

GETTING SICK MIGHT BE IN YOUR HANDS

Where and when do kids get the most germs on their hands?

PURPOSE

The purpose of my experiment was to initially help raise awareness of how easily we can get germs on our hands and that we need to make sure we practice proper hand hygiene. My experiment will benefit people in general, including: parents, school staff, and owners of indoor play places in particular. It will highlight the importance of having good hand hygiene to stay healthy, prevent spreading germs, and getting sick especially among kids. It will draw parents' attentions to certain places and activities that their kids will participate in and get germs on their hands from, so they can make sure their kids clean their hands properly after going to these places to minimize the chances of getting sick. School staff and owners of indoor play places will pay more attention on keeping their places clean and sanitize them more often to minimize the count of germs that kids can be exposed to, especially in flu season. And in light of the COVID-19 pandemic, I believe my experiment would be very helpful to also go on to show how often it is we come into contact with places that are full of germs from many different people, which shows how easy and fast we increase the count of germs on our hands

QUESTION

1. Do kids get more germs on their hands after going to the following places: school, the park, and indoor play places?
2. Which place do they get the most germs on their hands from: school, park, or indoor play place?
3. Does the number of germs on kids' hands differ according to their age, and which age group has the most?
4. Does the count of germs on kids' hands differ according to the weather temperature and in which season do they get the most germs?

HYPOTHESIS

I hypothesize that the germ count on kids' hands will be more after going to school, the park, and indoor play place than before going there.
 I hypothesize that the count of germs on kids' hands will be the most after going to the park, then school, last will be the indoor play place.
 I hypothesize that the highest count of germs will be on the hands of the preschooler, then the elementary kid's hands, then the middle schooler's hands, and last will come the high schooler's hands.
 I hypothesize that the count of germs on kids' hands will be higher during the colder weather temperature than during the warmer weather temperature

CONCLUSION

My hypothesis was partially wrong. I was right that the count of germs on kids' hands will increase when they go to the 3 tested places (school, the park, and indoor play place). However, I was wrong in my hypothesis about which place will give kids the most germs on their hands. It wasn't the park. It was indoor play place, then came the school, and lastly with the least germs came the park. I was wrong about which age group will have the most count of germs on their hands as well, the Pre-k age group didn't have the most germs on their hands, and the high school age group didn't have the least. Instead the High-School age group had the most count of germs on their hands, then came the Pre-K age group, then came the Middle-School age group, and lastly with the least number of germs on their hands came the Elementary age group. The last part of my hypothesis was right, kids had more germs on their hands in the colder weather than in the warmer weather. The count of germs on kids' hands was the most in November (the coldest month) then came October last came September (the warmest month).

BACKGROUND

According to the CDC there are many ways germs can get on our hands and make us sick, but the most common germs that are found on hands are fecal bacteria (poop germs) from people or animals. Some examples of these are Salmonella, *E. coli O157*, and noroviruses that can cause diarrhea, respiratory infections and hand-foot-mouth disease. These kinds of germs and viruses can get onto hands after people use the toilet or change diapers. Germs can also get onto hands if people touch any object that has germs on it because it's possible that someone coughed or sneezed on it or it was touched by some other contaminated object. When these germs get onto hands and are not washed off, they can be passed from person to person and make people sick. About 1.8 million children under the age of 5 die each year from diarrheal diseases and pneumonia, the top two killers of young children around the world.

According to healthyliving.com, three of the most common places for kids to get germs from are schools, parks, and indoor play areas. Teddy Myatt, a senior scientist and healthcare official at Brigham and Women's Hospital in Boston says that "the start of school often triggers the spread of illness, as kids return with germs that get transmitted to classmates". Most infectious diseases are transmitted by direct contact, either by touching an infected person or by touching surfaces contaminated with pathogens. Charles Gerba, a microbiologist and professor at the University of Arizona, says that "The crowded classrooms, cafeterias and gyms in schools can be a breeding ground for a variety of diseases including colds, influenza, norovirus and staph infections such as MSRA."

