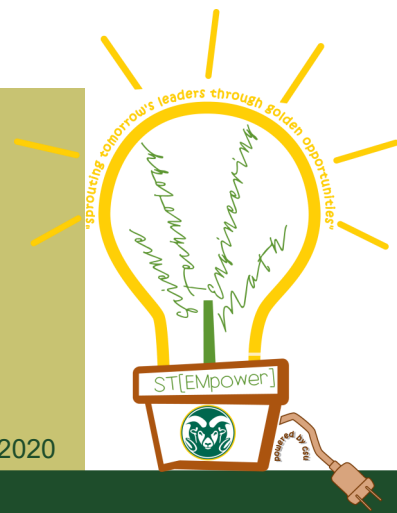# ST[EM]power

VIRAL-CYCLES: DOUBLING

VOLUME 10, ISSUE 5, May 18, 2020

Double Double Number Trouble...

THIS ISSUE
- Checkerboard page 2
- Allowance page 4

POWER WORDS
- **contagious**: spread from one person or organism to another by direct or indirect contact
- **doubling**: to double a number, either add the number to itself, or multiply it by 2; example 112 doubled is 112 + 112 = 224 OR 112 x 2 = 224 (also called double or doubled)
- **novel coronavirus**: a strain of coronavirus new to humans
- **pathogen**: a bacterium, virus, or other microorganism that causes disease

You may have heard about the concerns of how many days for the infection rate to **double**. What does that mean?

That means how long it takes for a person who is infected to pass the coronavirus to another person. How long it takes those two people to pass it on to four people. How long it takes to pass it on to eight people.

Contagious diseases spread at different rates. The bacteria *Mycobacterium leprae* causes Hanson's Disease (leprosy). It is one of the slowest spreading **pathogens** known. People exposed to this bacterium almost never get it. It takes close, frequent contact with someone who is infected.

The **novel coronavirus**, on the other hand, spreads very quickly. The Center for Disease Control (CDC) has found that the doubling time for COVID-19 was between 1 to 2 days in Hunan China, where the disease started.
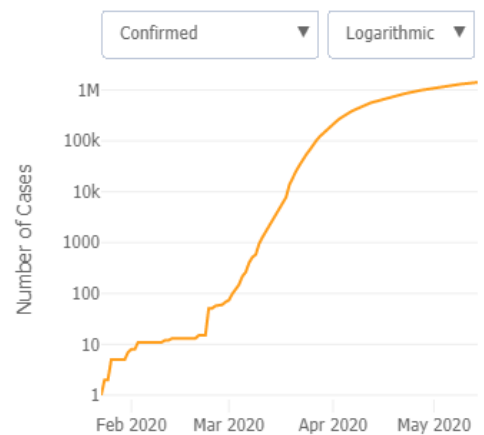
The USA doubling rate on May 11, 2020 is currently every 25 days, according to the Statista website. The Johns Hopkins graph above shows that we are slowing down the rate of doubling.

What does doubling really mean? Let's find out!

Get ready for more STEM fun!
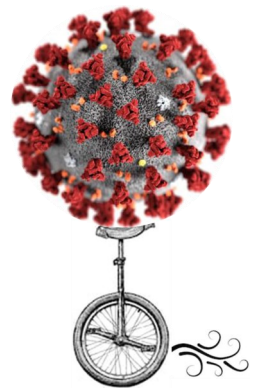
SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH
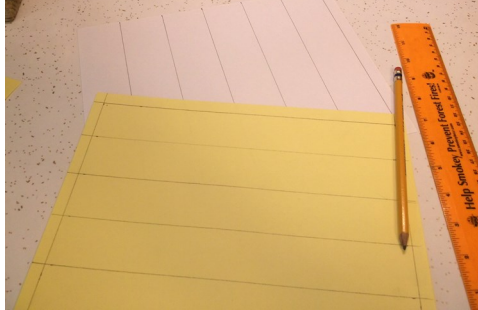COLORADO STATE UNIVERSITY EXTENSION

COLORADO STATE UNIVERSITY EXTENSION
4-H PROGRAMS ARE AVAILABLE TO ALL WITHOUT DISCRIMINATION

DO

This may seem like a totally random activity. Fear not! It sets up our experiment:

- Pick any big job around the house to tackle. It has to be a big job, like wash all the windows, inside and out, from June 1—30th.
- Present this job as a contract to your parent. You will do this work, and all they have to do is to pay you one measly cent on the first day. They double that on the second day, and pay you two cents. Each day, they double what they pay you.
- How much money will you earn by the end of June (30 days)?

