 9: Knows possible outcomes of scientific investigation.
- Level IV Standard 2: Designs and conducts a scientific investigation.
- Level IV Standard 3: Evaluates the results of scientific investigation, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists.
- Level IV Standard 5: Knows that conceptual principles and knowledge guide scientific inquiries; historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.

## Science Worksheet - Catenary Curves: Scientific Experimentation

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### Experiment Report

Answer the following questions in complete sentences. Be clear and concise, yet thorough. Document the process as it happened. If your hypothesis, variables, or experiment design changed during the project, explain why this happened.

#### ACTIVITY 1

What was your individual hypothesis?

What were the variables?

How did you plan to test it?

#### ACTIVITY 2

Who was in your group?

What was your group hypothesis?

How did you reach consensus about this hypothesis?

What were the variables?

How did you test it?

#### FINAL REPORT

Describe the experiment.

What worked well during the experiment?

How would you modify the experiment?

Why do you suggest these changes?

What were the results of your experiment?

Were these results as you expected? Why or why not?



# INTERDISCIPLINARY UNIT

# ONE BUILDING TO CHANGE MY COMMUNITY



## Teach This Unit

One Building to Change My Community combines five subjects into a multidisciplinary unit. The sequence of the unit builds on the individual skills and standards of each lesson and brings these together into one project: One Building to Change My Community. The recommended sequence for the lessons is:

- 1. English Language Arts: Historic Landmarks: Research and Writing**  
After students have practiced research and writing skills in the English Language Arts lesson, assign students to research local buildings and their impact on your community. This provides historical context for students to propose a building in the Social Studies lesson.
- 2. Social Studies: Build Something Better: Economic Impacts of Development**  
Based on their research on historical context in the English Language Arts unit, students will propose an architectural solution (e.g., new building, renovation, plaza, courtyard) for their community. Have students create a draft proposal that will be finalized at the end of the unit.
- 3. Art: Make Your Mark: Design With a Purpose**  
Students should use their understanding of historical context and economic development to inform brainstorming for their designs.
- 4. Mathematics: It's in the Details: Math and Scale**  
Once students have begun designing their buildings in the Art lesson, have students create scale drawings of their designs.
- 5. Science: Catenary Curves: Scientific Investigations**  
After students have created a design, have them design and conduct an investigation related to the design of their building. Suggestions for topics to be investigated include shape (as in the catenary curve experiment), building materials (e.g., bricks, steel, etc.), or environmental considerations (e.g., shading devices, energy consumption).
- 6. Final Project: One Building to Change My Community**  
Students will finalize their drawings (Mathematics) to include on their posters (Social Studies). Posters should include information about community context, including history (English Language Arts) and an explanation of what they learned about their building investigation (Science). Students should present their posters with a model (Art) of their building.