

The Longwood Gardens' Library and Archives staff invites you to use the following guide for our 2017 Community Read book. This guide focuses on three topics taken from the book and may be used for book discussions or as a component of a lesson or program. However you use it, we hope you enjoy this year's book as much as we have.

Don't forget that author David Macaulay will be speaking at Longwood Gardens, April 22, 2017! To register for this event or to see a complete schedule of Community Read events, please visit

www.longwoodgardens.org/community-read

An Overview:

Author David Macaulay, with the help of a narrator and a time-traveling, friendly woolly mammoth, uses art and humor to explore the science and engineering concepts underlying our technological world. *The Way Things Work Now* is an updated presentation that follows the format and information used in the previous two titles: *The Way Things Work* (1988) followed by *The New Way Things Work* (1998). David Macaulay has added the modern engineering and technology found in today's digital world.

Macaulay's humorous illustrations make this book fun to read. The woolly mammoth provides a creative avenue through which the reader can visualize the principles and scientific laws for the workings of machinery. For example, the woolly mammoth shows the narrator how simple machines can help him trim his tusks, put out a fire, operate an athletic trophy business, and press clothes. David Macaulay comically demonstrates where technology has solved mammoth problems.

The Way Things Work Now highlights some technology used for the 2014-2017 revitalization of the Main Fountain Garden at Longwood Gardens - real-world applications of Science, Technology, Engineering, and Mathematics (STEM). Pierre S. du Pont, Longwood's founder, developed a lifelong interest in fountains, landscape design, technology, architecture, and the arts. These combined interests were applied in the original 1931 Main Fountain Garden. He would no doubt be impressed with the application of modern technology that has enhanced his original, amazing, engineering feat. For more information about Longwood's Main Fountain Garden revitalization, please visit <http://newheights.longwoodgardens.org/>.

The following discussion questions focus on three topics from David Macaulay's book that were chosen for this guide because they lend themselves to discussions, lessons, and programs. Levers, Pressure and Power, and Light and Images--represent components that are all easily recognizable in Longwood's historic fountain garden. The Main Fountain Garden uses each of these concepts found in *The Way Things Work Now*. Some examples are: an excavator is a rotating assembly of three levers (p. 23), centrifugal pumps (p. 125), fiber optics (p. 187), light emitting diodes (LED lighting) (p. 273), barcodes (p. 331), logic gates (p. 341), and computer technology (p. 349).



Discussion Topics and Questions:

Mechanics of Movement – LEVERS – pp. 18-23

1. When weighing the mammoth: (pp. 18-19)
 - How is the weight of the mammoth calculated with a rock and a log?
 - How did they reduce the number of people required?
 - What caused the lad to be launched?

2. Your task is to lift a very heavy object, e.g., a recumbent Mammoth: (pg. 20)
 - How can a lever be used to complete your task?
 - Where would you place the fulcrum?
 - Create a diagram identifying the features of your lever, load, and effort.

3. Lever treasure hunt: (pp.22-23)
 - Using what you have read about first, second, and third class levers, search your kitchen, school supplies, or workshop for other examples of levers.
 - Create a 3-column chart identifying the three classes of levers, and list examples for each in the correct column.

4. **Challenge:** Review first, second, and third class levers found on pages 18-23.
 - a. Create and label a diagram of a tool for each of the three classes of levers. Identify examples of tools or equipment used in the construction of a garden in your neighborhood.
 - b. Make a working model of a lever of a first, second, and third class lever. Identify each lever and its features. Use classroom materials or materials found at home.
 - c. Use your artistic talents to show how a woolly mammoth can use a lever as part of a large construction project like the Main Fountain Garden at Longwood Gardens.



LONGWOOD GARDENS

Main Fountain Garden Examples- Levers



Large cranes on the Main Fountain Garden site employ the principles of levers (pg. 18)



A mallet used for placing paving stones near the Main Fountain Garden is a type of lever (pg. 23)



Community Read
Read. Think. Engage.

LONGWOOD GARDENS

Harnessing the Elements -- **PRESSURE POWER** – pp. 120-125

1. Improving a mammoth's fire fighting efficiency: (p. 120)
 - a. List the steps needed to improve the capacity and range of mammoths in fighting fires.
 - b. How was force applied to assist the mammoth?

