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Staying Healthy in Kindergarten

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Introduction

In this unit, my young students will become aware of disease pathogens. Two books will anchor the initial learning: *Germs vs. Soap* by Didi Dragon, a fun and funny picture book about the benefits of proper handwashing; and, *Germs Are Not For Sharing,* by Elizabeth Verdick. This book is a short course for kids on what germs are, what they do, and why it's so important to cover them up, block them from spreading, and wash them down the drain. The unit complements two aspects of our current kindergarten curriculum. Through a program called Michigan Model for Health, students learn about personal health and wellness, which of course covers hand washing. Our literacy curriculum includes a module, “A Happy Healthy You” which provides another avenue to help students learn how to care for themselves. They will investigate the benefits (or not) of products like Purell, learn that viruses and bacteria cannot be seen until magnified under a microscope, and discover that there are many strategies for helping ourselves and each other avoid “sharing germs.”

As a Kindergarten teacher in a self-contained classroom at Edgewood Magnet School in New Haven, I find the neighborhood/ magnet setting a rewarding environment, with students coming to school each day from a variety of home circumstances and with differences in academic levels. As a result of these variables, the children arrive with differing levels of background knowledge and life experiences. The classroom is a mixture of varied ethnicities, economic strata, and social and emotional strengths and weaknesses. Edgewood is a STEAM school, with our curricula focused on science, technology, engineering, arts, and mathematics. This planned unit aligns with the philosophy of the school. The use of scientific inquiry allows all students at all levels to learn in an inherently differentiated environment, learning new concepts and experiencing science in the classroom and outside, particularly across the street at Edgewood Park.

Evolution and Evolutionary Medicine

Evolution is a process that results in changes in the genetic material of a population over time. It reflects the adaptations of organisms to their changing environments and can result in altered genes, novel traits, and new species.

Evolutionary processes depend on both changes in genetic variability and changes in allele frequencies over time. Alleles are different versions of a gene that are located at the same position on a chromosome. Humans are diploid organisms, meaning they have two alleles for each gene, one inherited from each parent. Alleles can be identical, but they often have slight differences. These differences can have important effects on our bodies, such as how we look and our risk factors for certain diseases.

Alleles are often categorized as either normal or wild-type, or abnormal or mutant. They can also be described as dominant or recessive, depending on how their associated traits are inherited. For example, the brown eye allele is dominant to the blue eye allele, so a child with one brown allele and one blue allele will have brown eyes. However, a child with two blue alleles will have blue eyes.[1]

The study of evolution has two different scales. Microevolution reflects changes in DNA sequences and allele frequencies within a species over time. These changes may be due to mutations, which can introduce new alleles into a population. Macroevolution reflects large-scale changes at the species level, which result from the accumulation of numerous small changes on the microevolutionary scale. An example of macroevolution is the evolution of a new species.

One mechanism that drives evolution is natural selection, which is a process that increases the frequency of advantageous alleles in a population. Natural selection results in organisms that are more likely to survive and reproduce. In *On the Origin of Species*, Charles Darwin's endeavored to show that evolution has occurred and that natural selection is the main cause of this process. He claimed that natural selection provides legitimate explanations for facts that are otherwise inexplicable. What he called "artificial selection" made it easier to explain his idea of natural selection. Domesticated plants and animals were well known to be modified. A breeder might create a dwarf breed of chickens by selecting the smallest chickens to become parents. This breeding process establishes the plausibility of selection mechanisms in general. In the natural world, there is reproductive competition between organisms of the same species. Those that have what it takes to outcompete the others will be those that survive and reproduce.[2]

Evolutionary medicine, also known as Darwinian medicine, uses evolutionary biology principles to better understand, prevent, and treat disease. It also uses disease studies to advance evolutionary biology knowledge.[3]

It combines medicine with other disciplines, such as ecology, anthropology, psychology, and zoology, to create new ways to investigate and understand disease. It asks questions like how bodies work, why some people get sick, and why natural selection has left humans with traits that make them vulnerable to disease.[4]

