

Travel and Infections

Mummy: Sally's father has been sick ever since he came back from a holiday with friends; what do you think is the reason?



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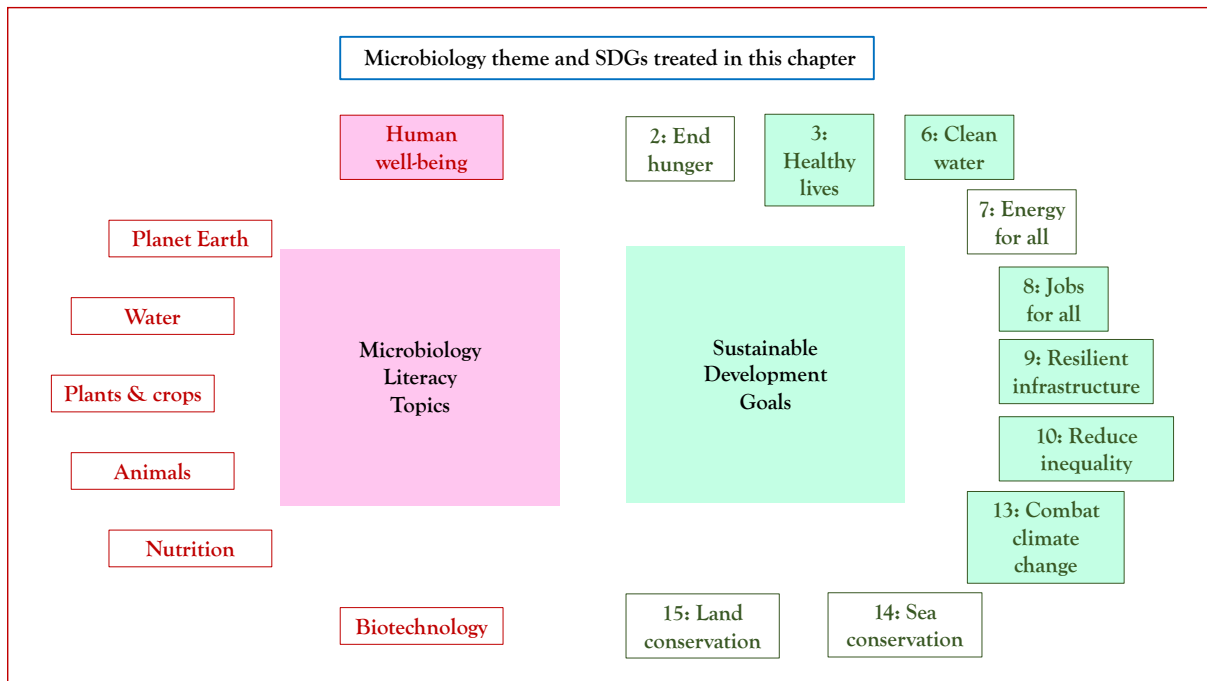
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Storyline

Traveling to different places is one of the most exciting and anticipated parts of any holiday. Whether it be for work or for a fun family vacation, we all love to explore new places. It could be a road trip across the country or a 20-hour plane ride to the other side of the world. Regardless of your destination, travel allows us to make new memories with our families and friends, to experience new cultures, to expand our perspective, and to taste new food. However, as amazing as travel is, there are risks to traveling that include acquiring infectious diseases that can in turn lead to transmission to others. Many of these infections can be prevented by taking certain preventative measures and educating yourself about how to stay safe.

The Microbiology and Societal Context



The microbiology: food and water-borne infections; insect-transmitted infections; zoonotic infections; respiratory infections and aerosols; infection-prevention precautions; vaccines.
Sustainability issues: health; food and water, infrastructure, inequality, and climate change.