The checkerboard is modified to 30 squares, one square for each day in June. So, let's make a checkerboard! (These directions use "Yellow" for the frame, and "White" for the strips. You can use any color.)

Directions:

- Measure—one piece of paper will form the frame (yellow) and the other piece of paper will form the strips (white). Your paper orientation is landscape.
- Yellow:
  - Measure a ¼" border on the edges of the paper. Measure

from the edge of the paper, and put two dots ¼" in from the edge on each side. Use your ruler and draw a line on each side, crossing over your two dots on each side. This will give you a ¼" border.
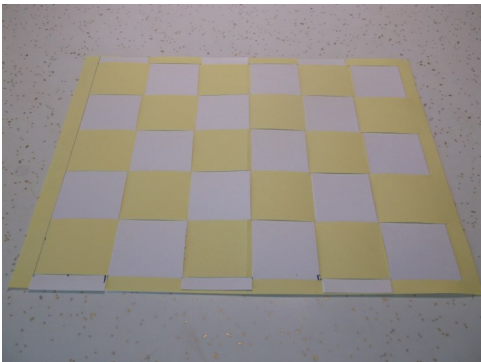
- You need to cut your frame with slits that run the length of the paper. To cut straight lines, you need to measure first. On each side, starting at the ¼" line, place a dot on the 1½", 3", 4½", and 6".
- Fold your frame in half with the measurements visible.

- Cut along the guidelines. Do not cut through the ¼" edge.

8½"

11"

MATERIALS
- 2 pieces of 8½" x 11" in two different colors (cardstock if available, but not necessary)
- scratch paper
- scissors
- ruler
- pencil
- tape
- wax paper about 15" long
- bag of rice

- White strips:
  - Measure the width your second piece of paper in 1¾" strips. The 6 strips are 8½" long and 1¾" wide.
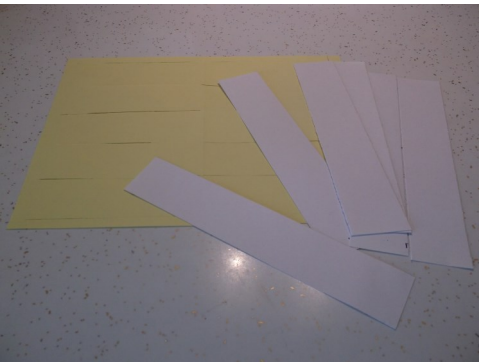
- **Weave** the checkerboard
  - Lace the white strip in the yellow frame slits. In the example below, the white strip starts over the edge, then alternates under, over, under, over, under, and finishes over the edge of the frame.
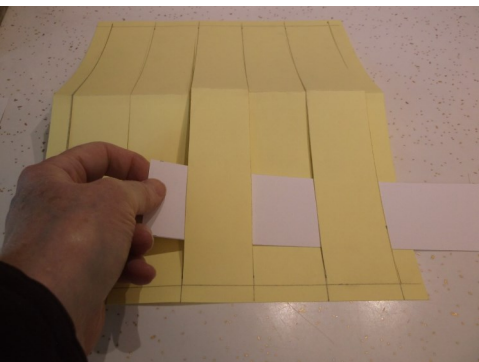
  - Push the white strip as close to the bottom edge of the frame as possible.