Evolutionary medicine can help us understand how anatomical and physiological changes over time in response to environmental changes can lead to disease. For example, the sickle cell trait can protect carriers from severe malaria infections, but is harmful to homozygotes. Giraffes also have a gene that protects their hearts from damage caused by their high blood pressure, which could help guide research to treat high blood pressure in humans.[5]

The COVID-19 pandemic was a devastating example of evolution in action. As it swept across the globe, the SARS-CoV-2 virus continually mutated into new variants. Evolutionary models were essential for tracking these variants, predicting their properties, and informing responses. Evolution-based approaches work to predict, monitor and manage future infectious disease outbreaks, including new pathogens that are a risk to humans.[6]

What are Microbes?

Microbes are tiny living organisms that may or may not cause disease. Germs, or pathogens are the category of microbes that can cause disease. These single-cell organisms are so tiny that millions can fit into the eye of a needle. They are the oldest and most abundant form of life on earth. Microbe fossils date back more than 3.5 billion years to a time when the Earth was covered with oceans that regularly reached the boiling point, hundreds of millions of years before dinosaurs roamed the Earth. Without microbes, we couldn't eat or breathe. Without us, they'd probably be just fine.

Understanding how microbes operate is vital to understanding the past and the future of ourselves and our planet. Microbes are in the air we breathe, the ground we walk on, the food we eat, and inside our bodies. We, along with other animals, could not digest food without them. Plants couldn't grow, garbage wouldn't decay and there would be less oxygen for us to breathe. Without these seemingly invisible organisms, our planet would not survive as we know it.

Students naturally have microbes on their hands and collect more and more throughout the day. Many microbes are normal and help keep us healthy; some are viruses and bacteria that make us sick. Within a classroom, students interact with each other and with common surfaces they share in the learning spaces they occupy. When they touch things, some of the microbes on their hands transfer to the things they touch, and the microbes from the things they touch are transferred onto their hands and body.

Bacteria

Bacteria are small single-celled organisms found almost everywhere on Earth and vital to the planet's ecosystems. Some species can live under extreme temperature and pressure conditions, making it possible for them to be found in every habitat on Earth: soil, rock, oceans, and even arctic snow.

They are microbes with a cell structure simpler than many other organisms. Their control center, which holds the genetic information, is contained in a single loop of DNA, rather than a nucleus. Some bacteria have an extra circle of genetic material called a plasmid. The plasmid often contains genes that give the bacterium some advantage over other bacteria. For example, it may contain a gene that makes the bacterium resistant to a certain antibiotic.[7]

Bacteria are classified into five groups according to their basic shapes: spherical (cocci), rod (bacilli), spiral (spirilla), comma (vibrios), or corkscrew (spirochaetes). They can exist as single cells, in pairs, chains, or clusters.[8]

Some live in or on other organisms including plants, animals, and humans. The human body is full of bacteria and other microbes such as viruses and fungi, which collectively comprise the human microbiome estimated to contain more bacterial cells than human cells. Most bacteria in the body are harmless, and some are even helpful. Amazingly, there are approximately 10 times as many bacterial cells as human cells in the human body. Many of these bacterial cells are found lining the digestive system. Bacteria live in the soil or on dead plant matter where they play an important role in the cycling of nutrients. Other types of bacteria cause food spoilage and crop damage while some are incredibly useful in the production of fermented foods such as yogurt and soy sauce. Relatively few bacteria are parasites or pathogens that can cause disease in animals and plants.[9]

All bacteria reproduce by binary fission, in which the bacterium, a single cell, divides into two identical daughter cells. Binary fission begins when the DNA of the bacterium divides into two (replicates). The bacterial cell then elongates and splits into two daughter cells with identical DNA to the parent cell. Each daughter cell is essentially a clone of the parent cell.