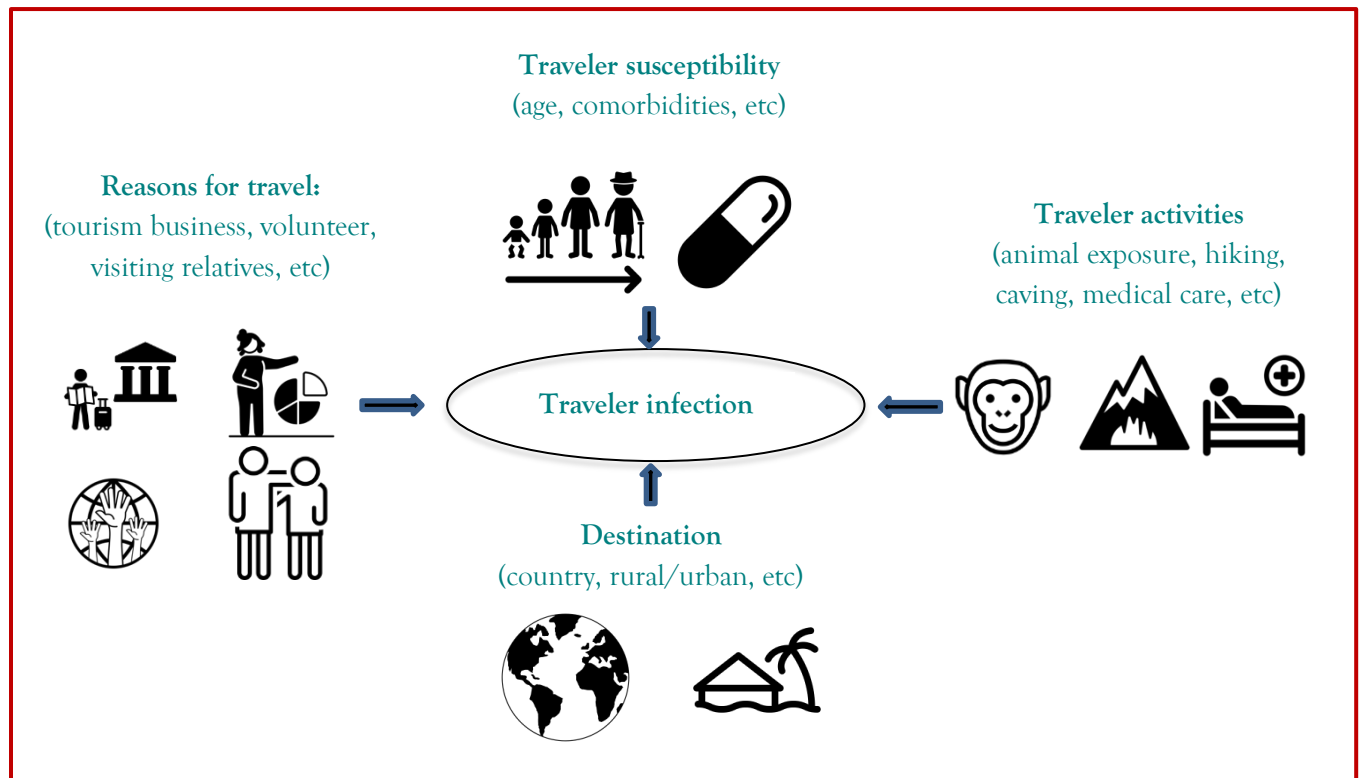
A child-centric microbiology education framework

Travel and Infections: The Microbiology

1. **Infection risks of travel.** The risk of infections in travelers continues to rise, as the number of people traveling internationally increases. The World Tourism Organization reported that there are 1.4 billion tourist arrivals per year, a 56-fold increase from 60 years ago. People travel for all sorts of reasons, including pleasure, work, education, to receive or provide healthcare, and to visit friends and relatives.

Furthermore, each traveler has unique underlying health conditions and other characteristics (such as older age) that affect their risk. Similarly, the infectious diseases that travelers face are also distinct, with some targeting only specific groups of travelers (such as people who do high-risk sports or explore caves), some existing predominately in certain locations (such as yellow fever which is only found in parts of Sub-Saharan Africa and South America), and others present more widely.

Perhaps more than ever, the importance of educating and protecting the personal health of travelers as well as safeguarding the communities into which they return is of the utmost importance. As evidenced by the 2019 Sars-CoV-2 pandemic, we live in a global, highly connected world; infections in one part of the world easily become infections worldwide. The need to inform people of travel-associated risks is clear. We aim to inform readers about the potential infections associated with travel and provide guidelines on reducing these risks.



Risk of traveler infection depends on a variety of factors including reasons for travel, characteristics of the traveler, travel destination and activities at the destination.

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2. *Travelers may be exposed to infections in a variety of ways*

a. Insects can transmit various diseases. A range of arthropods (including mosquitoes, but also ticks, lice, fleas, mites and flies) can transmit infectious diseases to unwitting travelers. Mosquitoes, including the *Aedes* and *Culex* species, transmit parasites (including *Plasmodium* species that causes malaria) and many viruses including chikungunya, dengue, Eastern equine encephalitis, Powassan, West Nile, yellow fever, and others. Other arthropods transmit bacteria such as the tick-borne *Borrelia* spirochete that causes Lyme disease.