  - On the next white strip, start under the edge of the frame and alternate lacing in the frame slits over, under, over, under, over, and finish under on the opposite frame edge.
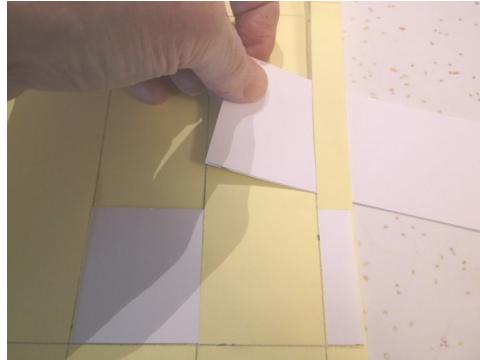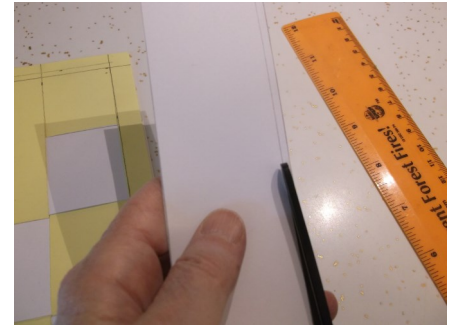
  - Continue **weaving** the white strips through the yellow frame slits until you have 5 of the 6 strips **woven** into the frame. Be sure to push each strip tight against the strip below.
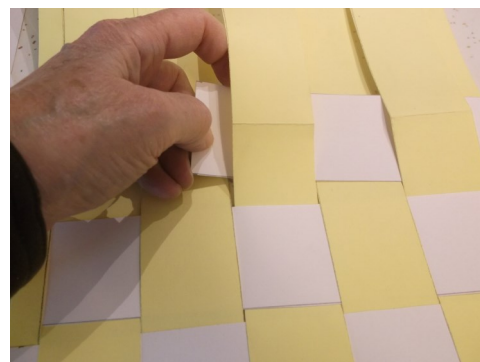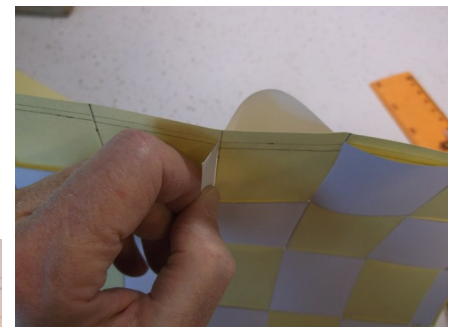
  - On the last strip, you may need to trim a bit so it will **weave** into your frame.

  Hold the strip up to the remaining space on the frame to estimate if or how much you need to shave from the edge.

  - Carefully **weave** the last strip into the frame.

  - Reinforce the frame edges with tape.

YOUTUBE VIDEOS
- Comparing sizes of virions, bacteria, and eukaryote cells (cells with a nucleus): https://www.youtube.com/watch?v=h0xTKxbIEIU
- Bacteriophages: https://www.youtube.com/watch?v=YI3tsmFsrOg

REFLECT

Directions:

- Pick any big job around the house for you to tackle. It has to be a big job, like wash all the windows, inside and out, from June 1—30th.
- Present this job as a contract to your parent. You will do this work, and all they have to do is to pay you one measly cent on the first day. They double that on the second day, and pay you two cents. Each day, they double what they pay you.
- How much money will you earn by the end of June (30 days)?
- **Wash your hands.**
- Place down a sheet of wax paper, about 15" long.
- Set your checkerboard on top of the wax paper.
- **Use a grain of rice to represent 1¢.**
- Before starting, predict how many grains of rice you will place on the last square. Write that number down in the last square.
- Write "1" and place 1 grain of rice on the first square.
- Double that, write "2" and place 2 grains of rice on the second square.
- Double that, write "4" and place 4 grains of rice on the third square.
- Double that, write "8" and place 8 grains of rice on the fourth square.
- Keep doubling write that doubled number in the next square, place that number of grains of rice on each subsequent square.

APPLY

- How close was your guess?
- What happened? Why?

- When were you unable to add more rice? How many squares were filled before you could not add any more rice?
- How much allowance would you earn on June 30th?
- How much allowance would you earn over the entire month?