Under favorable conditions (temperature and available nutrients), some bacteria like *Escherichia coli* (often called *E. coli*) can divide every 20 minutes. This means that in just seven hours one bacterium can generate 2,097,152 bacteria. After one more hour, the number of bacteria will have risen to an incredible 16,777,216. That's why we can become ill quickly when harmful microbes invade our bodies.[10]

Bacteria can play important useful roles in our daily lives. Lactic acid bacteria, such as Lactobacillus and Lactococcus together with yeast and molds, or fungi, are used to prepare foods such as cheese, soy sauce, natto (fermented soybeans), vinegar, yogurt, and pickles. Fermentation is useful for preserving foods and some of these foods may offer health benefits. For example, some fermented foods contain types of bacteria similar to those linked with gastrointestinal health. Some fermentation processes lead to new compounds, such as lactic acid, which appear to have an anti-inflammatory effect. Bacteria can break down organic compounds. This is useful for waste processing and cleaning up oil spills and toxic waste. The pharmaceutical and chemical industries use bacteria in the production of certain chemicals. Bacteria are used in molecular biology, biochemistry, and genetic research because they can multiply quickly and are relatively easy to manipulate. Scientists use bacteria to study how genes and enzymes work. Bacteria are necessary to make antibiotics. *Bacillus thuringiensis* (Bt) is a bacterium that can be used in agriculture instead of pesticides and does not have the detrimental environmental consequences associated with pesticide use.[11]

In 1900, pneumonia, tuberculosis, and diarrhea were the three biggest killers in the United States. Strategies for sterilization techniques and the development of antibiotic medications have led to a significant drop in deaths from bacterial diseases. Bacteria are needed to make antibiotics. But the overuse of antibiotics is making bacterial infections harder to treat. As the bacteria mutate, they become more resistant to existing antibiotics, which makes infections harder to treat. Bacteria evolve naturally, but the overuse of antibiotics is speeding up the process of bacteria evolution to resist antibiotic drugs.

Some types of bacteria can cause diseases in humans, such as cholera, diphtheria, dysentery, bubonic plague, pneumonia, tuberculosis (TB), typhoid, and many more. If the human body is exposed to bacteria that the body does not recognize as helpful, the immune system will attack them.[12]

General Timeline of Understanding Bacteria

Over 2,000 years ago, a Roman author, Marcus Terentius Varro, warned against locating homesteads in the proximity of swamps ‘because there are bred certain minute creatures which cannot be seen by the eyes, which float in the air and enter the body through the mouth and nose and there cause serious diseases’. [13]

Fracastoro stated that there were diseases that could be caused by a contagion that ‘passes from one thing to another’. These were transmitted in three ways: by direct contact with the infected, by contact with their clothes or carried by the air. Fracastoro described this agent of contagion as seminaria, a word which has often been translated as germs. Its literal meaning, however, is breeding ground or nursery. Although he stated contagion was affected by ‘small imperceptible particles’, Fracastoro never perceived these particles to be living creatures. He did speculate, however, that each disease had its own specific seminaria, an idea that was overlooked for more than 300 years.

In the 17th century, a Dutch scientist, Antonie van Leeuwenhoek created a single-lens microscope with which he saw what he called “animalcules,” later known as bacteria. He is considered to be the first microbiologist. The Dutch shopkeeper Leeuwenhoek had an obsession with microscopes and a talent for lens grinding. For more than 50 years he made important observations across every branch of natural science. After studying samples of plaque and spittle, Leeuwenhoek wrote to the Royal Society that he found ‘an unbelievably great company of living animalcules… in such enormous numbers, that all the water … seemed to be alive’. Although he never connected these creatures with disease, his observations and drawings are the first recorded descriptions of micro-organisms.[14]

In the 19th century, the chemist Louis Pasteur said that diseases were caused by germs. Pasteur’s discoveries on fermentation in wine, beer, and milk demonstrated that it was microorganisms in the atmosphere that produced fermentation diseases. His proof of external contamination was to finally overturn the theory of the spontaneous generation of microorganisms caused by internal or systematic imbalances. The report of his experiments has been called ‘the manifesto of the germ theory’. It established the fundamental concepts from which the science of microbiology would develop. This was known as the Germ Theory.[15]