The website homeadvisor.com conducted a study on playgrounds and found that they are a breeding ground for bacteria. They tested commonly touched surfaces to find the number of colony-forming units (CFUs) per square inch. The results? Rock walls, baby swings, and seesaws were by far the germiest: All three teemed with 9 million CFU/sq. in., which is over 52,000 times more bacteria than a typical home toilet seat.

The website parents.com also warns against public play areas. According to their research, enclosed play areas containing plastic balls are among the dirtiest places that children can play in. In fact, researchers at the University of North Georgia found 31 types of bacteria in the ball pits of six physical-therapy clinics. "Kids with leaky diapers play in them, and the pits rarely get cleaned," says Dr. Reynolds. A child's feces can contain *E. coli*, rotavirus, and salmonella, all of which can cause severe vomiting and diarrhea. Young children can also pass germs onto the balls with their hands and feet.

Toward the end of my experiment, I saw that COVID-19 was all over the news, there were constant reminders of the precautions we need to take to protect ourselves from it. One of the most covered topics was contaminated hands and how it is the most common way to transfer the virus and make people sick. As the World Health Organization said, "Current evidence indicates that the COVID-19 virus is transmitted through respiratory droplets or contact. Contact transmission occurs when contaminated hands touch the mucosa of the mouth, nose, or eyes; the virus can also be transferred from one surface to another by contaminated hands. Other viruses and bacteria causing common colds, flu and pneumonia also can be transmitted through contact." You might think that you don't touch your face very often, but it's much more than you realize. A 2015 study by Sara Rigby found out that people touch their faces an average of 23 times an hour.

PROCEDURE

I did my experiment on four kids divided into four different age groups based on their age and school grade, first group is PK, second is elementary, third is middle school, and fourth is high school. Kids' hands were swabbed before and after going to school, before and after playing for 2 hours in the park and in a famous indoor play place. The experiment was done in three different months with three different weather temperatures.

My experiment was done according to the following steps:

