Microbes in Science Fiction Films

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Submitted for your approval

"The single biggest threat to man's continued dominance on the planet is the virus." - Joshua Lederberg, Ph.D. Nobel Laureate

Worldwide infections seem like a monthly occurance these days. The "Next Big One", bird flu, swine flu, super flu, hemorragic fever, plague, black death, SARS, and MRSA all make up quite a scary list. New global outbreaks and pandemics may be on their way and these help to instill scary fears of horrible diseases, symptoms, and possible mass death. These invisible invaders of viruses, pathogens, and microbes do bring about thoughts of a doomsday. The World Health Organization and the Centers for Disease Control seem to issue warnings way too often. These organizations examine outbreaks, epidemics, and monitor infections. Since cinema does shape and influence society then depictions of fictional microbe invasion scenarios do influence the public's perception of what real-life microbes can do.

For microbes how tiny is tiny? Well, it depends upon scale. One microbe's Lilliput is another's Brobdinagian. Overall, microbes are tiny creatures too small to be seen with the naked eye and can either be a single cell or a multicellular organism. Microbes are so tiny that millions can fit into the eye of a needle. Though tiny, bacteria, fungus, archaea, parasites, yeast, spores and protists are all considered microbes. Though microbes are living creatures in that they self-replicate we can also include viruses as microbes eventhough they, as a class, do not self-replicate. Archaea are bacteria-like microbes that have some traits that are unique and not found in true bacteria. Protists include algae, amoebas, slime molds, and protozoa.

Microbe habitats and ecology

Microbes are found everywhere in nature and represent the majority of life on Earth populating a wide range of niches. They live in every nook and crannie of the planet including soil, hot springs, the ocean floor (microbes have been reported inhabiting the Mariana Trench, the deepest part of the ocean), ice flows, and the atmosphere. Our frozen poles, deserts, and even rocks are all populated by microbes. Some have suggested that the amount of living organisms below the Earth's surface is comparable to the amount of life on the surface. Some microbes can survive prolonged exposure to vacuums and can be resistant to radiation (suggesting they can survive in space; scary indeed). Many microbes have a symbiotic relationship with their hosts which are mutually beneficial whereas others can cause disease. Those microbes that do cause disease are called pathogens.

Due to their presence since life originated (microbes are the oldest forms of life) the tree of life is dominated by microbes. Microbes play a vital role in nutrient recycling in Earth's ecosystems. Microbes decompose matter into more useable forms including fixing nitrogen as part of the plant nitrogen cycle (plant roots contain microbes that fix atmospheric nitrogen making this important molecule biologically available for plants to use. In this way microbes have developed a symbiotic relationship with plants.). And as airborne particles they may even play a role in weather and precipitation. Furthermore, microbes are currently being used in the biotechnology industry from fermentation and beverage preparation to making new medicines through genetic engineering. Microbes have been found preserved in 220 million year old amber so their size and structures have remained relatively unchanged in all those millenia. And 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. Also, microbes "invented" photosynthesis by having oxygen as a waste product and currently probably make about half of the oxygen on the planet each year and indirectly for most of the rest. Ancient cyanobacateria became chloroplasts, the photosynthetic oxygen-producing engine of plant cells.

History of microbes

Microbes were first discovered by Anton van Leeuwenhoek in 1675 by using the microscope he invented. Using his microscope he showed that there were forms of life that were not visible to the naked eye. The reason for the late discovery of microbes was due to the microscope, a device necessary to see objects invisible by the naked eye. Until the microscope was invented microbes were unknown.

Types of microbes

Microbes do not simply swim – they push and pull, twitch and skitter, spin and corkscrew their way through fluids and across slimy surfaces. Microbes have evolved sophisticated and unusual ways of moving on their own. Many microbes have tiny appendages, called cilia and flagella that help them move about whereas others use intricate protein motors and slime-thinning enzymes.

Animals. Most animals are multicellular but there are a few microscopic arthropods such as mites and some nematodes (worms) that are quite tiny. Another example are the rotifers which are filter feeders found in fresh water.
Fungi have several unicellular species the most common being *Saccharomyces cerevisiae* (commonly known as baker's yeast). Some forms of yeast such as *Candida albicans* are pathogenic to man.
Plants. Since microbial algae, green algae, contain chlorophyll and are photosynthetic they are considered plants. These forms of algae can grow as single cells or as long chains of cells. In total there are about 6000 species of green algae.

Extremeophiles are microbes that have adapted to such extreme conditions that are fatal to most life forms. Such microbes have been found in temperatures as high as 130°C (266° F) and as low as -17°C (1°F); in acidic environments with a pH of 0 and alkaline environments with a pH of 11; from high pressures of 2000 atmospheres down to 0 atmospheres (vacuun of space); and exposed to mega doses of radiation (up to 5000Gy). Much of this extreme adaptability has been exploited by the biotechnology industry in generating unusual products.

Bacteria

Cell organisms that lack a cell nucleus are called bacteria, or prokaryotes, and are almost always unicellular. Almost all are invisible to the naked eye. Their genome is just a single loop of DNA and bacteria have a sturdy cell wall, providing strength and rigidity, that protects and isolates its internal cellular components from the environment. In total, prokaryotes are the most abundant and diverse group of organisms on Earth. They inhabit all environments that are below +140° C and are found in water, soil, and air. They are found in such diverse places as hot springs, deep beneath the Earth's crust, and gastrointestinal tracts. As a mechanism of survival some species of bacteria form extraordinarily resilient spores that can withstand extreme environmental challenges. And under optimal growth conditions bacteria can rapidly double in as fast as 20 minutes. It has been estimated that there are around five million trillion trillion (that's a scary 5×10^{30}!) prokaryotes accounting for at least half of the Earth's biomass.

Pathogenic bacteria

Symptoms of bacterial infections are localized redness, heat, swelling, and pain. In particular, localized pain is a key characteristic of such infections. For example, when a cut is infected the pain is localized at the site. For bacterial throat infections the pain is localized to one side of the throat whereas for a bacterial infection in the ear the pain is localized in only one ear. Cuts that produce pus or a milky liquid are most likely due to bacterial infections. Bacteria microbes release various toxins that can easily hobble host cells, oftentimes killing them. One recent example of this is toxic shock syndrome caused by bacterial toxins.

Viruses

There are thousands of types of viruses and they are everywhere. There are an estimated 10^{31} viruses on earth! What this means is there may be a hundred million times more viruses on earth that there are stars in the universe (just so you gentle readers know, a liter of seawater near the water surface contains 10 billion microbes and 100 billion viruses). Also, special viruses that attack and control bacteria, called bacteriophages, are replicated at an astounding rate of 2.5×10^{25} viral genomes every second.