In 1910, the scientist Paul Ehrlich announced the development of the first antibiotic, Salvarsan. He used it to cure syphilis. His aim was, as he put it, to find chemical substances which have special affinities for pathogenic organisms, to which they would go, as antitoxins go to the toxins to which they are specifically related, and would be, as Ehrlich expressed it, «magic bullets» which would go straight to the organisms at which they were aimed. He was also the first scientist to detect bacteria by using stains.[16]

In 2001, Joshua Lederberg coined the term “gut microbiome.” Scientists worldwide are currently seeking to describe and understand more precisely the structures, types, and uses of “gut flora,” or bacteria in the human body.[17]

Lederberg’s discoveries greatly increased the utility of bacteria as a tool in genetics research, and it soon became as important as the fruit fly *Drosophila* and the bread mold *Neurospora*. His discovery of transduction, the process of carrying a bacterial gene from one bacterium to another provided the first hint that genes could be inserted into cells. The realization that the genetic material of living things could be directly manipulated eventually bore fruit in the field of genetic engineering, or recombinant DNA technology.[18]

Culture of eight-year-old's hand[19]

The Facebook page for the American Society for Microbiology (ASM) shared a photo of a large bacterial culture plate bearing a handprint made of microbial colonies. Tasha Sturm, who works as a lab tech at Cabrillo College in California, created this culture by pressing her eight-year-old son's hand into an agar plate after he had been playing outside. Agar is commonly used to culture microbes because it provides a nutrient-rich base for microorganisms to grow. She then incubated the handprint for 48 hours and let it sit for another few days, photographing the final result.[20]

Sturm added some tentative IDs in the comment section of the original post: white colonies are probably a form of Staphylococcus, which lives in people's noses and skin and some colonies of fungi and yeast. Most strains are harmless or even beneficial, but some can cause disease when they grow where they shouldn't, especially when they develop antibiotic resistance. Sturm also posted two close-ups of colonies that are either species of *Bacillus* — a common soil bacterium. Researchers are working to explain exactly what this abundance of microbes on the body and its stunning diversity means for human health and disease.[21]

Viruses

A virus is an infectious agent that can only replicate within a host organism, small germs (pathogens) that can infect you and make you sick. They can infect humans, plants, animals, bacteria, and fungi. Each one infects only specific types of hosts.

Viral infections in humans can span the spectrum from causing no symptoms to making you extremely ill.

Types of diseases and conditions caused by viruses include respiratory illnesses, diarrhea and vomiting, sexually transmitted infections, and skin conditions.[22]

As infectious agents, viruses are small pieces of genetic information in a “carrying case” — a protective coating called a capsid. When a virus particle is independent of its host, it essentially consists of the viral genome, or genetic material, contained within a protein shell, the capsid. In some viruses, the protein shell is enclosed within a membrane called an envelope. Viral genomes are very diverse since they can be DNA or RNA, single- or double-stranded, linear or circular, and vary in length and in the number of DNA or RNA molecules.

Since viruses aren’t made up of cells, they do not have all the equipment that cells use to make more copies of themselves. Instead, they carry instructions and use a host cell’s equipment to replicate themselves.

It’s like someone breaking into your house to use your kitchen. The virus brought its own recipe, but it needs to use your dishes, measuring cups, mixer, and oven to make it. (Unfortunately, they usually leave a big mess when they finally leave.[23]

The viral replication process begins when a virus infects its host by attaching to the host cell and penetrating the cell wall or membrane. The process by which a lytic phage (virus that lethally infects bacteria) attacks its host cell illustrates many basic steps in virus replication. Here, the virus's genome is uncoated from the protein and injected into the host cell. Then the viral genome hijacks the host cell's machinery, forcing it to replicate the viral genome and produce viral proteins to make new capsids. Next, the viral particles are assembled into new viruses. The new viruses burst out of the host cell during a process called lysis, which kills the host cell. Some viruses take a portion of the host's membrane during lysis to form an envelope around the capsid.[24]

Following viral replication, the new viruses may move on to infect new hosts. Many viruses cause diseases in humans, such as influenza, chicken pox, AIDS, the common cold, and rabies. Vaccination is the primary way to prevent viral infections, which administers a vaccine made of inactive viral particles to an uninfected individual, to increase the individual's adaptive immune response to the virus if it infects later in time.[25]

Handwashing

Keeping hands clean is one of the most important steps we can take to avoid getting sick and spreading germs to others. Many diseases and conditions are spread from person to person by not washing hands with soap and clean, running water.