RELATE TO DISEASE

- You may have heard about the number of days for the confirmed COVID-19, called the rate of doubling or rate of infection.
- Examine the graph on page 5. It displays data of many different countries throughout the world. The US is highlighted as a dark blue line. Answer the thought questions below the graph.
- Look at your checkerboard. You doubled the number every day for 30 days. Compare the graph of our current data doubling every 6 weeks compared to every 3 days during the first 25 days. How much would you earn if you only received a doubled allowance every three days, instead of every day?
- How long would it take you to earn the total amount if you only doubled your allowance

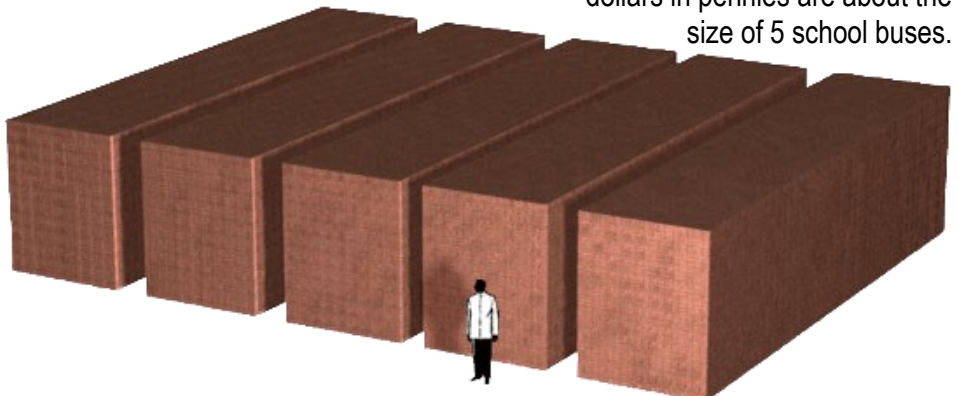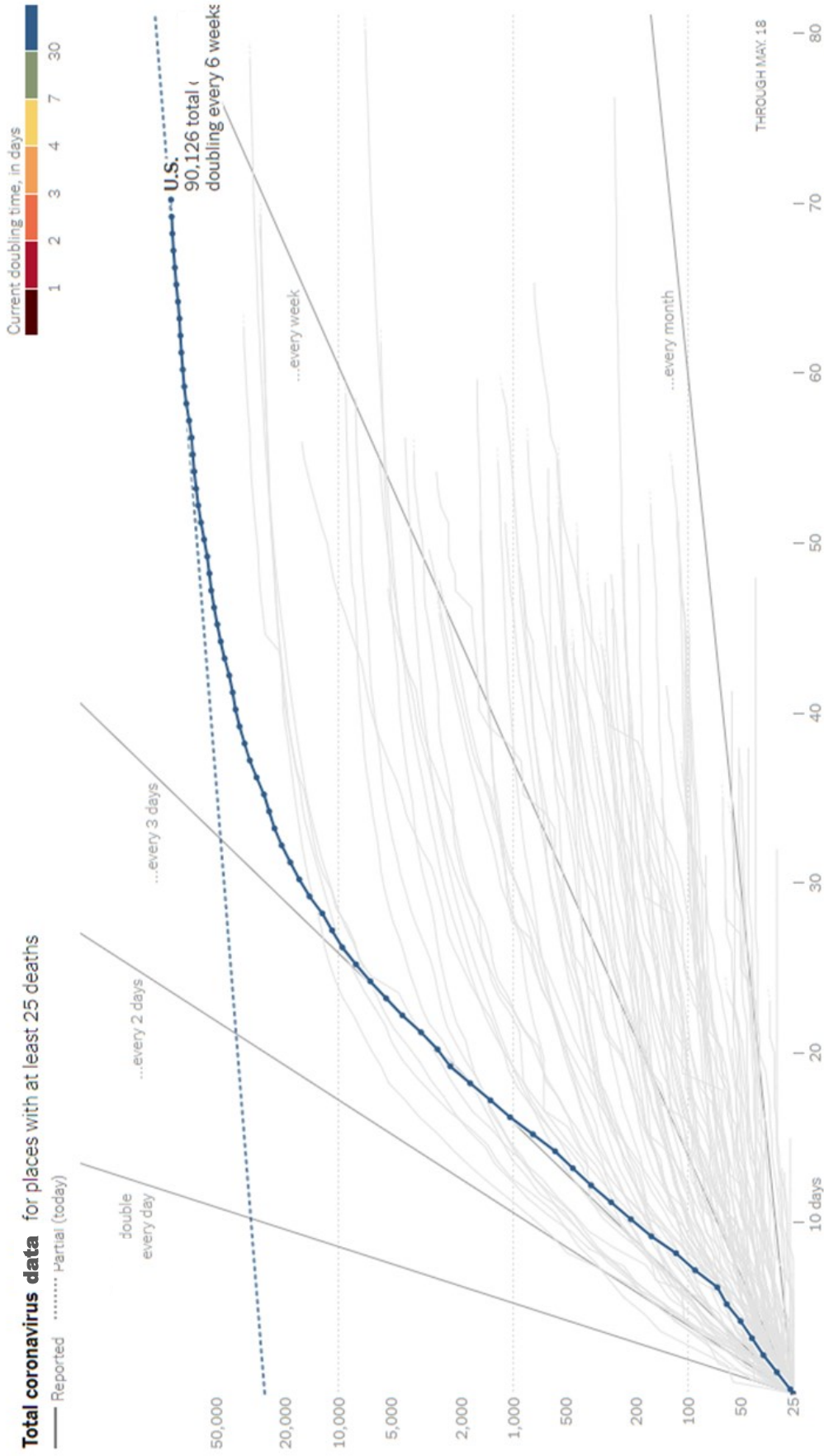every six weeks, starting in June?
- Can you describe why it is important to decrease the rate of doubling in an epidemic?