Most viruses are composed of a tiny piece of DNA surrounded by a protein coat and perhaps an outer envelope. Viruses are considered "life on the edge" in that individually, though they have genes, they cannot replicate but must hijack the DNA machinery of a living cell and use that to replicate by making many copies of themselves which in turn go on and infect other cells and so on. Viruses bind to the outer surface of a host's cell and enter thereby converting the cell's own genetic machinery into making more virus particles which in turn go onto infect other cells. In simple terms, viruses as a class cannot convert carbohydrates into energy so they must rely on the host cell to do that. Since viruses cannot make their own energy, they do not metabolize, they must hijack it.

In some instances the virus kills its host cell which can lead to certain diseases. As a class, viruses are very tiny and are much smaller than bacteria. Such common diseases as the cold (rhinovirus), flu (influenza virus), and cold sores (herpesvirus) are all caused by viruses. Also, such deadly diseases as HIV/AIDS, smallpox, and some cancers are caused by viruses.

Since viruses "live" inside cells they are difficult to treat without harming the cell. By being inside cells viruses are essentially protected which is why vaccines have been developed that immunologically treat viral infections. Due to the physical nature of viruses antibacterial medicines are not effective. However, the good news is the body's own natural defense system, the immune system, is capable of killing most viruses. Indeed, in many instances, people do not know they were even infected since the natural immune system took care of the problem before any symptoms were present. So, while many existing medicines are not particularly effective against viruses our body's natural defense mechanisms are. So, by keeping a healthy body means you will also have a healthy immune system.

Pathogenic viruses

Most viral infections are systemic meaning they infect many parts of our bodies at the same time. Even though the infection may be localized (like a nasal cold, "pink eye" or viral conjunctivitis) few are actually painful, like herpes. Since many of these viruses also attack nerve cells many symptoms of viral infections are described as a burning or itchy feeling. Some pathogenic viral infections can cause cancer.

Parasites

Organisms that live off other organisms are called parasites. Overall, there are two types, ectoparasites that live outside a host and endoparasites that live inside a host. Obligatory parasites require a host during its life cycle. There are microparasites such as viruses and bacteria and macroparasites such as mites and fleas. Human parasites include protozoa (such as malaria, algae, and amoebas), worms (tapeworms), and flukes that can either cause infections inside the body or topically on the skin surface. Other examples of ectoparasites are lice and ticks. Also, parasites can be used as vectors to infect various forms of DNA into its host. Typhus, a deadly flu-like disease, is spread by body lice. There are subtypes that infest the head and others that infest the body which thrive in clothing. Malaria carrying mosquitoes also use parasites as a vector to carry on the infection.

Fungus/Fungi/Yeast
Mycology is the study of fungi and yeast. A fungus is a eukaryotic, heterotropic, spore-bearing organism with chitinized cell walls. Fungi are common in the environment and are found in soil, on plants, trees, vegetation, skin, mucous membranes, and perhaps somewhat surprisingly, commonly in the human intestinal tract. Though most fungi are dangerous to humans some can be beneficial; penicillin, bread, wine, and beer use fungi in their manufacture. Also, mushrooms are considered a fungus.

Some fungal infections are mild with only a rash or some breathing stress whereas others are very pathogenic that can lead to serious complications like meningitis. Those with a weakened immune system, such as cancer patients, transplant recipients, and those with HIV/AIDS are susceptible to opportunistic fungal infections. Also, climate change could affect some fungi since even small changes in temperature or moisture can affect their growth (see below, HOUSE OF DRACULA). The potato famine of Ireland (late 1840s) was due to a fungus infection that wiped out the potato crop and ultimately over a million people starved.

MICROBE FUN FACTS
No man is an island
Humans are made up of about 10 trillion cells and also harbor about 100 trillion microbes so by cell count about 10% of the total cells of our body are human. Since microbes are much smaller that human cells the 100 trillion microbe cells weigh about 3 pounds, about as much as a human brain. Though the roughly 21,000 genes that makes us humans what we are it is the additional microbes that add another 8 million or so genes, many of which provide behind-the-scenes activities such as processing food, tweaking the immune system, and helping to regulate some human genes by turning them on or off. Therefore, due to all the help of our body’s microbes no man is an island but rather a metropolis. So the total human genome (hologenome) is a combination of human DNA *plus* microbe DNA. Microbes help establish a healthy genetic equilibrium.

Microbes inhabit almost every corner of the body and all told there are more than 10,000 species in and on our bodies. For example, there are over 1000 microbe species in your mouth; 150 species behind your ears; 440 species on the insides of your forearm; 120 bacterial species living on human skin; 5,000-35,000 bacterial species in your intestines. Even microbes on our right and left hands are different and they have only about 17% of species in common between the hands. In total, there are more microbes on a person's hand than there are people on the entire planet! Of all these thousands of species of bacterial microbes only about 100 are pathogenic to man. Also, so you scary readers are better informed, 33% of humans (with or without illness) are colonized with

Mycobacterium tuberculosis; 50% of humans (with or without illness) are colonized with *Helicobacter pylori*; and 50% of humans (with or without illness) are colonized by *Staphylococcus aureus*.

Of the 1000 species of bacteria that live in the human mouth, some are harmful (those causing cavities) and some helpful (keep breath smelling fresh) but most are unspecified. It is like a Tower of Babel in your mouth, all these divergent species doing different things. At best we can keep some of the microbes at check but they quickly do repopulate. Also, in total, more than a trillion microbes live within your mouth and they multiply so fast that you literally swallow trillions a day without even denting the population. Furthermore, in total, millions of bacteria are enjoying a comfortable stay on your face. The rest of the body is no better with your guts being, so to speak, the mother load.

Importance of microbes

Since microorganisms participate in Earth's carbon and nitrogen cycles they are vital to humans and the environment. Many ecosystems are highly dependent on microorganisms including the recycling of remains and waste products. In addition to the environment many microbes also inhabit life forms from plants to animals. Many microorganisms have a symbiotic relationship with higher life forms and are co-dependent upon each other.

Animals, including humans, couldn't digest food without them. Also, without microbes, plants couldn't grow, garbage wouldn't decay and there would be a lot less oxygen to breathe. Microbes also help in remediation and recycling of nutrients. So, microbes are essential to the processes of decomposition that recycles nitrogen and other elements back into the natural world. At the human level, disruption of our microbiome can lead to certain disorders such as obesity, allergies, diabetes, bowel disorders, even psychiatric disorders like autism, schizophrenia, and depression.

Gut microbiome.