2. Molecules of a fluid:
 - a. How does a simple pump affect the movement of molecules?
 - b. How is pressure involved in the process of pumping out, or sucking in, a fluid?
 - c. What happened when pressure was released from the mammoth?

3. Pumping out: (p. 121)
 - a. How do the dimensions and size of a pump's chamber and nozzle affect the operation of a pump?
 - b. Create and label a diagram of a simple pump that could be used to make a water fountain. How would you increase the height of expelled water?

4. **Challenge:** Review the types of pumps identified on pages 122-125.
 - a. Choose and identify the type of pump you would use to create the pressure required to create a fountain at Longwood Gardens. Explain your choice.
 - b. Create and label a diagram that describes the steps to move water from a storage reservoir to a fountain jet. Include the recycling of water.
 - c. How could a woolly mammoth be used to provide the energy needed to pump water in Longwood Gardens' fountains? Show your woolly mammoth in a watery cartoon.



LONGWOOD GARDENS

Main Fountain Garden Examples- Pressure & Pumps



Large water pipes in the tunnels under the Main Fountain Garden (pgs. 120-121)



Historical water pumps in the original Main Fountain Garden Pump House (pgs. 120-121)



Water pipes in the tunnels under the Main Fountain Garden (pgs. 120-121)



Community Read
Read. Think. Engage.

Main Fountain Garden Examples- Pressure & Pumps (cont.)



Nozzles inside one of the basins at the Main Fountain Garden (pgs. 120-121)



Large electric generators provide the power for the pumps and lighting in the Main Fountain Garden (pgs. 284-285)



Community Read
Read. Think. Engage.

Working With Waves – **LIGHT AND IMAGES** – pp. 180-191

1. The athletic trophy business: (pp. 180-181)
 - a. What event led the trophy business owner to believe his apprentice was overworked?
 - b. What was the cause of the fire in the workshop?

2. Light refraction or bending: (pp.180-181)
 - a. What happens to light rays when they pass through the lens of an eye?
 - b. How is the eye similar to a glass lens such as the crystal discus?

3. Changing colors: (pp. 184-185)
 - a. How does additive mixing create the color yellow?
 - b. Using subtractive mixing, what happens when a surface absorbs green from the white light that strikes it?

4. Applying lenses in modern devices: (pp.188-189)
 - a. Describe how an image of an object is changed when viewed through various lenses. How are lenses used to make modern optical instruments?
 - b. Create a diagram of a telescope, binoculars, or camera including the placement of lenses.

5. **Challenge:** Review the function of a magnifying glass/large convex lens found on page 189.
 - a. Combine the use of 1, 2, or 3 hand lenses to view an object. Record how the image of an object changes with the number and placement of the hand lenses.
 - b. Show how a faraway image of a Longwood Gardens fountain is viewed through a lens by the woolly mammoth.



LONGWOOD GARDENS

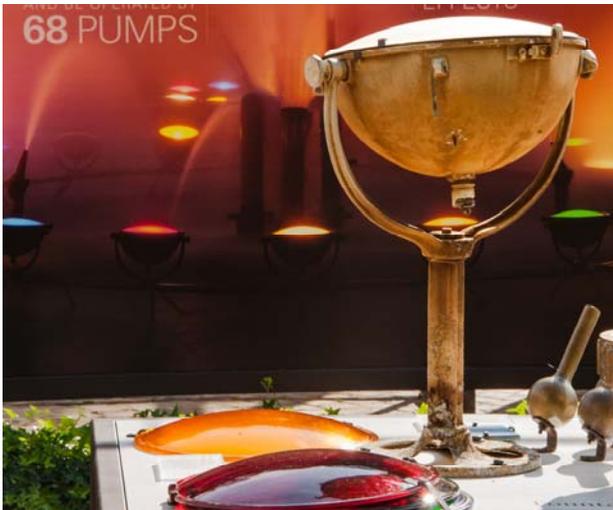
Main Fountain Garden Examples- Light & Images



Heritage lamps with colorful lenses from the Main Fountain Garden (pgs. 182-185)



New LED lighting for the Main Fountain Garden (pgs. 182-185)



Heritage lamp and colored lenses from the Main Fountain Garden (pgs. 182-185)



Community Read
Read. Think. Engage.