Although handwashing with soap and water has been a sign of personal hygiene for centuries, the link between handwashing and disease prevention wasn't established until the 1800s. In ancient times, washing hands before and after meals was a sign of good manners and social status. However, early hospitals had little understanding of hygiene, and the mortality rate for patients was three to five times higher than those cared for at home.[26]

Hospitals then had little idea of the significance of hygiene; thus, they were often mocked as diseaseproducing incubators or as “houses of death.” Many of the ill and dying were kept in wards with no ventilation or access to clean water; hospitals were found to offer only the most basic care. Doctors did not routinely wash their hands until the mid-1800s, and they would proceed straight from dissecting a corpse to delivering a baby, providing the basis for the spread of puerperal fever (postpartum infection). Despite advances in modern medicine, healthcare providers still face the issue of infection outbreaks caused by patient care. While the body of scientific data supporting hand hygiene as the key strategy to prevent the spread of pathogens is substantial, we highlight that achieving this crucial, long-awaited breakthrough was a hard task throughout history.[27]

The significance of hand washing in patient care was conceptualized in the early 19th century. Antoine Germain Labarraque (28 March 1777 – 9 December 1850) was a French chemist and pharmacist, notable for formulating and finding important uses for *Eau de Labarraque* or *Labarraque's solution*, a solution of sodium hypochlorite widely used as a disinfectant and deodorizer. Labarraque provided the first evidence that hand decontamination can markedly reduce the incidence of puerperal fever and maternal mortality.

Ignaz Semmelweis, a Hungarian doctor working at Vienna General Hospital, is known as the father of hand hygiene. In 1846, he noticed something about the two maternity clinics in his hospital, which had an alternate-day admission policy. The first clinic was attended by medical students and doctors, who moved straight from autopsy rooms to the maternity ward and had an average maternal mortality rate due to puerperal fever of about 10 percent.[28]

The women in his hospital were much more likely to develop a fever and die compared to the women giving birth in the adjacent midwife-run maternity ward. He decided to investigate, seeking differences between the two wards. Based on this observation, he developed a theory that those performing autopsies got ‘cadaverous particles’ on their hands, which they then carried from the autopsy room into the maternity ward. Midwives did not conduct surgery or autopsies, so they were not exposed to these particles.

As a result, Semmelweis imposed a new rule mandating handwashing with chlorine for doctors. The rates of death in his maternity ward fell dramatically. This was the first proof that cleansing hands could prevent infection. However, the innovation was not popular with everyone: some doctors were disgruntled that Semmelweis was implying that they were to blame for the deaths and they stopped washing their hands, arguing in support of the prevailing notion at that time that water was the potential cause of disease. Semmelweis tried to persuade other doctors in European hospitals of the benefits of handwashing but to no avail.[29]

A few years later in Scutari, Italy, the Crimean War brought about a new handwashing champion, Florence Nightingale. At a time when most people believed that infections were caused by foul odors called miasmas, Florence Nightingale implemented handwashing and other hygiene practices in the war hospital in which she worked. While the target of these practices was to fight the miasmas, Nightingale’s handwashing practices resulted in a reduction in infections.[30]