The human gut microbiome contributes 36% of the small molecules that are found in human blood. On the down side some gut microbes contribute greatly in creating susceptabilities to certain human diseases. The human gastrointestinal tract (GI), which includes the stomach and intestines, harbors trillions of bacteria belonging to more than 1000 species and there are 10 times as many bacterial cells within the GI tract as there are human cells within our bodies. The GI microbiota plays essential roles in human nutrition, physiology, development, immunity, and behavior so disrupting the structure and balance of these microbes can lead to disease. Most of these microbes are our friends, helping us digest food, strengthen our immune systems, and keep dangerous enemy pathogens from invading our tissues and organs. Humans co-evolved with our microbial gut communities so they are naturally there for a reason. Many people, especially relatives and family members, share gut microbe strains most likely through touching each other or sharing the same environments.

There are good microbes (such as those which provide nutrients and help metabolism) and there are bad microbes, those that cause health problems (including those that invade us). This mass of microbes can be considered as an "organ" because they carry on all the functions of what we consider an organ. After all, if the immune system is considered the "liquid organ" then the combined mass of microbes that have their own DNA, carry out key metabolic steps, and make all sorts of useful biochemicals, should also be thought of as an organ. And as an organ it too needs to be cared for, nurtured, and "fed properly".

How are gut microbes so stable? The gut is continually being washed but these microbes manage to withstand all our bodies can throw at them. They are exposed to severe environmental extremes not to mention all of the natural metabolic and immune responses of their hosts but they still manage to survive. Which is why it is so impressive that these "small soldiers" are so effective an army against alien invaders. They have evolved/developed impressive survival tactics on Earth that serve us well against invaders whose natural bodily defenses are not equipped to handle such 'pests' (See WAR OF THE WORLDS below).

Use in digestion. The microbial flora and fauna in the human gut have formed a symbiotic relationship. These natural gut microbes help in synthesizing such vitamins as folic acid and biotin as well as helping to digest complex carbohydrates. Furthermore, these microbes contribute to gut immunity. Some forms of bacterial microbes live in animals' stomach to help in digestion. Cows have several stomachs and a variety of different microbes inhabit their stomachs to aid digestion of grass and hay.

Use in foods. Most famously microbes are used in fermentation in brewing and wine making. Also, baking and pickling processes require microbes as well as dairy products like cheese and yogurt. Some microbes add flavor and aroma to the products.

Water treatment. Sewage treatment is an oxidative process that requires microbes to perform the task. These microbes process sludge that produces, among other things, methane gas.

Energy. Microbes used in fermentation can also be used to produce ethanol, a form of biogas. Both algae and bacteria have been used for this process to create useable fuels from agricultural and urban waste.

Use in production of chemicals. Microbes are used routinely for commercial and industrial applications such as in the making of some forms of biological acids made from bacteria like acetic and lactic acids as well as bioactive molecules like enzymes. An example is streptokinase that is used to dissolve blood clots and some statins used to lower cholesterol levels. Microbes have become essential tools in the biotechnology and biomedical areas since they grow rapidly and are easily manipulated. Microbes have also been effective in cleaning oil spills and used as living fuel cells.

Warfare. Biological warfare has been in the news recently but the idea has its roots in the Middle Ages when diseased corpses were thrown into castles during sieges using catapults. Those near the microbe-contaminated corpses were likely to spread the deadly pathogen to others.

Diseases caused by microbes
Examples of some common diseases caused by microbes are (alphabetically) AIDS, HIV, bronchitis, cancer, chickenpox, colds, dengue, ebola, encephalitis, genital warts, german measles (rubella) hantavirus, hepatitis, herpes, influenza, lassa fever, leukemia, measles, meningitis, mononucleosis, mumps, plague, polio, rabies, shingles, STDs, and warts. Such diseases as plague, tuberculosis, and anthrax are caused by pathogenic bacteria. Protozoas cause such diseases as malaria, sleeping sickness, and toxoplasmosis. Fungi cause such diseases as ringworm and candidiasis. Pathogenic viruses cause such diseases as yellow fever, and, as mentioned, influenza and AIDS.

Issues with viruses/microbes
With viruses/microbes a series of questions can be asked. How do viruses/microbes infect the body? Viruses primarily enter the body through any of the openings, primarily the nose and mouth. Once inside the virus attaches itself to an appropriate host cell and begins to replicate or make copies of itself. The rhinovirus, the one that causes the common cold, finds host cells in the nose whereas an enterovirus, one that causes intestinal issues, finds host cells in the gut. After making copies of itself the virus exits the host cell to find another host cell and begin the cycle all over again. In many cases the virus ends up destroying the host cell. Also, not all viruses attack one part of the body (localized) but some are disseminated throughout the entire body via the blood stream such as the AIDS virus. Latent viruses are infections that are dormant or hidden that are not involved in active signs and symptoms of a disease. Also, some microbes do not cause an illness by themselves but, rather, by the body's reaction to it. If some key tissue, say nerve cells, are viral infected and the body's reaction is to destroy the cells and tissues then some neurological disorders can result.

How long do viral/microbial infections last? In most instances the viral infection is cleared by the immune system within a few days to a few weeks. Some viruses are persistent and can last years in the host. These viruses can lead to latent infections in which symptoms can appear much later. The infected person may seemingly recover and be normal with the virus still present but perhaps dormant waiting to be re-activated. Examples of these viruses are the herpesviruses, hepatitis B and C viruses as well as HIV.

Viruses/microbes cause illnesses by destroying or interfering with cell functions, especially important cells that are key regulators of body physiology. The virus can destroy a cell by a process called “programmed cell death” (or apoptosis) or keep it from making energy to grow and live by interferring with cellular biochemical balance.

Microbial disease is usually caused by the host’s inability to use its immune system to protect itself. Microbes cause damage by releasing a variety of toxins or destructive enzymes that destroy a host’s cells. Some microbes, like *Clostridium tetani* releases toxins that parlyzes muscle cells whereas *Staphylococcus aureus* releases toxins that produce shock and sepsis. It should be noted that not all microbes cause disease in all hosts and some are even beneficial.

Infectious Disease

An infection is an invasion followed by a multiplication of some sort of parasitic disease-causing organism (a virus or a bacterium can also be considered a parasite) within a host’s body. Even larger organisms like macroparasites and fungi can cause infections. These organisms typically enter, invade, or inhabit another body, causing infection and/or contamination oftentimes releasing toxins that can be detrimental to the host. Some infections take over the entire body, and others affect a specific organ, like the brain, lungs, or liver. The world’s most deadliest infectious disease is tuberculosis. Approximately one third of all people on Earth are infected with tubercuosis and about three million die every year from this disease.

Infections can either be acute (short-term) or chronic (long-term). Bacterial infections are based on the symptoms and medical signs shown by the patient. Some infections are not readily apparent and referred to as silent or subclinical and others that are inactive, though still in its host, are dormant and called a latent infection. Also, infections can be either primary or secondary depending upon the stage of infection and whether it is the same infection or a succeeding infection in which the offending microbe can repopulate the host or reappear from latent hiding. Furthermore, occult infections are those that are essentially hidden and recognized by secondary symptoms.