If traveling to a region endemic for malaria or other arthropod-transmitted diseases, travelers should take precautions to minimize the number of insect bites and prevent infections:

i. *Use insect repellent.* Travelers should use repellents certified by the United States Environmental Protection Agency (EPA) or other national authorities. When looking for repellents, these should include active ingredients such as N,N-Diethyl-meta-toluamide (DEET) or Picaridin. Some repellents can be applied to skin and others to clothing.

ii. *Wear appropriate clothing.* Travelers can minimize areas of exposed skin by wearing long sleeved pants and shirts, boots, and a hat (when tolerable).

iii. *Sleep in rooms with bed nets or screens on the windows.* Bed nets (including insecticide-treated nets) and window screens can provide protection from insect bites.

iv. *Avoid outbreaks.* Travelers should avoid destinations with known outbreaks of vector-borne diseases. Information about outbreaks can be obtained from the United Kingdom National Health Service, the US Centers for Disease Control and Prevention (CDC), and other public health entities.

v. *Check for ticks.* Travelers, particularly those traveling rurally, should check themselves for ticks.

b. Contaminated food and water can pose a threat to travelers. Food and waterborne illnesses include a range of bacteria (such as *Salmonella* and *Vibrio cholera*) and viruses (such as Hepatitis A) that induce a number of symptoms: stomach aches, diarrhea, and vomiting, but occasionally more serious complications such as infection of the blood or brain.

In many countries, particularly parts of the world with inadequate water quality and poor sanitation, tap water may contain a variety of infectious organisms. Raw or undercooked meat but also uncooked vegetables or raw, unpeeled fruits can be sources of infection.

Methods to address this source of infection include:

i. *Wash hands with soap and warm water before eating or preparing food.* If soap and water are not available, hand sanitizer can be effective.

ii. *Fruit and vegetables should be peeled or boiled before eating.* The famous travelers' health mantra is **“boil it, peel it, or forget it.”**

iii. *Avoid undercooked meat and fish, as well as unpasteurized milk and cheese.*

iv. *Avoid street food and vendors.* Eating food or drinks that come from street food vendors has been linked to increased risk of illness.

v. *Avoid tap water.* Water should be boiled before drinking; alternately, travelers can drink bottled water or beverages. The same rule applies to water used for preparing food and beverages, making ice, and brushing teeth.

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c. Animal bites pose a serious threat to humans and can result in severe illness or death. A large part of the risk that animals pose is that they don't have to appear sick to infect humans, as many animals naturally carry organisms that are harmful to humans. Thus, animals such as bats, rodents, goats, and even more common animals such as cats and dogs can pass infections to humans.

The most common form of transmission from animals, particularly mammals (dogs, squirrels, bats, etc.) is through bites. In some instances, even without a bite, saliva entering a cut can transmit a pathogen such as rabies which causes thousands of deaths each year. These types of infections can be prevented by:

- i. *Avoid petting, feeding, or interacting with unfamiliar animals (domestic or wild).* Avoiding unfamiliar animals can help mitigate the risk of exposure to rabies and other diseases.
- ii. *If scratched or bitten, travelers should clean the wound quickly with soap and water and contact medical professionals.* Any wound, even if appearing insignificant, should be examined by a professional.
- iii. *Caves or other animal habitats should be avoided or entered with the proper equipment and protective gear.*
- iv. *Travelers should receive the proper immunizations before travel.* Depending on the destination, travel health providers might recommend receiving a rabies vaccination.

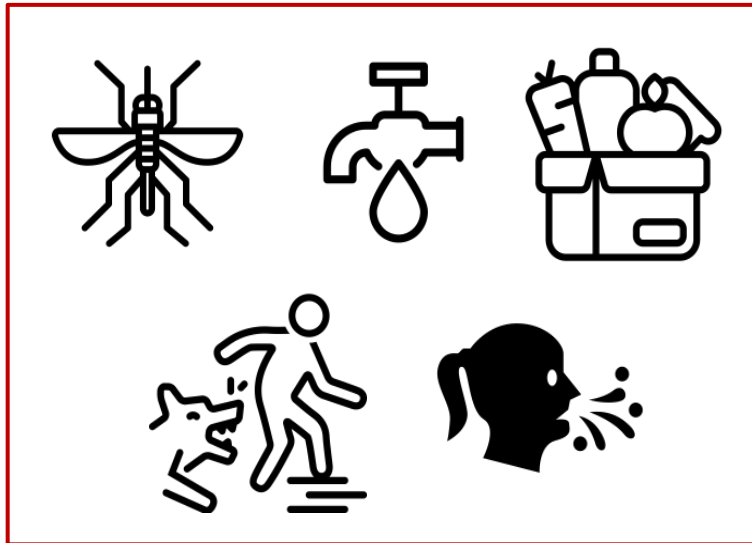
d. Respiratory diseases are a leading cause of travel-related illness. Viral pathogens are the most common cause of respiratory infection in travelers; common viruses include influenza, respiratory syncytial virus, parainfluenza and others (such as the 2019 SARS-CoV-2). Outbreaks are more likely to occur following mass gatherings of people (see below). Depending on the virus, they can be transmitted through the air, droplets, or contact with an infected person or surface.

