# STEM Connections

Colorado State University Extension

Connecting Science, Technology, Engineering, and Math concepts to our everyday lives.

## Meet Extension Agents!

Have you ever thought about a career in Extension? This series of Farm to Home STEM Connections will focus on our own agents, their work, and their professional interests.

Extension agents have bachelors degrees in a wide variety of fields, and either are working on a Masters or have a Masters or Ph.D.

Look for the bios on the different agents in the Western Region.

Pictured below are just some of the people who will be highlighted!

**Karen Massey**

**Trent Hollister**

**Deborah Alpe**

**CJ Mucklow**
**(our fearless leader)**

Photo credits:
CSU Extension Agents: http://www.ext.colostate.edu/cedirectory/s_display.cfm
Petri Dish Microbes: http://www.temple.edu/dentistry/admissions/course_descriptions.html

# MICROBES!

## What you can't see CAN hurt you!

**Microbes are living organisms too small to see except in a microscope. These organisms can be beneficial (like *Saccharomyces cerevisiae* (yeast fungus) rising bread) or harmful (like *Escherichia coli (E. coli), a* bacteria that can make you very sick .**

**Microbes** are everywhere; in the soil, in the air, in the water, and even on you! Some microbes are beneficial—they make cheese and yogurt, plants would not thrive without them, and bacteria form a barrier on your skin to protect you from bacteria that can harm you. Some microbes are harmful—they cause terrible diseases like leprosy or strep throat, to name just two.

If we can't see them, then how do we know that they are there? We are going to grow colonies, and when there are millions and millions of individual cells, you can see them (photo above). Most microbes are single cells. To reproduce, they simply divide from 1 cell to 2 cells, 2 cells to 4 cells; etc. They double, so that they can grow extremely fast. After 10 divisions, how many cells are there? How many divisions until there are over 1 million cells? Over 1 billion cells? (Answer is in the newsletter.) How fast do microbes **replicate**? That depends on the organism. E. coli takes about 30 minutes if all the conditions are right. After 24 hours, there could be **theoretically** over 70 trillion cells!

**Microbe Experiment:**

- With the sharpie, write the date on each ziplock bag, careful not to damage the gelatin in the foil liner.
- You will collect a sample from 8 different locations, and each baggie needs to be labeled with that location. Label the 1st bag "Hand," the 2nd "Washed Hand," the 3rd "Mouth," the 4th "Meat," the 5th "Kitchen Sink," the 6th "Doorknob," the 7th Toilet," and the 8th ""Dirt." Keep the bags sealed except when you inoculate them. Immediately seal the bag.
- Open the bag marked "Hand," and with your 4 fingertips, touch the gelatin lightly, leaving your fingerprint indents. Seal the ziplock bag.
- Wash your hands for 1 minute with warm water and plenty of soap. Rinse and dry with a clean paper towel. Open the bag marked "Washed Hand," and lightly touch the gelatin lightly with your 4 fingertips. Seal the bag.
- The remaining samples will be collected with cotton swabs. Use a clean swab for each surface, and throw the swab away when you are done.
  - Gently rub the swab in your mouth; inoculate the "Mouth" gelatin.
  - Ask for parent permission to rub a clean cotton swab on the meat you are having for dinner. Rub the swab on the meat, open the bag, gently rub the swab on the gelatin.
  - Rub the kitchen sink with a swab; inoculate the "Kitchen Sink" gelatin.
  - Rub a doorknob with a swab; inoculate the "Doorknob" gelatin.
  - Rub the toilet handle; inoculate the "Toilet" gelatin.
  - Scoop a small amount of dirt into the paper cup. Add water and stir. Dip a swab into the cup; inoculate the "Dirt" gelatin.
- Guess which will grow the most microbes? Which will grow the least?
- Store for 1 week in a dark, warm place (like under the kitchen sink). DO NOT UNSEAL BAGS. Examine your 8 samples. Were your guesses right?

**Age Appropriate:**
4th—HS grades

**Time Required:**
60 minutes

**Materials:**
- 1 pkg. plain gelatin
- 1 c water
- 2 tsp. sugar
- 1 beef bouillon cube
- 8 foil muffin/cupcake liners
- 2 muffin pans (w/6 cups)
- 8 ziplock sandwich bags
- Measure cup and teaspoon, saucepan, wooden spoon
- 6 cotton swabs
- 1 sharpie marker
- 1 paper cup

**Directions to make the growth medium:**
- Place 8 foil muffin/cupcake liners in the muffin pans.
- In a saucepan, mix gelatin, water, sugar, and boullion, slowly bringing to a boil, stirring constantly with the wooden spoon.
- Cool slightly.
- Pour the gelatin solution into the 8 foil liners, distributing evenly. DO NOT TOUCH THE GELATIN!!!
- Cool in refrigerator until gelatin is solid.
- Remove the gelatin in the foil liners from the muffin pan, and store each individually in a ziplock sandwich bag. (DO NOT TOUCH THE GELATIN!!!)
- Follow the directions for the Microbe Experiment.

**Power Words**
- **inoculate**: transplant microbes from one surface to a growth medium
- **microbe**: from French: micro (small) and Greek: bios (life)
- **replicate**: make an exact copy, reproduce
- **theoretically**: possible, based on the given facts (note that this the results could be very different)

**Big Numbers**: One million pennies would make a wall 1 foot thick, 4 feet high and 5 feet long; 1 billion pennies are larger than 5 of the long school buses!

Cells reproducing by dividing, starting with a single cell:

- 1st division is 2 cells
- 2nd division is 4 cells
- 3rd division is 8 cells
- 4th division is 16 cells
- 5th division is 32 cells
- 6th division is 64 cells
- 7th division is 128 cells
- 8th division is 256 cells
- 9th division is 512 cells
- 10th division is 1024 cells
- 21st division is 1,048,576,cells (over 1 million)
- 31st division is 1,073,741,824 (over 1 billion)