Some microbes cause persistent or chronic infections because the body in unable to naturally clear the organism after initial infection. The microbe is continually present in these hosts in amounts low enough to not be a problem. Sometimes relapses occur in which the microbe repopulates giving rise to another infection. Latent infections are also perisitent infections that can repopulate by different mechanisms and an example is herpes virus that likes to hide in nerves and when certain circumstances occur become reactivated (cold sores are examples of this).

Each host has its own specific response to infections though most often this response comes from the immune system, both innate and induced. In many instances the invading microbe causes inflammation which activates and stimulates an immune response. Should the host not have an effective physiological means to stop the invading microbe then eventually the microbe will win and could ultimately cause the death of its host.

Though a fantasy an example of the reverse where a human microbe infected an alien race is seen in the film, FIRST MEN IN THE MOON, where Prof Cavor had a seemingly inconsequential nasal cold that infected the local moon inhabitants, the Selenites, causing the destruction of their entire race. This is an example of how an infectious disease can cause mass destruction (much like native American Indians who were decimated by ‘European diseases’ such as small pox, venereal diseases, and cholera, to which they had no natural defenses or resistance. Smallpox epidemics of 1818 and 1839-1840 and the cholera epidemic of 1849 wiped out large populations of Indians.)

Plague

Mankind has been affected by various plagues since recorded history, many of which are described in the Old Testament of the Bible. Moses inflicted the plague on Pharaoh Ramses II before the Exodus. A plague is any disease of wide prevalence that results in excessive mortality or death. The best examples are the plagues of the Middle Ages that decimated Europe in which the bacterial microbe, *Yersinia pestis*, was transmitted to man by the fleas of rodents. Clinically, signs of plague are high fever, toxemia, prostration, hemorrhagic ruptures, lymph node enlargement, and pneumonia. All in all a scary way to go. In man, plague comes in four different forms: bubonic (the most common, marked by extensive inflammation of internal tissues and glands), septicemic (a generally fatal form with high levels of microbe growth and excessive toxemia), pneumonic (a progressive and generally fatal form with excessive fluid buildup in the lungs making it hard to breathe), and ambulant (a mild form of bubonic plague with mild fever and tissue swelling).

Chain of events

For a microbe to cause an infection a series of events must occur in a particular sequence. First, of course, is the presence of the infectious agent or microbe, then a reservoir to maintain its population, the ability to enter a susceptible host, an exit, and subsequent transmission to new hosts to continue the propagation. Each of these steps must occur in the chronological order for a microbe infection to develop. Should any one of these steps be blocked or inhibited then the infection can be stopped.

Signs and symptoms

Bacterial and viral infections can both cause the same sorts of signs and symptoms sometimes making a diagnosis difficult. It is important to distinguish the two since medications for one do not work on another. Symptoms such as fatigue, loss of appetite, weight loss, fever, chills, and aches & pains are common between bacterial and viral infections. Other signs and symptoms can be limited to certain body parts such as skin rashes, coughing and runny noses.

Treatment and prevention of microbes

Microbes are responsible for infections as well as food spoiling. Proper hygiene should help in eliminating such problems. However, since microbes are literally everywhere then the best that can be done is to reduce their levels to harmless amounts. In some cases, complete sterile conditions are necessary so all microbes must be removed. For food preparations there are many rules that must be followed to help insure proper preservation. Most foods stored in cool temperatures for short periods of time are adequate to reduce microbe populations.

Effective ways to treat and prevent microbe infections rely on disrupting their infection cycle and the easiest way to do this is to maintain a sanitary environment that includes health education. Effective hygiene can be as simple as washing your hands (still the most effective) and for health care workers should also include wearing appropriate gowns and facemasks to help prevent the microbe from being passed from patient to health care workers. Also, properly preparing and cooking food is important for minimizing microbe issues.

When microbes do cause infections then the first line of defense to suppress the infection are anti-infective drugs and there are four types: antibacterial, antiviral, anti-tubercular, and antifungal. Drugs that work on one microbe type will not work on another. Depending upon the severity these drugs can be given orally, topically, or by injection. In some cases, cocktails or combinations of drugs are necessary for multiple microbe infections. For bacterial infections the antibacterial drugs act by primarily slowing down their multiplication. The most common antibiotics are penicillin and tetracycline. It is important to not take antibiotics longer than needed to help prevent mutations and therefore resistance to the drugs. On the scary side the excessive use of antibiotics results in resistant strains like MRSA.

Transmission

For a microbe to repeat its infection cycle it must leave one host and infect another to repeat the cycle again and again. This is how diseases are spread. The transmission from one host to another can take a number of different paths, either by direct or indirect contact. Direct contact requires touching which could also include body fluids, drinking contaminated water, inhalation (including particles from sneezes or coughing), or being bitten by a vector such as a mosquito. Sexual activity also contributes to direct contact transmission.

Indirect contact occurs when the microbe is away from a host and able to infect another host when the opportunity arises. In many cases the microbe is on some sort of object (toys, furniture, hand rails, scary monster magazines) from an infected person waiting for an appropriate new host to repeat its infection cycle. Also, foods can be an indirect source of microbes for disease transmission. In many underdeveloped countries contaminated sewage water is a major source of infectious microbes.

All types of microbes can be transmitted from host to host in this manner and the above examples are of horizontal transmission since the microbe is transmitted from person to person. Microbes transmitted vertically are primarily from mother to child during pregnancy that includes the birthing process; most of these vertical microbes are viruses.

Another route of transmission of microbes is, believe it or not, in hospital settings. Even with careful healthcare practices microbes can cause infections not only in fellow patients but also in healthcare workers. Many drug-resistant microbes are created in hospital settings since patients are given anti-microbial drugs that over time give rise to drug-resistant strains. MRSA is an example of this scary development.

A famous example of a carrier was Typhoid Mary (Mallon), a immigrant Irish woman who spread typhoid fever through her cooking of varoius puddings and cakes during the years 1900 to 1938 when she finally died. She was an asymptomatic carrier of *Salmonella typhi* in which she did not show any symptoms but was able to infect more than 50 others. She was isolated for years on North Brother Island on the East River in New York where she eventually died. Maybe both Frankenstein's monster and Dracula are 'typhoid mary" equivalents in that they carry microbes (the monster has bacteria whereas Dracula has parasites) that can be transmitted to others while they themselves appear normal and asymptomatic (see film descriptions below).

Colonization
An infection begins when the microbe is able to successfully colonize a host by growing and multiplying. Fortunately, most healthy humans are resistant to infections but those who are sick or malnourished have an increased susceptibility to infections. Also, those who have a suppressed immune system are susceptible to opportunistic microbes.