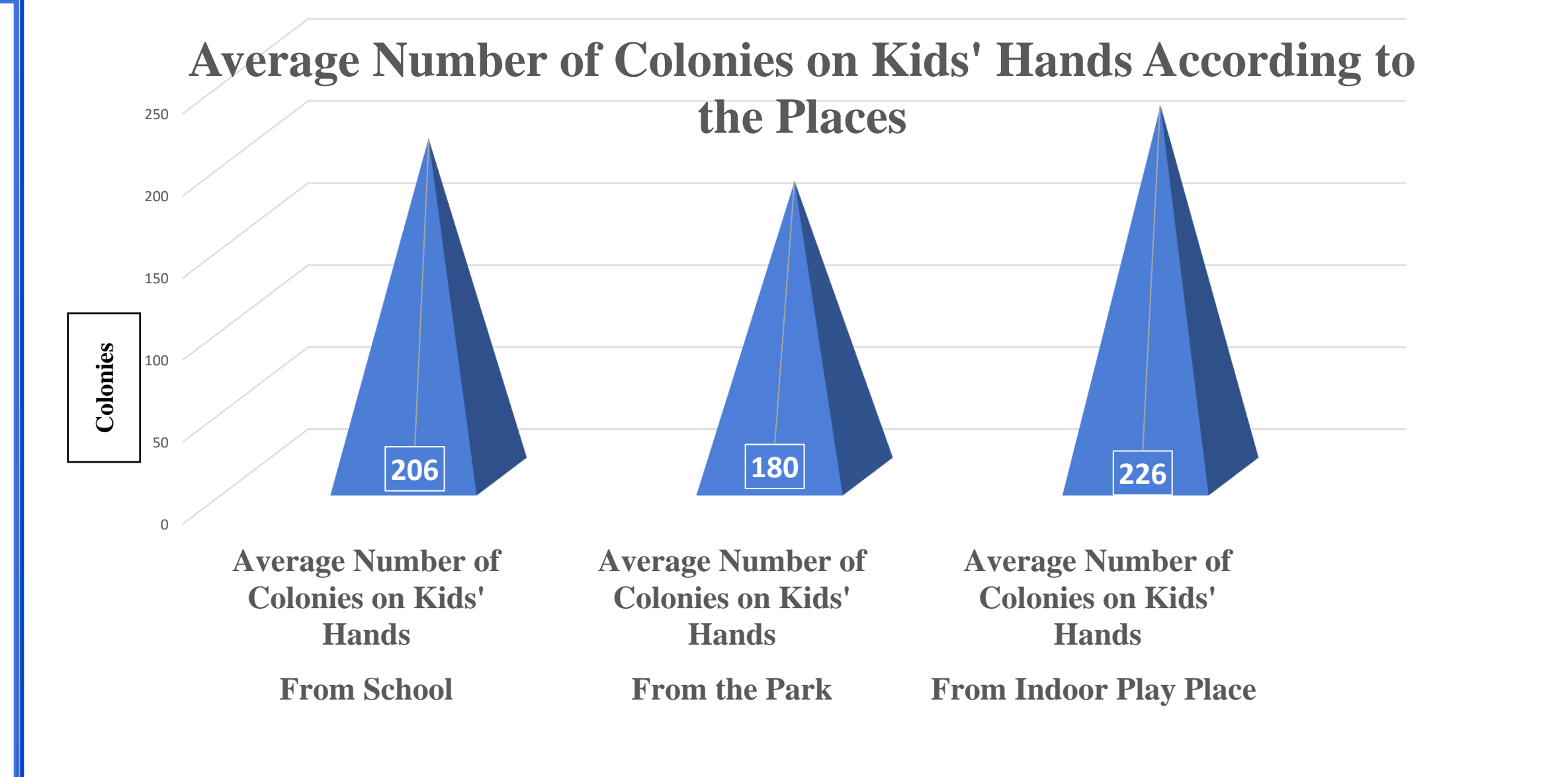
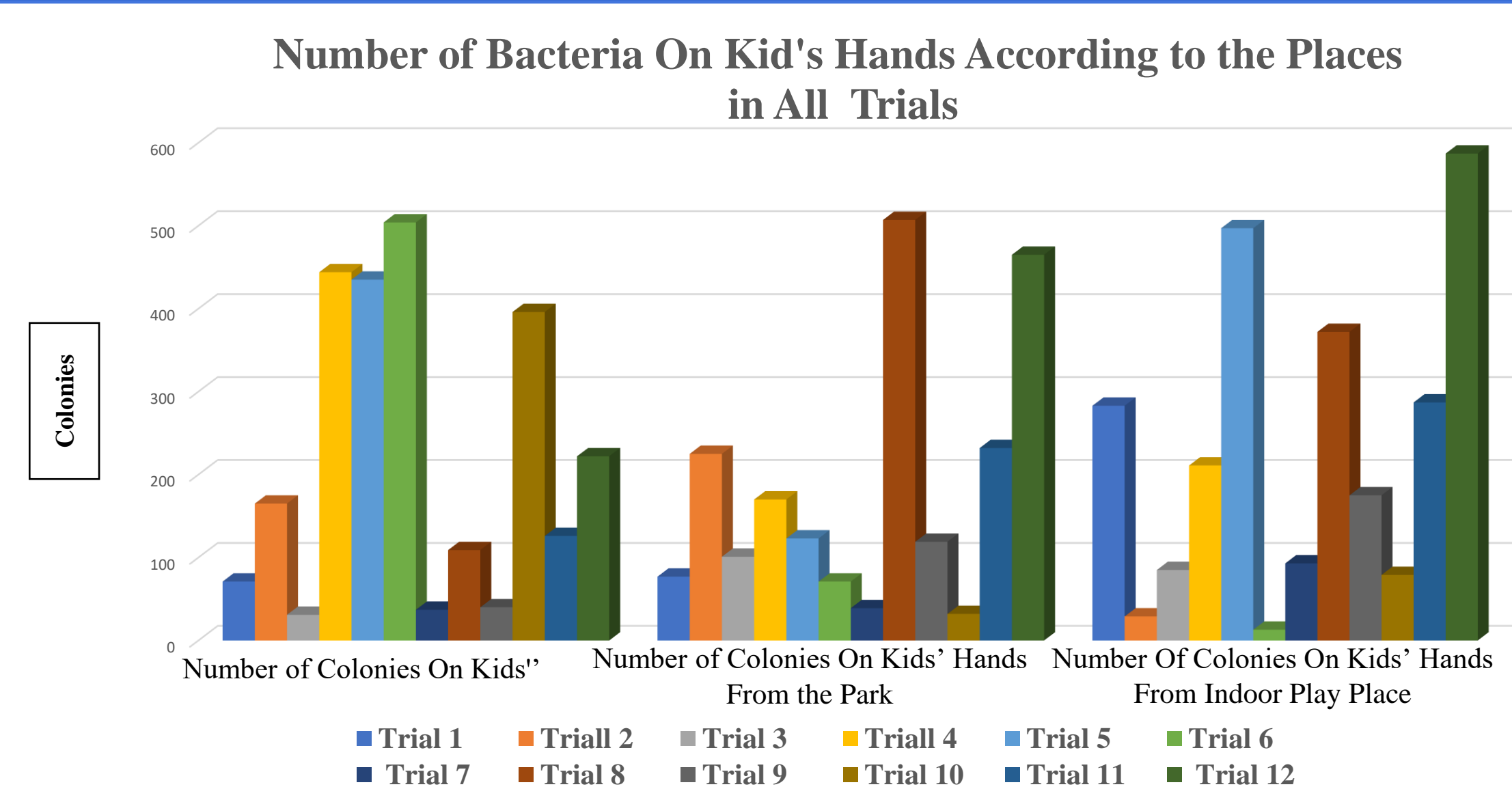
1. Ask the kids to wash their hands before you swab them.
2. Take a swab out. Swab the pre-school participant's hands before going into school.
3. Place the swab in the nutrient test tube
4. Label the test tube 'PK before school'
5. Take out another swab. Swab the elementary participant's hands before going into school
6. Place the swab in the nutrient test tube.
7. Label the test tube with 'Elementary before school'
8. Take out another swab. Swab the middle school participant's hands
9. Place the swab in the nutrient test tube.
10. Label the test tube with 'MS before school'.
11. Take out another swab. Swab the high school participant's hands
12. Place the swab in the nutrient test tube
13. Label the test tube with 'HS before school'
14. Repeat steps 2-13 when participants come out of school, make sure they don't wash their hands before swabbing them, change the labels to 'after school'
15. Repeat steps 1-13 before participants go to the park, change the label to 'before park'
16. Repeat steps 2-13 after participants are done and leaving the park, make sure they don't wash their hands before swabbing them, change the labels to after park
17. Repeat steps 1-13 before participants go to the indoor play place, change the label to 'before indoor play place'
18. Repeat steps 2-13 when participants finish playing in the indoor play place, make sure they don't wash their hands before swabbing them, change the labels to 'after indoor play place.'
19. Schedule an appointment with the lab you are going to.
20. Take the tubes back to the lab. Ask for nutrient agar plates.
21. Take the swabs and spread them on the nutrient agar/sheep blood plates.
22. Close the nutrient plates. Label them. Place them in the incubator.
23. After 24 hours come back to the lab and count the bacteria.
24. Record the number of colonies that are in each plate. Every dot on the plate counts as one colony of the bacteria.
25. Repeat steps 1-24 for trials 2 and trial 3

