



# Chemistry in the Library: You are Contagious! - Chemistry of Germs/Bacteria

Website: [http://mdchem.org/citl/CitL\\_main.html](http://mdchem.org/citl/CitL_main.html)  
E-Mail: [chemists4fun@yahoo.com](mailto:chemists4fun@yahoo.com)

Introduction (most of the following is from PKIDs' *Infectious Disease Workshop (IDW)* - <http://www.pkids.org/idw.htm>).

Germs are all around us every day. Germs are not like animals or plants. A germ is so small you can't see it! But even though you can't see it, it can still get inside your body and make you sick.



\* Picture from Educational Innovations  
(<http://www.teachersource.com>)

Because you can't see germs, you never know where they might be! Germs can stick to your hands, they can stick to food and countertops, they can stick to noses, mouths, and cuts. Germs can travel through the air. Germs can travel place-to-place when germey things touch other people or objects.

Germs are often found at home. There are many places in our homes where germs can hide. Can you list 2 rooms in the house where germs would be the most likely present:

---

Germs are in the kitchen. Sometimes they are in the food we prepare to eat. Cooking food kills the germs. But if we don't wash our hands after handling certain foods, we can get these germs on other food or people. It is very important to keep cold food refrigerated. Cold food that is not stored in the refrigerator can grow germs that make us sick! Sometimes germs are found on fruits and vegetables. Foods should be washed or cooked before we eat it. Sometimes we leave dirty shoes or dirty bags on countertops where food is prepared. The germs from this dirt can get onto our countertops and into our foods.

One of the places germs like to be most is on DIRTY HANDS. If we eat with dirty hands we can get many different kinds of germs inside us. Once the germs are inside us, they can upset our stomach. Some types of germs can get in our blood too. This is why it is very, very important to wash our hands with soap and warm water.

Washing your hands is an easy way to keep germs out of your body:

- Wash your hands before you eat.

- Wash your hands after using the toilet.
- Wash your hands after playing outside.
- Wash your hands after you sneeze or cough in them. (There are many germs in sneezes & coughs.)

There also can be many germs in another person's blood. NEVER touch another person's blood.

Now, let's list ways of transmission (you'll be asked about this later!):

- Direct contact (person-to-person spread) Involves actual physical contact with an infected individual.
- Indirect contact (Object-to-Person spread)- Involves contact with a contaminated object.
- Air-borne (Air-to-Person)- Organisms can be contained within a droplet nuclei or dust particles, and can be suspended in the air for extended periods.

From the Clorox website:

Germs are passed around when infected objects come in contact with a surface. If the surface is not disinfected, the next time it is touched, germs can be transmitted around the house.

A study conducted by the University of Arizona's Charles P. Gerba, Ph.D., and team found that household bleach and bleach-based cleaning products are one of the most effective ways to disinfect surfaces in the kitchen and the bathroom. By properly using the right products\* to clean and disinfect, you'll eliminate 99.9% of germs.




Just because a surface looks clean, doesn't mean that germs are gone. In fact, the University of Arizona study also found that "anti-bacterial" household cleaning products like certain dish detergents and hand soaps cannot actually disinfect surfaces. And the numbers they found were staggering:

- 300 germs per square centimeter on kitchen countertops.
- 10,000 per square centimeter on bathroom faucets.
- And a whopping 100 million per square centimeter on sponges and dishcloths!

But don't let the numbers scare you. Winning the fight is as simple as knowing what products to use. So consider the following germ-killing table to help in your landslide victory:

*\* Only products registered by the EPA are approved for disinfecting and sanitizing.*

Germ Defense:

	<ul style="list-style-type: none"> <li>• Toilet surface &amp; bowl</li> <li>• Shower/tub &amp; drain</li> <li>• Kitchen &amp; bathroom floors</li> <li>• Bathroom countertops</li> </ul>		<ul style="list-style-type: none"> <li>• Faucets, appliance handles</li> <li>• Kitchen countertops &amp; appliances</li> <li>• Flush handles</li> </ul>
		<p>Tip: Fill sink with water &amp; bleach solution, soak sponges then drain - attacks 3 problem areas in one easy step.</p>	

## Safety Rules

- ❑ **Wear safety goggles when handling chemicals.** This means from when you're told to put them on until you're told they can come off.
- ❑ **Detect odors safely.** Use you hand to wave fumes to your nose. Never stick your nose directly into anything.
- ❑ **Wash spills immediately. Clean up your mess!**
- ❑ **No running, pushing, or shoving.**
- ❑ **Get help.** If you have any questions, please ask before proceeding.
- ❑ **No eating or drinking.**
- ❑ **No unauthorized experiments.** Only do the things the leader tells you to.

## Experiment #1: We're protected?

Often people and kids think that their protected from getting germs because germs can't get through our skin or because they wear gloves or because they wear a mask, etc. It is this sense of security that we want to examine in the following experiment.