The microbe typically enters a body through mucous membranes such as the mouth, nose, eyes, genitals, and open wounds. After infecting the microbes often migrate through the body causing general infections that can affect different internal organs. Some microbes grow within host cells whereas others grow in body fluids. It should be noted that some colonizations are not intrinsically infectious. Therefore, all infections are a colonization but not all colonizations are infectious. Some non-pathogenic microbes can, under certain conditions, become pathogenic. The variables involved include the route of entry, the particular virulence of the microbe (more virulent in some species than in others), the amount of infecting microbes, and the overall immune status of the host.

THE FILMS

There are way too many films that have microbes, one type or another, as a part of their plots so we must limit ourselves for discussions. Listing all films that have microbes is scary indeed. The films mentioned here will serve as representative examples of the various microbes in SF cinema including bacteria, viruses, and parasites, the main culprits in the microbial world.

SON OF FRANKENSTEIN (1939; bacteria)

During a medical examination Dr. Frankenstein, played by Basil Rathbone, is seen looking at a blood sample of the monster (aka, Boris Karloff) under the microscope. From a point of view shot of looking down the microscope we can clearly not only see the occasional red blood cell float by but we also see a myriad of small “circles” moving all over the place. Far more of these are moving about than blood cells. These little circles are indeed bacterial microbes and since there are so many of them this blood sample would be considered heavily contaminated since a normal healthy blood sample would not have *any* microbes. Also, judging by how the “circles” are moving differently it is apparent that there are many different species of microbes present.

The microbes in the monster’s blood sample provides two interpretations. Either the blood sample was contaminated after it was taken from the monster (possible) or the monster’s blood actually does contain bacteria. If the latter is true, then we have to explain what the bacteria are doing there and what benefit, if any, they provide for the monster. As discussed above microbes are critical for natural human metabolism and perhaps the monster, stitched together from less that sterile sources (cadavers can be heavily contaminated), has developed (evolved?) with a “natural” microbe flora that would be fatal for normal humans. The monster has so much natural microbe flora that it naturally spilled into his blood stream.

Bacteria secrete endotoxins that damage and kill cells and it doesn’t take much to kill a human. With that many bacterial microbes coursing through the monster’s blood then large amounts of endotoxins must be released. These endotoxins cause inflammation which can lead to toxic shock and ultimately death but since the monster can withstand such a microbe assault then the excessive toxic shock may actually invigorate his metabolism and provide much energy and superstrength. These microbes could provide major energy boosts, like a constant supply of an energy drink, enabling him to have his superhuman strength. Also, the microbes could also influence hormonal levels which may help to explain some of the monster’s emotional outbursts. All from simple microbes.

In any case, since this film is the monster's third outing, behind the original FRANKENSTEIN (1931) followed by the BRIDE OF FRANKENSTEIN (1935), then along the way his immune system and metabolic needs could have adapted to accommodate a larger number of microbes. In other words, the monster evolved, from sequel to sequel, into accepting more and more microbes.

Another consideration is if the monster's microbes are infectious. If true, then both Dr. Frankenstein as well as Ygor and Benton, the assistant, are at risk of contracting the microbe. It is unknown if these microbes are infectious as indirect airborne particles or directly infections by physically touching. It would, of course, be more dangerous if the monster's microbes were infectious airborne particles and, if true, then they all would be infected.

HOUSE OF DRACULA (1945; parasite)
This is an underrated film. A significant amount of interesting science is discussed in which part of the plot involves Dr. Edelman using a medical procedure to not only cure Larry Talbot's lycanthropy but to also "effect a cure" of vampirism and these alone elevated this film into deserving a closer look.

Baron Latos (disguised as Count Dracula who was disguised as John Carradine) sought out Dr. Edelman to "effect a cure" and rid him of his vampire curse. While examining a blood sample from Latos under a microscope Edelman says, "The examination of your blood reveals the presence of a peculiar parasite, the form of which I am completely unfamiliar. It's possible it may have something to do with your problem…I am having an anti-toxin prepared so that we may see." Later, Edelman says, "a pure culture of a parasite introduced into the parent bloodstream will destroy not only its own kind but themselves as well." In theory, this is what vaccines do.

The actual parasite seen was described in the previous article, "The microscope in science fiction films". The bizarre looking parasites are wrapped around individual red blood cells and composed of a long thin arm that branches out to finger-like projections (some have three whereas others have 4 'fingers'). Though no such parasite exists there are many that specifically do attack red blood cells, the most serious being the plasmodium sporozoite of malaria. In trying to treat the parasite Edelman gives Latos a transfusion of his own blood reasoning that the natural antibodies in the doctor's blood would counteract and perhaps destroy the parasites in Latos' blood. This may be one of the first examples of what is now called immunotherapy in that the power and intelligence of the natural immune system is used to treat and regulate a disease.

Once Edelman recognized the existence of the parasite he asks his assistant to "make a culture of this and prepare an antiserum as soon as possible." Well, only in SF films can such things be done since culturing parasites is tricky business that often have unique and unusual conditions for proper growth. To prepare an antiserum you must have enough of the sample to use which means

Edelman would have to harvest more of Latos' blood. Also, some mammal would have to be immunized with the parasites to generate an antiserum. There would have to be multiple immunizations with parasite extracts and these are typically spread over several months. Which species of mammals to choose to make the antiserum? Typical antiserum species are goats, mice, and rabbits (try to imagine a vampire rabbit?) and may take months to prepare. "Attenuated parasite" is what is needed to properly immunize a host to make an antiserum.

Let us take a closer look at the parasite seen in Latos' blood since we get a good point of view shot of it. Also, an important question to ask is what contribution did this organism make to vampirism? Latos, as a vampire needs blood to survive. If the parasite feeds off red blood cells then over time the number of RBCs would diminish resulting in anemic-like conditions and a "transfusion" would be beneficial in helping to alleviate the symptoms. And like many infections the parasite population most likely rose and fell depending upon a variety of conditions. If the parasite population were high then severe anemic conditions could result making Latos have a 'craving' for more blood. The converse is also true when the parasite population is low then there would not be any anemic conditions and the need/craving for blood would be less. Another important consideration is how long does it take for the parasites to reproduce? Since vampires apparently need blood nightly then the parasites must have rapid doubling times, less than 24 hours.

In addition to the vampire parasite, another microbe, a fungus, was used as the source of a specific enzyme to help Larry Talbot's cranium surgery. When Dr. Edleman found the cave with the "perfect environment" (meaning temperature and humidity) to grow the fungus he could then extract enough enzyme to do the necessary work. Though not an infection per se at least the fungus did provide an interesting plot device to provide a 'scientific explanation' for its use.

WAR OF THE WORLDS (1953; bacteria)
Though a Martian invasion is a fantasy we can still learn quite a bit from analyzing this interesting film. For example, among many remarkable elements, WOTW is one the earliest films that uses germ warfare as part of its plot. Since the military was ineffective in dealing with the Martian invasion scientists were included to come up with a different method of combating the aliens.