RESULTS

The results of my experiments showed that the count of germs on the participants' hands were more after going to school, park and indoor play place. than before in all 36 trials, the count of germs on the participants' hands increased by tens, which answered my first question and proves my first hypothesis correct.

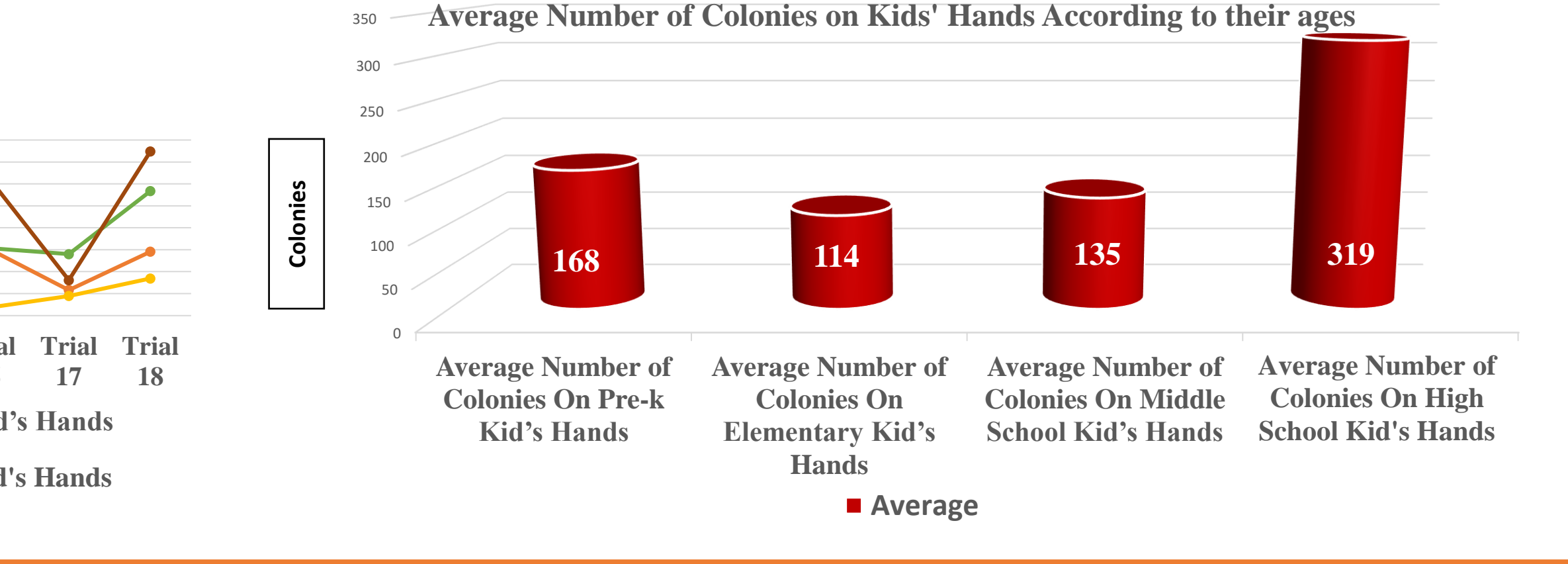
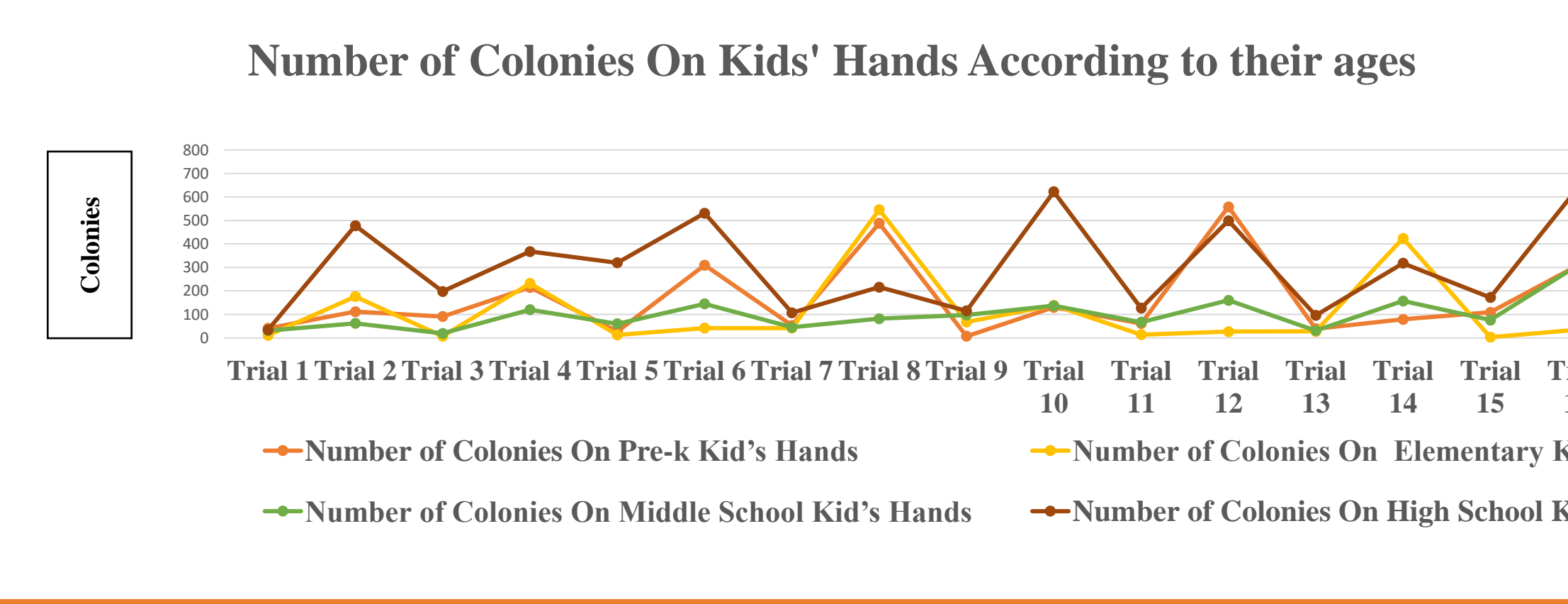
To answer my second question, I subtracted the count of germs on kids' hands after going to the tested places from the count of germs on kids' hands before going there to get the exact number of colonies that the kids got on their hands from the tested places. Then I took the average of all 12 trials, I found out that the kids got the greatest number of germs on their hands from indoor play place with an average of 226 colonies, then from school with an average of 206 colonies, and finally came the park with an average of 180 colonies.

