# How Much Rain Can You Catch?

## Overview:

Youth use math to determine the amount of rain that can be captured from a roof.

> ***The amount of water that can be captured from a roof surprises most people.***

## Materials:

For each participant, pair, or small group:

- Recycled ½ gallon milk or juice carton
- 8 ½" by 11" sheet of card stock paper
- Ruler
- "How Much Rain Can You Catch?" handout (included)
- Pencil

## Activity Duration:

25 minutes

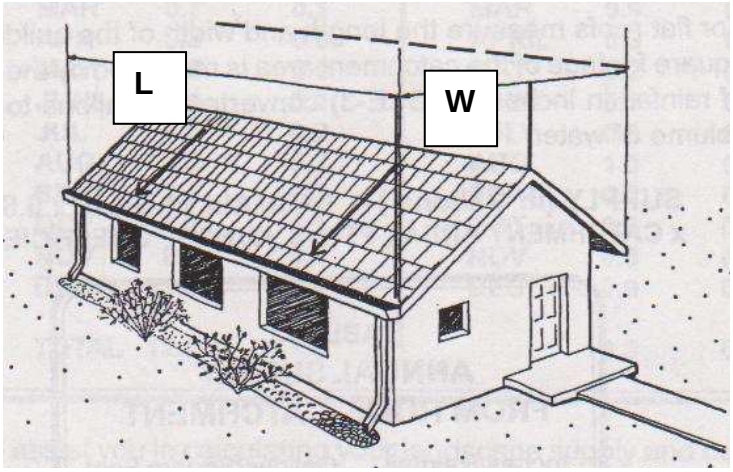
## Preparation:

- Collect or encourage participants to bring in recycled ½ gallon cartons.
- Purchase card stock paper and any other necessary materials.
- Photocopy "How Much Rain Can You Catch?" handout.
- Go through the steps of measuring the amount of rain that can be collected from the paper roof so the process is familiar.

## Activity Steps:

1. Review components of an active rainwater system. Explain that in designing and building a rainwater harvesting system, one of the steps is to use math to calculate the amount of roof runoff (the number of gallons of water) that can be collected from a roof. Knowing the potential for rainwater collection helps in planning for the water's usage.
2. Show participants a ½ gallon carton and a sheet of cardstock paper. Explain that they will go through a step by step process to determine the amount of rain a surface like a roof can catch and collect.
3. Distribute the cartons, cardstock paper, rulers, pencils, and the "How Much Rain Can You Catch?" handout.
4. Explain that to determine the amount of rainwater a roof will capture, participants will first measure the surface area that is receiving the rain. This may be a different measurement than they think.
5. Have participants fold their card stock paper in half, width-wise, and place the paper over the tops of their cartons as roofs.

6. Ask participants to imagine that it is raining and to envision the way that water would fall on the roof. Using the model as an example, demonstrate measuring the roof collection area. Participants measure the length of the roof; with a pitch roof, the width will be the distance between the eaves. (See drawing on the next page as an example.)
7. Work through the handout with the participants, explaining each equation for determining the amount of water that could be collected.
8. Participants use their models and the handout to calculate how much rainwater they could "catch" from their "roofs."
9. Discuss different kinds of surfaces and their collection capacity (a grass soccer field versus a paved parking lot for example). Ask youth what kinds of surfaces would work best for active rainwater collection. Get responses.




Drawing to demonstrate measurements for roof runoff capacity courtesy of Patricia Waterfall

## Extensions:

- Youth can determine the collection area of their houses and research the average rainfall where they live to determine their capacity for rainwater collection.
- Families can be encouraged to build their own rainwater harvesting systems.

## Leader/Teacher Note:

The calculations for determining the amount of rain that can be collected from a roof in this activity do not include a runoff coefficient which is the average percentage of rainwater that runs off a type of surface. The calculation is determined by the permeability of the surface. As an example, a roof with a runoff coefficient of 0.95 would indicate that 95% of the rain that falls on that roof will run off. As an extension activity, participants can add a runoff coefficient to their calculations.

## Sources:

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Rainwater harvesting drawing courtesy of *Harvesting Rainwater for Landscape Use*, by Patricia Waterfall, Extension Agent, University of Arizona Cooperative Extension/Low 4 Program, Second Edition, August 2004.
Publication may accessed at: http://ag.arizona.edu/pubs/water/az1052/harvest.html

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Name _____ Date _____

Directions: Calculating the collection of rainwater from an impermeable surface involves several steps that take into consideration the surface area of the roof, the amount of predicted rainfall, and a multiplier to convert the inches of rain per square foot of roof into gallons. Follow the steps to find out the amount of rain you can catch.

1. Determine your roof's collection area. For this activity, ¼" = 1 foot.

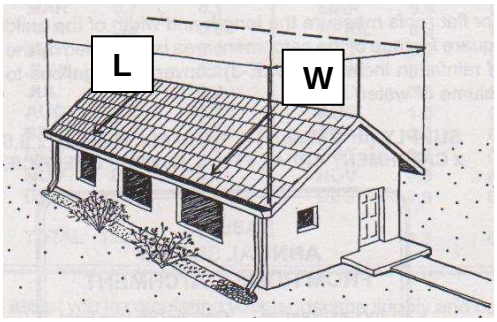
   With the card stock "roof" on the carton, use a ruler to measure its length (L) in inches. _____

   Since ¼" = 1 foot, multiply the number of inches by 4 to get "ft": _____"ft"

   Measure the width (W) of the "roof" at the eaves in inches (see diagram below)

   _____

Safety Note: When measuring a real house roof's collection area, measure from the ground the area the roof covers. You do not have to go up onto the roof.




Since ¼" = 1 foot, multiply the number of inches by 4 to get "ft": _____"ft"

Multiply the length x the width of the collection area: _____"$ft^2$"

2. The next step is to multiply the square footage ($ft^2$) by an amount of rainfall in inches. Rainfall varies by location and month. Use the graph on the next page to choose a rainfall amount.

   Month _____ City _____ Rainfall (in inches) _____

   Multiply $ft^2$ above _____ by rainfall above _____ = _____
   Volume of water in inches of rain per square foot

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Name _____ Date _____

| Average Monthly Rainfall in Arizona Cities (in inches over a 30-year period) | | | |
|---|---|---|---|
| Month | Flagstaff | Phoenix | Tucson |
| Jan. | 2.2 | 0.8 | 1.0 |
| Feb. | 2.6 | 0.8 | 0.9 |
| March | 2.6 | 1.1 | 0.8 |
| April | 1.3 | 0.3 | 0.3 |
| May | 0.8 | 0.2 | 0.2 |
| June | 0.4 | 1.0 | 0.2 |
| July | 2.4 | 1.0 | 2.1 |
| Aug. | 2.9 | 0.9 | 2.3 |
| Sept. | 2.1 | 0.6 | 1.5 |
| Oct. | 1.9 | 0.8 | 1.2 |
| Nov. | 1.9 | 0.7 | 0.7 |
| Dec. | 1.8 | 0.9 | 1.0 |

http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmpcp.txt

3. The final step is to multiply the volume of water in inches of rain per square foot (the answer to question 2) by 0.623, called a "multiplier." The number 0.623 is the "conversion coefficient," which converts the inches of rain per square foot of roof into gallons.*

   Volume of water (page 1) _____ x 0.623 = _____ gallons of water that could be harvested

4. List three ways that people can use rainwater.

   _____

   _____

   _____

* Where does the number 0.623 come from?

It is the number of gallons there are in 1 square foot, 1 inch deep.