Florence Nightingale (1820–1910), known as the *The Lady with the Lamp*, should also be credited with recognizing the need for excellent cleanliness. She was the driving force behind the mid-nineteenth century hospital reform movement. She rose to fame because of her contributions to the Crimean War (1853–1856). At that time, it was customary for two soldiers to die of sickness for every soldier killed on the battlefield, from illnesses like dysentery, diarrhea, typhoid, and malaria. Soldiers from small, secluded rural communities who had never experienced general childhood diseases such as measles and mumps compounded the issue. They lacked immunity to these dangerous, debilitating, and deadly illnesses. The overcrowded and unclean circumstances in the hospital increased outbreaks of these illnesses. Florence Nightingale's humanitarian endeavor during the war was a great success, and she was able to persuade the world of the importance of increasing hygiene and sanitation. She began to professionally train nurses to care for patients in hospital wards. Nightingale urged nurses to wash their hands and faces regularly throughout the day, demonstrating a long-standing appreciation for the effectiveness of hand hygiene. By the time she returned to her home country of England, she was a national hero.[31]

The hand hygiene practices promoted by Semmelweis and Nightingale were not widely adopted. In general, handwashing promotion stood still until the 1980s, when a string of foodborne outbreaks and healthcare-associated infections led to public concern that the United States Centers for Disease Control and Prevention identified hand hygiene as an important way to prevent the spread of infection. In doing so, they heralded the first nationally endorsed hand hygiene guidelines, and many more have followed.[32]

Handwashing vs. Hand Sanitizer

As we know, our hands can be a critical vector in transmitting infectious organisms. Infectious viruses can live on surfaces for several days and are easily transferred between surfaces to hands upon contact.

Good hand hygiene is a simple preventative strategy that most people can easily do. When we touch our face, the infectious pathogens can now enter the body through mucus membranes in our mouths, eyes, and nose, and travel to the throat and lungs. Given that the average person touches their face approximately 20 times per hour and is particularly likely to rub their nose or eyes, it is clear why hand hygiene is a useful method to help prevent illness, including COVID-19.[33]

Many studies have shown the effectiveness of hand hygiene in preventing the transmission of infectious pathogens, including respiratory diseases. There are options for good and reliable hand hygiene products, the most obvious being soap and hand sanitizer.

Soap is an amphiphile, meaning it is a chemical compound possessing both water-loving and fat-repelling (hydrophilic) and fat-loving, water-repelling (lipophilic) properties. Public health systems across the globe recommend thorough handwashing with soap and water as the first defense against disease transmission. In the specific case of COVID, soap dissolves the lipid membrane surrounding the coronavirus particle, causing the virus to fall apart and die before it can enter a host cell and replicate. Handwashing with soap also dislodges dead microbes and viral cells from the hands and washes them down the drain. This reduces the likelihood of infection by touching your face and reduces the possibility of cross-contamination of surfaces.[34]

In 1966, a student nurse in Bakersfield, California named Lupe Hernandez first dreamed up the idea of hand sanitizer. The story goes that Hernandez realized alcohol delivered through a gel could clean hands in a situation where there was no access to soap and warm water. Recognizing the commercial potential of her idea, she contacted an inventions hotline she had heard about on television to see about registering the patent. [35]

Effective handwashing depends on access to a clean running water supply; therefore, hand sanitizer can prove a valuable disease prevention tool in populations with limited water supplies. In 2023, it was estimated that over a quarter of the world's population does not have access to basic safe and clean water. [36]

Teaching Strategies

Experiential Learning: The major strategy for this unit is to engage the students in hands-on learning. I want them to be actively participating as inquisitive scientists. The finger paints and cake decorating sprinkles activities are exploratory for the students, to engage them in the enjoyment of the inquiry and design as well as the process.

Differentiated Instruction: The students will use a variety of approaches, working sometimes individually and sometimes in small groups, determined by the activity's complexity. Because these are young children with variance in levels and background, guidance, and pacing are adjusted to ensure that all students are engaged and active throughout the learning experiences. Students will have opportunities to work with a variety of peers as they explore ideas using various materials.

Cooperative Learning: The students will be given opportunities to work as cooperative groups to complete assignments and activities. This strategy will allow students to work collaboratively taking on various roles necessary to complete the experiments and journal work, focusing on success for all.

Classroom Activities

Goals and Objectives: In the activities for this unit, students will identify, explain, and demonstrate how handwashing can prevent germs from spreading. They will identify and explain how handwashing is one technique to keep our bodies healthy from germs. They will use classroom materials to demonstrate how to properly wash hands to eliminate germs.