Trial#	Number of Colonies on kids' hands From school	Number of Colonies on kids' hands From the park	Number of Colonies on kids' hands From indoor place
1	71	77	283
2	165	225	29
3	31	101	85
4	444	170	211
5	435	123	497
6	504	71	13
7	37	39	93
8	109	507	372
9	40	119	175
10	396	32	79
11	126	232	287
12	222	465	587
Control	0	0	0
Average	206	180	226



Trial #	Number of Colonies on Pre-k Kid's Hands	Number of Colonies on Elementary Kid's Hands	Number of Colonies on Middle School Kid's Hands	Number of Colonies on High School Kid's Hands
1	41	11	31	34
2	112	176	62	478
3	91	7	19	198
4	215	232	120	368
5	27	13	60	320
6	310	42	145	531
7	53	42	45	107
8	488	546	82	216
9	7	68	98	115
10	130	139	137	622
11	61	14	67	127
12	558	27	160	499
13	39	28	31	96
14	79	424	157	318
15	109	3	76	172
16	308	35	308	637
17	116	89	280	161
18	291	169	567	748
Control	0	0	0	0
Average	168	114	135	319

To find out which age group has the most count of germs on their hands, I listed all of the counts of bacteria before and after going to the tested places according to the age and grade. Then I took the average of all 18 trials. I found out that the high school age has the highest count of germs on their hands with an average of 319 colonies, then came the Pre-K age within average of 168 colonies, then came the middle school age within average of 135 colonies, and lastly came the elementary age with 114 colonies.



Trial #	Number of Colonies on kids' hands In September	Number of Colonies on kids' hands In October	Number of Colonies on kids' hands In November
1	41	53	39
2	112	488	79
3	91	7	109
4	215	130	308
5	27	61	116
6	310	558	291
7	11	42	28
8	176	546	424
9	7	68	3
10	232	139	35
11	13	14	89
12	42	27	169
13	31	45	31
14	62	82	157
15	19	98	76
16	120	137	308
17	60	67	280
18	145	160	567
19	34	107	96
20	478	216	318
21	198	115	172
22	568	622	637
23	226	127	161
24	531	499	748
Control	0	0	0
Average	152	184	218

To find out which month kids get the most germs on their hands in, I listed the results of all the trials that were done in the three months which are equal to 24 trials. I listed them in one table then took the average of them all. I found out that in the month of November when temperature was in the forties, kids' hands had the highest count of germs with an average bacteria count of 218, then came October with an average bacteria count of 184 when temperature was in the sixties, lastly came September with an average of 152 when temperature was in the high seventies