As expected, the scientists have the most effective discussions in the film. In analyzing the Martians one scientist says, "Our gravitational pull would weigh them down and our heavier air would oppress them." The observation is made that Martian hearts beat at a slower rate and their veins are distended making it physically difficult for them to exist on our planet. One of the scientists, Dr. Forrester, makes a very important point by saying, "If they're mortal, they must have mortal weaknesses." And this sets the stage for the real invasion to begin, namely, Earth's microbes.

During the film a machine lands near a farmhouse and the Martians come out, “unprotected” (meaning no spacesuits nor protective clothing or gear) with no resistance to our microbes, to investigate. As such they are exposed to Earth’s microbe germs in the air as well as touching the Earth’s surface with their feet so there are plenty of opportunities for our microbes to colonize their immunologically defenseless bodies. Furthermore, we see a Martian touching Sylvia’s clothing in the farmhouse so here is another opportunity for Earth’s microbes to infect a Martian. And once infected they will transmit the microbe germ to other Martians to begin the chain of events in the infection cycle. The converse could also be true in that humans touched a “wet” scarf stained with Martian blood so this begs the question, do the Martians have their own microbes (likely) and were any transferred to humans via the bloody scarf?

An army general comments, “Guns, tanks, bombs (including atomic), they’re like toys against them…our best hope lies in what you people (scientists) can develop to help us.” As Dr. Forrester intuits, “We may get a lead from their anemic blood.” A colleague replies, “You mean by some biological approach?” To which Forrester says, “We know now we can’t beat their machines. We’ve got to beat them.” While examing a Martian blood sample under a microscope a scientist says, “I don’t ever remember seeing blood crystals as anemic as these. They may be mental giants but by our standards, physically, they must be very primitive.” Forrester replies with, “That Martian blood. Let’s make a quick analysis of it and see what we got.” A colleague replies, “It might give us something.” Then Forrester says, “Something we can use.” The implication is using some sort of biological weapon to defeat them and analyzing Martian blood may give them a clue as to what to design or use.

At the end the Martian machines “die” and slowly crash. A Martian arm is seen falling out a hatch that dehydrates and turns a whiteish color. Unfortunately, Forrester touches the Martian arm thereby potentially transferring Martian microbe germs to humans. (Maybe a film sequel could be about a “second” Martian invasion with their microbes unleased onto a resistance-less Earth population.)

With the death of the Martian invasion a voiceover says, “The Martians had no resistance to the bacteria in the atmosphere to which we have long since become immune. Once they had to breathe our air, germs which no longer affect us, began to kill them. The end came swiftly. After all that men could do had failed the Martians were destroyed and humanity was saved by the littlest things which God in His wisdom had put upon this earth.”

An interesting microbe discussion point centers on wondering if one of the Martians was wounded and microbes entered the wound site? If so, then the infection could easily spread from Martian to Martian like a zoonotic virus. (This brings up an even larger question whether an alien force can conquer a planet without breathing the local atmosphere or dealing with local microbes.)

It should be noted that when the Martian cylinders first landed on Earth they entered our atmosphere as a firey ball and after landing they still had a lot of external heat from the friction of entering our atmosphere. This would be enough heat to sterilize the cylinder surface and the immediate surroundings so a microbe invasion was not stopped, just delayed. After everything cooled down the microbes would appear and be as prevalent as before so the threat of Earth microbes is always there.

BEAST FROM 20,000 FATHOMS (1953; virus)
Once again, atomic explosions awakened an ancient beast. After awakening in the frozen north the beast sought out its ancient breeding grounds of New York harbor. After the beast roams the city some large blood stains are seen on the streets that are attributed to the wounded animal. Soldiers are seen walking next to the beast's blood stains without touching them and they subsequently become sick suggesting the pathogen is air borne. The soldiers collapsed in under 5 min of exposure so the pathogen is fast acting.

In a conversation between a doctor and a colonel the doctor says, "The monster is a giant germ carrier of a horrible virulent disease. Contact with the animal's blood can be fatal (what about other fluids such as urine? How about the animal's breath?). If you use shell fire who knows how far the air will spread the particles of it." The colonel responds saying, "Should have used flame throwers. Would have cremated the beast and the plague with it." The doctor replies, "The smoke would have carried the blood particles just as far as the air." Scary but true. Though it is implied the infection is viral it could also be interpreted as being bacterial.

In one early exchange a doctor sees a sick patient and says, "a screen here", meaning have this person checked for the beast's pathogen. Another patient has a temperature of 105 degrees that only a pathogen can induce. With a blood specimen in hand from a patient a doctor says, "Get it to the laboratory quickly. I'm afraid…of what that creature has brought to us. Dead afraid." Yes, the scary fear of deadly microbes. In this scene the handling of samples of the beast's pathogen was less than satisfactory and if the "blood particles" are as virulent as they say then all those in the room, not to mention the technicians who would do the blood screening, would become infected.

A scientist says, "There is only one way to beat him (beast). Use radioactive isotope. Shoot it into him and destroy all that disease tissue" (along with also destroying all the normal tissues; radiation does not discriminate). Then he continues, "The only isotope of its kind this side of Oak Ridge". (Oak Ridge National Laboratory, TN is a government facility that produces radioisotopes for the scientific community and are one of major suppliers of such compounds. ORNL does indeed furnish radioactive samples to the East Coast of the US. In my research career I have used radioactive samples obtained from ORNL.) One followup question is what happens to the isotope after the beast is killed? Most isotopes have a long half life, some measured in years, so after the beast was killed that isotope is still in him and just as deadly. Lastly, death by isotope, meaning radiation poisoning, will take a long time, it could take weeks, and not the brief time seen in the film.

ANGRY RED PLANET (1959; parasitic amoeba)
Though no known Martian life form exists that can infect humans this film can nevertheless provide an interesting example of a fascinating possibility.
After landing on the red planet one of the crew says to an onboard scientist, "You take a microbe count", which is exactly what should be done to assess what type of life is present. A problem here is being able to identify Martian microbial life; if you don't know how to identify it then how can you asses what is there not to mention getting a 'microbe count'?

An astronaut says, "The atmosphere is pretty much like we thought – thin, extremely thin. Not enough oxygen to sustain us, but undoubtedly enough for some kind of native animal life…with all that vegetation out there (looking out a window in the rocketship), there's bound to be something alive." It appears that plant vegetation is not considered "alive", at least on Mars.

In the film a giant unicellular amoeba attacks the ship and crew. A scientist comments, "I'm sure its a unicellular animal. The two areas inside it must be the nucleus and the contractile vacuoles. Like an amoeba, a giant amoeba. One single cell without intelligence, without a nervous system at all. Reacts completely on instinct to external stimuli. The amoeba engulfs its prey and digests it with extremely acids." (this amoeba is larger than the rocketship so it would be physically impossible to be a single cell since its sheer weight would flatten it!) Part of this amoeba comes in contact with astronaut Tom's arm that subsequently eats right through the clothing and onto the skin. This is the infection brought back to Earth.