Poor air quality and high levels of pollution can also be problematic in many urban centers; travelers with pre-existing cardiorespiratory diseases should limit exposure. Other strategies to reduce airborne illness include:

- i. *Wash their hands frequently and avoid touching the face.*
- ii. *Consider wearing masks in areas with poor air quality to limit exposure to pollution.* In settings with infectious respiratory outbreaks, masks can prevent transmission.
- iii. *Limiting exposure to large groups of people can reduce the risk of respiratory illness in travelers.*

3. ***Traveling to mass gatherings poses a unique risk***, primarily due to the number of people mass gatherings attract (ranging from 1000 to >25000 people). These can include religious events (such as the Hajj), political protests, and sporting events like the Olympics or World Cup tournament. Respiratory diseases are the most common illness present at mass gatherings and the most easily transmitted.

Crowding, poor sanitation and hygiene, and the type and location of the gathering can contribute to the spread of infections. In the past, such gatherings have been associated with outbreaks of influenza, meningococcal disease, and norovirus. Travelers to mass gatherings may also spread diseases when they return home.



4. ***Vaccines and Immunizations.*** Vaccines protect travelers from diseases that they would not encounter in their country of origin - and ensure that travelers don't bring diseases home to family and friends. Ideally travelers are vaccinated at least 4-6 weeks before travel to ensure enough time for vaccines to start working and to get vaccines that require more than one dose. The vaccines needed when traveling will depend on a few things including:

a. Travel destination: Traveling in less-developed countries and rural areas may bring travelers into contact with more pathogens. In some countries, you are required to show proof of vaccination for certain diseases before entering, such as yellow fever in Nigeria. Before visiting a country, travelers should check the list of required vaccinations.

b. Season of travel: Some diseases are more commonly transmitted during certain seasons (such as meningococcal meningitis during the dry season in Sub-Saharan Africa).

c. Underlying health: Vaccines are even more important for individuals who are pregnant or have a weakened immune system, although certain vaccinations (such as live virus vaccines) may be contraindicated in these individuals.

d. Which vaccinations have already been received: It is important for travelers to be up to date on routine vaccinations. Vaccinations against tetanus, diphtheria, and pertussis (Td, Tdap); measles, mumps, and rubella (MMR); varicella, and other pathogens are routinely administered in childhood in developed countries, although one may require a booster. The need for primary or booster vaccinations should be discussed with one's healthcare provider.

Relevance for Sustainable development goals and Grand Challenges

The microbial dimension of travel and infections relate to several SDGs including:

- **Goal 3: Ensure healthy lives and promote well-being at all ages** (improve health, reduce preventable diseases and premature deaths.) Educating travelers on the various ways they can become infected (and prevent infections) while traveling can directly impact their

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health and the well-being of others. By taking simple steps such as drinking bottled water, wearing insect repellent, and receiving appropriate pre-travel vaccinations, travelers promote a healthier lifestyle. Unfortunately, the opposite is true. Travelers who don't address the potential risks of travel or prepare adequately can be at risk for serious illness.

- **Goal 6: Clean water and Sanitation** (ensure availability and sustainable management of water and sanitation for all). In many parts of the world, tap water is unclean and may contain infectious pathogens or chemical contaminants. Travelers can become infected, so addressing water and sanitation is a key component of travel safety.

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (*promote economic growth, productivity and innovation, enterprise and employment creation*). According to the World Travel and Tourism Council, prior to the COVID-19 pandemic, travel and tourism accounted for 25% of all new jobs created worldwide, 10.6% of all jobs, and 10.4% of global GDP (or almost 10 trillion USD: <https://wttc.org/Research/Economic-Impact>). The COVID-19 pandemic reduced this spending by almost 50% in 2020. Since the pandemic has been facilitated by travel, it is a dramatic illustration of the link between disease, travel and employment. The pandemic is also a powerful argument for adoption of a variety of measures that reduce disease and transmission, including vaccination, mask wearing indoors, ventilation of indoor spaces, and avoidance of large gatherings.