Activity One: Introduce Staying Healthy

Over two lessons, introduce the focus of this unit with the books *Germs Are Not For Sharing,* by Elizabeth Verdick and, *Germs vs. Soap* by Didi Dragon, which explains in child-friendly language and with humor, the benefits of proper handwashing.

Show the video and sing the song *Wash Your Hands* by The Singing Walrus on YouTube.

Record on chart paper the ways students learned they can keep from sharing germs.

Either prepare a coloring page with this sentence or have students write it for themselves "Germs absolutely, postively do NOT like soap!" Students will draw themselves washing their hands. Encourage them to include soap, a sink, bubbles, and a towel - components needed for proper handwashing.

Activity Two: Handwashing with Finger Paints

Materials: finger paint of various colors, painting smocks, access to sink(s), hand soap, paper towels

Finger paints are non-toxic water-based paint and thicker than tempera paint. They seem to adhere to hands a little better and are better for supporting instruction on proper handwashing.

Procedure for teaching proper handwashing using finger paint:

Show the children the picture of the culture of the child's hand (above). Explain the things they see growing on the culture plate are a mix of "good" and "bad" microbes and that we all have microbes on our bodies all the time.

Ask the children what they know about germs and how bacteria and viruses are transmitted. Record their comments on chart paper or the board.

Ask the children what they know about how you can prevent or slow down the transmission of illnesses. Record their comments on chart paper or the board.

Discuss methods for preventing or slowing the transmission of germs, referring to strategies from Activity One.

Again, show the video and sing the song *Wash Your Hands* by The Singing Walrus on YouTube.

Review proper handwashing techniques and have the children practice handwashing in the air for 20 seconds. They need to be sure to rub the inside and backs of their hands as well as between their fingers and their fingernail beds while singing Happy Birthday two times OR the ABCs once.

Place a dollop about the size of a nickel of finger paint on each child's hand. (Depending on your group size and how many sinks are accessible, it may be done as a whole class or in small groups.)

Tell them to rub the paint all over their hands and be sure to spread it between their fingers and on their fingernails. (If children touch objects in the classroom, they will also see how paint/microbes are spread through contact.)

Line them up at the sinks to wash their hands.

Have them wet their hands with running water, put soap on their hands, and then wash their hands rubbing all parts of their hands while singing (Happy Birthday 2x or the ABCs 1x). Ask them to watch the paint on their hands, and wash until all the paint is gone. How easy/hard is it to get all the paint off their hands? How long did it take to get all of the paint off every part of their hands?

After the activity is complete, re-group as a class and debrief the activity talking to the children about what they observed and again discussing ways they can keep themselves and their families and classmates healthy.

Activity Three: Handwashing with Cake Decorating Sprinkles

Materials: jar(s) of sprinkles (small dot-sized if available), painting smocks, access to sink(s), hand soap, paper towels

Using sprinkles provides opportunities to teach about both proper hand washing and transmission of bacteria/viruses. In this activity, children shake hands or do fist bumps to reinforce what happens when they touch each other's hands.

Put sprinkles on your own hand and then shake the hands of the children in the room. OR Put sprinkles on the hands of a few students.

Ask the children to go around the room and shake hands with their classmates or exchange fist bumps.

Gather everyone for a whole class discussion.

Remind the children of the picture of the culture of the child's hand and that there are "good" and "bad" microbes.

Ask the children what they remember from our reading about germs and how bacteria and viruses are transmitted. Record their comments on chart paper or the board.

Ask the children what they know about how you can prevent or slow down the transmission of illnesses. Record their comments on chart paper or the board.

Again, show the video and sing the song *Wash Your Hands* by The Singing Walrus on YouTube.

Review proper handwashing techniques and repeat air washing practice as in Activity Two.

Show the children you have some sprinkles on your hands. Tell them you shook children's hands and touched several classroom objects. Place a small amount of sprinkles in the hands of a few students and ask them to walk around to shake their friends' hands.