Materials:

1-vial Cornstarch	2-vials water	1-Iodine/Water mixture in vial
3- plastic cups (can use a beaker)	1 pipet	1 snack-size Ziploc bag

Directions:

- Pour 1/3 of the cornstarch into 1 plastic cup (Cup #1 - standard), pour 1/3 of the cornstarch into the other plastic cup (Cup #2), pour the last 1/3 of the cornstarch into the Ziploc bag
- Add 1 vial of water to each plastic cup

Cup #2:

- Taking the pipet, add 1 drop of the iodine mixture to Cup #2

Questions:

- What happens? Does the iodine stay in one place?
- Is the change immediate or does it take a little bit of time?

Experiment:

- In the Ziploc bag, pour the cornstarch/water mixture - seal the bag
- In the last clear, plastic cup, pour the iodine/water mixture  
*Make a Hypothesis: Do you think that the same reaction will occur? Is the Ziploc bag is enough of a protective barrier to prevent this reaction?*
- Place closed Ziploc bag into the container with the iodine/water mixture
- Make observations every 5 minutes for 15 minutes.

Time (in minutes)	Observations
0	
5	
10	
15	

Follow Up Questions:

- Do you observe the same thing happening in both reactions?

- Where did the color reaction occur? How did the cornstarch and iodine mix?
- Are foods in plastic bags completely safe to germs on the outside? What might a
- For that matter, are our bodies safe from bacteria just because we have skin? Where are possible entry points for germs?
- Think about alternate storage materials. What might be better?

## Experiment #2: Spreading Germs

It is easy to forget to cover our mouths when we sneeze or cough. Let's do a short experiment investigating what happens when we forget. (Remember that germs are spread in many ways!)

Materials:

Spray bottle with water in it	Vial of Talcum powder (baby powder)
Ruler	Dark paper

Partner up with someone. (You don't have to know them!)

Spreading Germs through Sneezing (Pick one person to be the germ spreader):

- Place dark paper in front of this person on the table
- Place the spray bottle right in front of this person. This is the site of initiation.
- Make a hypothesis as to how far the spray will go (Remember that when you sneeze the force of air is much greater than a spray bottle so it will go farther!!)
- Spray the spray bottle - measure with the ruler how far the water droplets traveled

Spreading Germs through Coughing (Pick one person to be the germ spreader):

- Place dark paper in front of this person on the table (move the paper in front of this person)
- The germ spreader should put a small amount of the powder in the palm of their hand.
- Placing their hand near the table surface, blow on your hand as if you were coughing.
- Measure with the ruler how far the powder traveled.

Follow Up Questions:

- What type of transmission would this be through sneezing?
- What type of transmission would this be through coughing?
- What are the two things that we need to do to prevent spreading germs?

## Experiment #3: Transferring Germs to/from Food

Materials:

Potatoes	Baby wipes	Dirt	2-Ziploc bags
----------	------------	------	---------------

Directions:

- Partner up with someone (you don't have to know them!)
- Get 2 slices of raw potatoes and 2 plastic bags.
- One young scientist will clean their hands with baby wipe and touch the two pieces of potato.

- The other young scientist will put hands in dirt and touch the two pieces of potato.
- Label the bags either clean or dirty depending on what you handled before handling the potato.
- Give one of the bags to your partner so that you have 1 clean potato and 1 dirty potato.
- Each day view your bags and record what you see! (Use the table below)

Day	Condition of Clean Potato	Condition of Dirty Potato
0 (first made sample)		
2		
4		
6		
8		
10		
12		
14		

## Experiment #4: Transferring Germs Through Touch

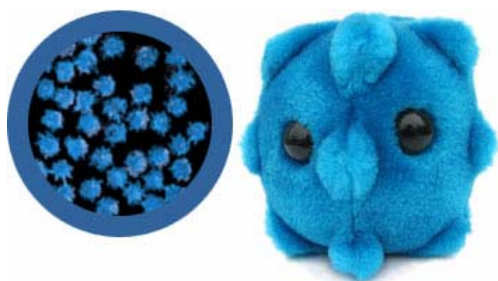
Materials:

Glow Lotion	Fluorescent light
-------------	-------------------

- Allow instructor to spray or place glow lotion on your hand
- (With lights off or dim) see how lotion glows on your hand with the fluorescent light
- Rub lotion into your hand
- Observe with the fluorescent light whether you can still see the lotion

One of our favorite demonstrations is using 'Glow Lotion'. Doctors & nurses use this when they are learning how to wash well. The lotion has a fluorescent dye in it that will not easily wash off.