- **Goal 9 & Goal 10: Industry, Innovation, and Infrastructure, and Reduced Inequalities** (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, Reduce inequality within and among countries). When it comes to infections, low and middle-income countries suffer the most. Countries may lack sufficient facilities and infrastructure to filter their water and the resources to address health needs. Travel, and witnessing such disparities, can shed light on the conditions, infrastructure and inequalities worldwide.
- **Goal 13: Climate Action** (Take urgent action to combat climate change and its impacts). The climate is changing rapidly, and this is affecting the spread of infectious diseases. For example, warmer air and water temperatures and changes in rainfall can expand vector and animal populations to new areas (such as mosquitoes and bats) or increase bacterial growth (such as increased *Vibrio cholerae* in warmer waters). Furthermore, as pollution worsens, contaminated water enters drinking water systems. Hence learning about travel-related infectious diseases requires awareness of the impact that climate change has had.

Potential Implications for Decisions

1. Individual

- a. Weighing up the various factors surrounding infections and travel and aligning them with personal convictions (Does the risk of getting yourself and others infected outweigh the inconvenience and sometimes discomfort of following precautions and protecting yourself?)
- b. Masks or no mask? (Is the inconvenience of wearing a mask worth keeping yourself and others around you healthy?)

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- c. Do you want to pay for vaccines? Are you willing to experience the potential discomfort associated with vaccines? Do you want to risk an infection and its discomfort, the treatment and perhaps hospitalization?
- d. Do you want to follow precautions when traveling even if it's inconvenient and/or affects your ability to immerse yourself fully in the culture?
- e. Can you acknowledge that your pre-existing medical conditions, age or other factors will affect your risk of travel-related infections?
- f. Your choice of travel destination and activities will affect your risk. How can you mitigate those risks?

2. *Community Policies*

- a. Local hospitals and doctors which provide vaccines and immunizations
- b. Health costs
- c. Local environmental consequences (pollution of bodies of water)

3. *National Policies*

- a. Economic disparities (individuals in poorer countries may be at greater risk of infection, mainly due to the lack of resources to properly protect against diseases)
- b. Ensuring safe drinking supply
- c. Insect control measures
- d. Policies around mass gatherings (Hajj, sporting events, etc.)

Pupil Participation

1. *Class discussion of travel and infectious diseases.*

- a. What are different ways that travelers are exposed to infections?
- b. Why is preventing these diseases important - not just for the traveler him/herself?
- c. When traveling, what are some precautions that should be taken?

2. *Pupil Awareness and Responsibility*

- a. Traveling can have negative and positive effects on the SDGs. What SDGs are you passionate about and how can your actions reflect that?
- b. What is your responsibility towards your own health and the wellbeing of the community?

3. *Exercises*

- a. Review the world map and learn about which diseases are endemic to which locations (i.e. match locations with where diseases are commonly found)
- b. Matching game to help students remember common precautions when it comes to traveling and diseases (mosquitoes - wear repellent, long sleeve clothing, etc.)
- c. Looking at the SDGs, how can we change our approach towards travel? How can we aid people living in less-developed countries who are at greater risk of many infections? What are the challenges and concerns with the SDGs?

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The Evidence Base, Further Reading and Teaching Aids

Travel Advice, Resources, and Partners | Travelers' Health | CDC.

<https://wwwnc.cdc.gov/travel/page/travel-information-centers>

CDC Yellow Book. <https://wwwnc.cdc.gov/travel/page/yellowbook-home-2020>

UK Fit For Travel. <https://www.fitfortravel.nhs.uk/home>

Ryan ET, Wilson ME, Kain KC. Illness after international travel. *N Engl J Med*. 2002 Aug 15;347(7):505-16.

Angelo KM, Kozarsky PE, Ryan ET, Chen LH, Sotir MJ. What proportion of international travellers acquire a travel-related illness? A review of the literature. *J Travel Med*. 2017 Sep 1;24(5). doi: 10.1093/jtm/tax046.

Regina C. LaRocque,* Bhushan R. Deshpande, Sowmya R. Rao, Gary W. Brunette, Mark J. Sotir, Emily S. Jentes, Edward T. Ryan, and the Global TravEpiNet Consortium. Pre-Travel Health Care of Immigrants Returning Home to Visit Friends and Relatives. *Am J Trop Med Hyg*. 2013 Feb 6; 88(2): 376-380. doi: 10.4269/ajtmh.2012.12-0460