Back on earth doctors examine the Marian amoeba-infected arm of astronaut Tom and one says, "An enzymatic reaction. A minute particle of the amoeba creature must have reached Tom's skin, and it's growing, literally eating his tissues." A scientist comments, "We've been attacking the alien amoeba as if it were a disease. But it isn't. It's an animal, an animal with instincts. And the most important of all, a will to act." Taking advantage of amoeboid instincts the scientists use electricity to force off the "amoeba particles" on Tom's arm thereby saving him. For most infections humans spike a temperature and during Tom's infection he spiked a temperature which supports some sort of microbe attack.

After the return landing of the rocketship on earth the recovery team has no gloves, helmets, suits, or masks on as they remove the contaminated astronaut effectively demonstrating that no sterile conditions were used. Also, all of the other personnel, including the surrounding press corps, could potentially be contaminated.

As the doctors are examining the infected arm they have the following conversation. Doctor 1 says, “That growth. What are we up against?” Doctor 2 replies, “I don’t know.” Doctor 3 says, “Its spreading rapidly.” Doctor 1 says, “Do you have any idea what it might be?” Doctor 3 says, “No, I haven’t…yet. If we only know how or by what he was infected with we might know how to combat the disease, but we are working in the dark.” During this conversation doctor 3 takes off his examination gloves and drops them into a bag a nurse (ungloved and unmasked) is holding again demonstrating very poor containment conditions for a potentially devastating infectious disease. Since generals are supposed to say important things (which is why they are generals) the one with the doctors sums it all up by saying, “Suppose this alien infection spreads to all of us. Every moment counts.”

Eventhough the astronaut appeared to be cured of the infectious disease it is unknown if some of the alien amoeba DNA was able to integrate into his cells and tissues, much the same way natural viruses work. Over time, as a latent infection, this Martian DNA could eventually take over his body creating a major infectious disease outbreak (much like herpes outbreaks come and go). Who knows what could happen if alien DNA were mixed with human DNA (shades of Sil from SPECIES or perhaps the aliens from ALIEN).

LAST MAN ON EARTH (1964; plague bacillis)
In this film, some sort of bacillis plague was unleashed upon the world that turns people into vampire-like zombies. According to a newspaper clipping, “Plague Claims Hundreds”, with a subheadline of, “Is Europe’s disease carried on the wind?” suggesting the microbe originated over the pond. Ultimately, those who are exposed to the microbe die and/or become vampire like in that they are repulsed by sunlight, mirrors, and garlic and want to eat flesh. Morgan (Vincent Price) kills the vampire people with a wood stake through their heart (though, in a later scene one victim is seen with a metal spike in his body).

Bodies are seen everywhere over a desolate and empty urban city. Since bodies apparently dropped dead in the streets suggests an airborne microbe though it could also be transmitted physically. In an effort to clean up Morgan collects bodies and takes them to a massive crematorium for disposal and while doing this he wears a gas mask to prevent inhalation of the germs. Apparently, animals are not infected since we see a dog later in the film who appears normal so the microbe appears to be human specific.

In an early discussion between Morgan and his wife he says, “I can’t accept the idea of a universal disease.” His wife says, “Is it possible this germ or virus could be airborn?” Morgan responds, “The germ is visible under a microscope but is not like any bacillis ever known. It can’t be destroyed by any process we’ve been able to uncover." Symptoms of infection by the microbe are hard breathing, fever, and cramps with eventual blindness. It should also be noted that the infected also feel pain since a door was slammed on the arm of one who yelled, "ow" in response. Since the wife says "virus" and the husband says, "bacillis" it is confusing. As mentioned above, treatment for one microbe will not work on another. Furthermore, real viruses are too small to be seen using a standard light microscope as seen in this film. To "see" viruses you need an electron microscope.

In a scientific exchange at the Mercer Institute of Chemical Research Morgan says, "The bacilli are multiplying." (A microscope view of the "bacilli" shows the microbes to look suspiciously like spirochetes and definitely NOT bacilli, nor viruses.) Then, "And this bacilli is found in the blood of every infected person." Mercer, the head of the institute, responds, "That kicks the bone marrow theory in the head." Morgan then says, "This specimen shows the higher white count than when I put it on the slide. Those cells are still living off one another." (If they were living off one another then their number would decrease due to eating each other and not "show the higher white count".) Mercer replies, "You two stay on this virus theory." (Not sure what a "virus theory" has to do with the problem of bacillus microbes.) Morgan says, "An unknown germ is geing blown around the world. Its highly contagious and its reached plague proportions." His assistant says, "Why are they burning the bodies? Why don't they bury them?" Morgan says, "Because it's the best known way to control the contagion. To keep the germ from spreading."

Later in the film a woman is seen alive and she says to Morgan: "You lived through all this. Do you know why?" Morgan says, "A long time ago when I worked in Panama I was bitten in my sleep by a bat. My theory is the bat had previously acquired the vampire germ. By the time it had entered my blood it had been strained and weakened by the bat system. As a result, I have immunity." At face value this is certainly plausable. Morgan could have developed a natural immunity, like he was vaccinated, to the vampire germ.

While commenting on a possible cure Morgan says, "There might be a way. If not of killing the germ then at least of containing it, keeping it from spreading." Morgan gives the woman a transfusion of his immune blood that seems to work since the woman is no longer repulsed by garlic and can look at herself in a mirror. As Morgan explained, "The blood feeds the germs and the vaccine keeps it isolated. It prevents it from multiplying…the antibodies in my blood worked. My blood saved you." Later, she says, "We're alive. Infected, yes…but alive." Human antibodies do indeed work and it is satisfying that a 1964 film got this right.

FLESH EATERS (1964; parasitic amoeba)
Dr. Bartell, a professor of marine biology, is on an island doing research on flesh-eating organisms. Flesh eating microbes are real and do pose a serious threat.

The worst of the bunch is *Staphylococcus aureus* (SARS: staph aureus resistant strains) that gets into muscle and those unfortunate people who are infected have a difficult recovery and often loose limbs and tissues in the process.

While walking on a beach a bone white human skeleton is seen. Nearby are 'glowing' fish skeletons as well as sparkly, shiny cells in the ocean water (note: salt water). When Murdock is about to touch the fish skeletons Bartell says, "What you are about to do is extremely dangerous (touch fish)…I would guess that these fish were destroyed by some microscopic parasite. There's the possibility this same parasite could be transferred to your body if you should touch them." Later, Murdock explains that there is something out in the water that "eats the skin right off you."