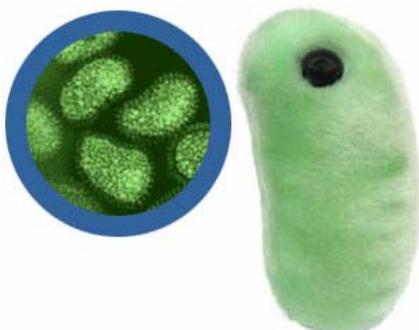
**Germs for Consideration:** (we show them in the session but they were purchased through Educational Innovations ([www.teachersource.com](http://www.teachersource.com))). Giantmicrobes are also available through Giantmicrobes, Inc (<http://www.giantmicrobes.com>)).



The Common Cold (Rhinovirus)

FACTS: There are over 250 different kinds of cold viruses! But rhinovirus is the most common. With over 100 different varieties, rhinoviruses are responsible for almost 35% of colds.<sup>1</sup>

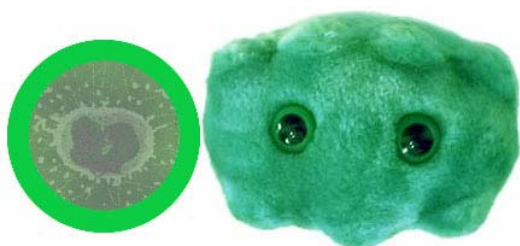
... more facts available on card that comes with microbe... but you can get more info from books at your library or via the internet



The Flu (Orthomyxovirus)

FACTS: Every year 5-40% of the population gets the flu. Fortunately, most people recover completely in a couple of weeks. Even more fortunately, since there are only about a dozen different flu viruses, vaccines have been developed that can be up to 90% effective in preventing infection in the first place.

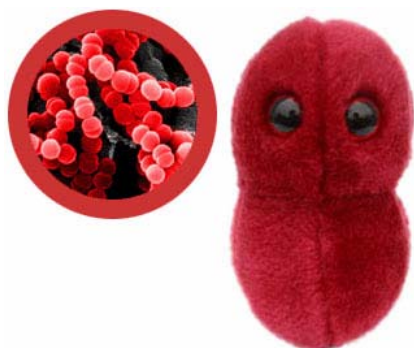
... more facts available on card that comes with microbe... but you can get more info from books at your library or via the internet



Halitosis - Bad Breath (Porphyromonas gingivalis)

FACTS: Between 300-400 types of microbes typically call the human mouth home. Most are harmless. But a few produce "volatile sulfur compounds." These compounds, which smell like rotting eggs, give bad breath its characteristic odor.

... more facts available on card that comes with microbe... but you can get more info from books at your library or via the internet



Sore Throat (Streptococcus pyogenes)

FACTS: Streptococcus bacteria cause about 15% of sore throats; viruses cause most of the rest! It can be difficult to tell if your sore throat is being caused by strep or a virus, but it is important to try.

... more facts available on card that comes with microbe... but you can get more info from books at your library or via the internet

## Experiments To Do at Home with a friend and/or a parent:

- When working at Home: ALWAYS remember the safety rules!!
- When working at Home: ALWAYS ask a parent before you start any experiment!!

<sup>1</sup> Giantmicrobes, Inc.

- When working at Home: ALWAYS remember to work on a surface that is easily cleaned - never work directly on a table. Working on a wax paper or plastic surface will minimize any problems with cleaning up afterwards!

**Experiment #1 (To Do at Home or at the Library on the Computer!):** Solve some microbe mysteries with Microbe Sam -  
(<http://crimesitecleanup.com/urlredirector.asp?url=http%3A//www.microbe.org>)

**Experiment #2 (To Do at Home or at the Library on the Computer!):**  
**Transferring Germs to/from Food**

You've probably heard of germs. But do you know exactly what they are? "Germs" is the everyday word that refers to bacteria, viruses and protozoans that make you sick.

Materials:

Three apples-two good ones and one with a rotten/mushy spot	Two sewing needles
Rubbing alcohol	String

- Dip one of the sewing needles in rubbing alcohol to sterilize it.
- Stick the sterile needle into the rotten spot of the rotten apple.
- Stick it immediately into one of the good apples.
- Tie a string around the stem of the good apple so you can identify it later.
- Throw away the rotten apple.
- Sterilize the second needle in the same way as the first.
- Stick it into the second good apple. (This apple will serve as a control in this experiment to insure that sticking an apple with a sterile needle will have no effect on the results.)
- Place the two good apples in a warm place and check them daily. The apple with the string should develop a rotten spot; nothing should happen to the control apple.

Explanation: When you stuck the needle in the rotten spot on one apple, then into the good apple, the needle transferred the bacteria from the rotten spot. The same thing can happen with people. If your friend has the flu, and coughs near you, it's possible that the cough can pass the bacteria to you. And that can make you sick.

Follow Up Questions:

1. Is this a direct or indirect method of transmission?
2. How long (in days) did it take for the 'contaminated' apple to form a mushy spot?