Ask them to look around the classroom and explain what they see. Discuss how easily and rapidly the sprinkles spread from student to student and from person to object. Discuss how germs spread with person-to-person contact and by touching surfaces.

Connect these observations to the importance of frequent hand washing and regular wiping down surfaces (handles, tabletops, phones, tablets…).

Have the children wash their hands for 20 seconds, using proper technique, in the classroom sink using soap and water.

Put soap and water on wet paper towels and wipe down tabletops or surfaces that people touched during the activity. Depending upon the age of the children and availability you may choose to use other cleaning products.

After the activity is complete, re-group as a class and debrief the activity talking to the children about what they observed and discussing again ways to keep themselves and their families and classmates healthy.

Activity Four: Transmission of Microbes

Materials: Glo Germ and UV light (purchased items), access to sink(s), hand soap, paper towels, worksheet from Glo Germ website for Kindergarten students

Working with Glo Germ provides opportunities to teach about both proper hand washing and transmission of bacteria/viruses. Inform parents about this experiment, letting them know the product, provide the website for their information, and invite them in for the day of the experiment.

Show the five-minute video on DragonflyTV/PBS Learning Media that shows two students using Glo Germ in an experiment to show how germs might be transmitted.

Give each child a dollop of Glo Germ powder or liquid and ask them to rub the product all over their hands.

Gather everyone for a whole class discussion.

Remind the students of the picture of the culture of the child’s hand.

Ask the children what they remember about germs and how bacteria and viruses are transmitted and record their comments on chart paper or the board.

Ask the children what they know about how you can prevent or slow down the transmission of illnesses, again recording their comments on chart paper or the board.

Tell the children that, just like they saw in the video, the Glo Germ product is visible under UV light. Turn off the lights in the classroom. Go around the room with UV flashlights. As the children have been sitting many of them probably touched their clothes, faces, and objects around them. Without shining the flashlight in anyone’s eyes. Look to see where the Glo Germ product has spread.

Ask the children to share their thoughts and observations.

Discuss how easily and rapidly the Glo Germ was spread. Discuss how germs spread with person-to-person contact and by touching surfaces.

Review proper handwashing techniques, and have the children wash the Glo Germ off of their hands. Use the UV light to show they were successful.

Activity Five: Using Hand Sanitizer

Materials: Purell

In this Mystery Science five-minute video, scientist Doug takes a question from a second grader who is asking “How does hand sanitizer work?”

Ask the children what they know about how and when they should use hand sanitizer, again recording their comments on chart paper or the board.

Review the information that:

Sanitizers can quickly reduce the number of germs on hands in many situations. They are helpful when you cannot wash with soap and water. However, they do not get rid of all types of germs. Hand sanitizers are not as effective when hands are visibly dirty or greasy.

Teach the correct procedure and have the students practice:

Pour or pump a dime-sized amount of the gel into the palm of one hand

Cover all surfaces of hands.

Rub your hands and fingers together until they are dry. This should take around 20 seconds.

Do not use a towel to dry hands – they should air dry to be most effective.

Resources

Bielawski, Rebecca. *Meet bacteria!* United States Books; Beck, 2014.

This children's book explains in student-friendly language how a microscope works, basic bacteria shapes and habitats, and why we should wash our hands

Darwin, Charles, and George W. Davidson. *On the Origin of Species: By Means of Natural Selection.* London: Arcturus, 2014.

This is one of the most famous books on evolutionary biology, in which Darwin explains his hypothesis of the process of natural selection, a term he named.

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This book does a good job of introducing microbes to a young audience.

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This book teaches students not only how to wash their hands but why in a clever, funny way.

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A book with colorful illustrations and clear explanations. The focus is not so much on explaining germs, but strategies for how to prevent spreading them.

Appendix - Implementing District Standards

Kindergarten Next Generation State Standards:

Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.

K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

Common Core Connections

W.K.7 Participate in shared research and writing projects (e.g., explore some books by a favorite author and express opinions about them). (K-LS1-1)

Endnotes

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