A man on a raft appears and some contaminated ocean water splashed his face with instant flesh dissolving activity. The man also drank some contaminated water and the parasite began to eat his insides out. (To show the parasitic amoeba eating away we see a skeleton with bits of fumes coming off clothes. In reality, these are just bits of dry ice evaporating.)

Bartell, a German scientist, described some Nazi war experiments where German biochemists were accused of making another form of life that had a "peculiar metabolism" consuming only one form of nurishment, living matter (an early example of biological warfare?). This is the supposed inspiration for his work with the flesh-eating microbes. Bartell had an interesting lab on this remote island that was adequate enough to do his implied research. In a tent were various table benches, copious glassware, test tubes with cotton plugs, a glass vacuum dessicator (the parasitic amoeba does not react with glass), and an adequate monocular microscope.

In trying to explain how Bartell managed to create the giant parasitic amoeba from the flesh-eating microbes with electricity he says, "the charge of energy bound the amino acids together and it formed this." Hmmm… In essence Bartell used electricity to congeal the smaller microbes into a larger one (much like real slime molds congeal into a stalk and bulb). The gigantic parasitic amoeba has external structures such as appendages, cilia, an 'eye', surface ridges, which an amoeba would not have so amoeba is really a misnomer. (It should be noted that this parasitic amoeba was sensitive to electricity much like the amoeba in ANGRY RED PLANET discussed above.)

It was discovered that the parasite has "hemoglobin sensitivity" so the survivors use their own blood (pooled) as a weapon. A standard evaporator tube was used to pool their blood donations to attack the parasite (tube served no purpose and was a visual prop only). They made a crude hypodermic syringe to inject blood into the giant parasite. The main component of blood is hemoglobin which contains iron atoms so it seems appropriate that iron was the toxic element that killed the parasitic amoeba. The amoeba essentially died of lead poisoning.

OUTBREAK (1995; virus)
An African monkey carrying a deadly virus is smuggled into the US and those people exposed to the virus develop hemorrhagic fever, the main symptoms being the loss of blood through blood vessels. As explained by Casey, “When the patient first gets the virus he has flu-like symptoms and in two or three days pink lesions begin to appear all over his body, along with small pustules that soon erupt with blood and pus. A kind of milky substance begins to form. These particular lesions, when they become full blown, feel like mush to the touch. There’s vomiting, diarrhea, bleeding in the nose, ears, gums, they eyes hemmorhage, the internal organs shut down, they liquify.” Quite a nasty and scary way to go. Examples of hemorrhagic viruses are ebola, lassa, and hanta viruses. Most viruses are confined to one species and those that start in one species and are transmitted to man are called zoonotic viruses. The “Motaba” virus in the film is a zoonotic virus, which means it jumps from one species to another, in that it starts in a monkey, mutates, infects humans, and mutates again to become airborne, the most deadly form.

During the beginning of the film the first viral outbreak is ebola and is shown to require direct human-to-human contact to spread (very similar to HIV). All viruses (as well as other microbes) need a host as a carrier. A carrier is any person or animal that literally carries a specific infections agent or microbe in the absence of any visible clinical symptoms and can serve as a potential source of infection to others (very much like Typhoid Mary discussed above). Later in the film the virus is seen infecting others as an airborne infection so it must have mutated. As it turned out the military had developed an antidote which was duplicated as can only be done in SF films to save the inhabitants of the infected town.

Summary
Microbes come in all sorts of shapes and sizes but in essence all share a common trait. Namely, microbes live off of and are dependent upon other species, sometimes beneficial and sometimes detrimental. Microbes hijack a host’s biology to serve their own needs. And when microbes encounter a friendly host, either of this Earth or not of this Earth, then the invasion begins.

The 8 films discussed cover a span of over 55 years and during this time infectious diseases have become more prominent in our lives. Infections can be truly scary and every reported outbreak causes much concern and nervousness. Especially in the food industry when contaminations are reported way too frequently. The idea that a foreign visitor (an “alien”?) can take over our bodies is troubling and provides a sense of helplessness and perhaps help to scare others into thinking doomsday is near. Since art mimics life this does sound like a scary film plot. However, it should be noted that historical diseases such as the Black Death and bubonic plague came before film was invented. Nevertheless, films have captured the angst the public experiences over the real life problems of essentially unseen microbes. And films with microbes as part of their plot provide a good source of screen thrills about real world problems. Scary indeed and may even serve a purpose in convincing some to get vaccinations.

Thanks for reading. Its back to the lab for me. Stay healthy and eat right.

Legends to Photos:

Photo 1 (SOF); The microbes coursing through the monster's blood could influence hormonal levels giving rise to moments of outbursts and angst.

Photo 2 (HOD); Dr. Edelman preparing to examine the vampire parasites using his trusty microscope. Note the lamp aimed at the microscope mirror to provide adequate light.

Photo 3 (WOTW); Examining the scarf stained with Martian blood, as well as Martian microbes, thereby potentially contaminating all those present since none of them are wearing any protective gear.

Photo 4 (WOTW); The *second* Martian invasion has begun. Dr. Forrester physically touches the Martian arm and all those Martian microbes are now on him and anyone else he touches. Thusly begins an infection.

Photo 5 (TBF20KF); Newspaper headline announcing the appearance of the Beast.

Photo 6 (TBF20KF); Army personnel following a blood trail of the Beast. Their close proximity to the microbe-infected blood resulted in their becoming infected.

Photo 7 (ARP); View through a porthole window at the gigantic amoeba that has engulfed the rocketship; this view suggests considerable cellular microstructure, unlike a real amoeba which would have very little.

Photo 8 (ARP); The astronaut's infected arm as a result of coming in contact with the amoeba.

Photo 9 (LMOE); Morgan looking down his microscope.

Photo 10 (LMOE); POV shot of the "bacillis" which in reality are spirochetes with their characteristic corkscrew shape; these cells are mammalian cells and much too large to be microbes.

Photo 11 (LMOE); Human antibodies at work. Morgan transfuses his antibody containing blood to an infected woman to help combat the infection. An early version of what is now called immunotherapy.

Photo 12 (FE); Bartell examining a fish skeleton aglow with the flesh-eating microbes.

Photo 13 (FE); As a result of electrical stimulation the tiny flesh-eating microbes congealed into a larger organism.

Photo 14 (FE); Bartell's glowing skin being eaten away by the flesh-eaters in the ocean. Note the similarity to the cover of FM#29 (suggestion: if you have the space you could also show the cover to the original FM #29 with the "Flesh Eaters").

Photo 15 (FE); The microbes kept growing until it reached the size of a battleship.

Photo 16 (Outbreak); This old world monkey is the host/carrier of the Motaba virus. From this little monkey comes about 200 liters (53 gallons!) of high-titer antisera to combat the virus! You have to feel sorry for that monkey.