Answers are on page 6.

The image below is from The Mega Penny Project. Ten million dollars in pennies are about the size of 5 school buses.

Counties with Coronavirus Doubling Data

New York Times graph on different countries in the world with data on Coronavirus. The United States is the blue line. The Y axis (vertical line—the top is directly above the bottom of the line) shows the total number. The X axis (horizontal line—the line runs left to right) are the number of days since the first known case in each country.

- Look carefully at the top of the graph. You can see the line representing these data doubling every day. There is one country that had a doubling rate of very day—Great Brittan. They were not implementing any stay-at-home orders at that time. They changed their behavior, and their rate began to slow down.
- What was the US doubling rate during its first 10 days? How about the first 20 days? What is the doubling rate on May 18th (the last day of data on this graph)?

AUTHORS
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CITATIONS
Information:
- Muniz-Rodriguez K, Chowell G, Cheung C-H, Jia D, Lai P-Y, Lee Y, et al. Doubling time of the COVID-19 epidemic by province, China. Emerg Infect Dis. 2020 August [*date cited*]. http://dx.doi.org/10.3201/eid2608.200219; https://wwwnc.cdc.gov/eid/article/26/8/20-0219_article; https://www.nytimes.com/interactive/2020/us/colorado-coronavirus-cases.html

Images:
- Johns Hopkins University of Medicine coronavirus infection rate chart: https://coronavirus.jhu.edu/data/cumulative-cases
- Checkerboard "how-to" images: Barbara J. Shaw, Ph.D., CSU Extension, 2020.
- One billion pennies: http://coinsblog.ws/megapenny from Mega Penny Project—Adapted from images provided by the Coin Collectors Blog (http://coinsblog.ws)

Answers from page 4:
- Checkboard with each day's doubled amount. The right margin has the total earned for the month of June: $10,737,418.23
- Doubled every three days payment in June: $5.12 for the day, and a total of $10.23.
- Doubling every 6 weeks, starting in June, you would earn the $10,737,418.23 in the third week in December.