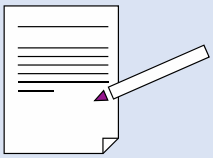
Bacteria are not only enemies – in truth, they are also our partners

The tasks of a scientist include publishing their findings and working creatively. One such creative method is the preparation short films for the purpose of providing the public with information on a complex problem or topic in the least possible time. In order to present information, messages and data which the listener will not only hear but also remember, scientists create films which package their research findings in the form of an exciting story. Today it's your turn to play the role of creative scientist and to inform the public (preferably your class) on the topic of 'Microorganisms and Sponges'.

To do this you will create a stop-motion film. In this film technique, still drawings are brought to life. It involves photographing the desired image, then making a slight change in the image before taking the next photograph. When this process has been repeated enough times and the images are then displayed one after the other in rapid succession, the result is a film which appears to show fluid motion. On the following pages you are provided with all further information on the endosymbiotic theory, other forms of coexistence, and the symbiosis of sponges and microorganisms, as well as an infobox which could help you in preparing your film. Good luck!



Task:

1. Devise a storyboard (see template) for a stop-motion film which concerns itself with the fundamentals of the intestinal microbiome. You can select a main focus for the film such as 'A World inside Us' or 'Fecal Microbiota Transplant'.

2. Now produce your own stop-motion film. Create your own images, either by making your own drawings or using the templates. Follow the instructions for the stop-motion app in preparing the film.

3. Prepare to make a presentation to the public (your class) during which you show your film and make clear why your topic is of scientific importance.

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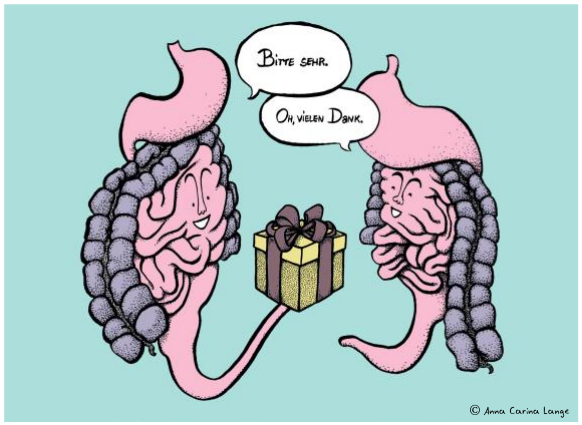
A world inside us!

(Based on the book 'Der Mensch als Holobiont – Mikroben als Schlüssel zu einem neuen Verständnis von Leben und Gesundheit' (The Human as Holobiont - Microbes as the key to a new understanding of life and health) by Thomas C. G. Bosch)



If we take a closer look at humans, each one appears as a world in itself. We populate the earth and are populated ourselves. Thanks to new technologies and methods in DNA analysis, every day we learn more about our microscopic inhabitants – the microorganisms. These include archaea in general, protozoa (eukaryotic single-celled organisms such as the paramecium), multi-celled microorganisms such as fungi and algae, and viruses (which is not a life form but is categorized as belonging to the group of microorganisms) and the new information on these revolutionizes our previous evolutionary thinking about life and coexistence. Nowhere else do so many species and families live together as on our skin and mucous membranes, in our intestinal tract, urinary and sexual organs, and our respiratory tract and lungs. Ninety-nine percent of our human microbiome – the term used to refer to the totality of microorganisms which inhabit and are associated with the human – are located in the intestines.

Our intestinal flora weighs up to 1.5 kilograms and houses around 1,000 different species of bacteria. These perform such functions as breaking down food constituents, providing important vitamins and nutrients in the gastrointestinal tract, supporting the immune system, protecting against pathogens, or remaining in constant communication with the brain, and appear to be capable of influencing our behavior. Even our human waste product – feces – is in fact filled with the life of 100 billion bacteria and many millions of viruses and archaea per gram. It also contains many more mucous membrane cells destined for excretion, single-celled fungi such as yeasts and a relatively small proportion of metabolites and other substances. This means that one gram of feces contains more bacteria than there are humans on earth. These new insights are applied in a new form of therapy called fecal microbiota transplant which is presented on the following page.

Today, **fecal microbiota transplant** (FMT, also known as stool or microbiome transplant) is a promising and unconventional therapeutic approach to correcting an intestinal microbiome imbalance. It involves introducing the feces (stool) of a healthy person into the patient's large intestine, either by enema, the swallowing of capsules, or as part of colonoscopy. The objective of this type of therapy is to replace the damaged intestinal microbiota of the patient with microorganisms from the intact microbiota of a healthy donor. To date, promising results have been obtained in applying this method, particularly in the treatment of *Clostridium difficile* infections (CDI).

One of the first major medical studies was published in the *New England Journal of Medicine* in 2013. It was demonstrated in this study that in *Clostridium difficile* infections, FMT succeeded in healing in more cases than did traditional antibiotic treatments. In this study the patients were divided into two groups. One group was treated with traditional antibiotics, while the other received a fecal microbiota transplant. In 13 out of 16 patients (81 percent) the diarrhea was already cured after the first fecal transplant. In the control group only 4 out of 13 patients (31 percent) were healed through treatment with antibiotics. The FMT patients tolerated the therapy very well and only in isolated cases were there complaints of side effects such as mild diarrhea or cramps on the day of the infusion. Examination of the fecal samples indicated that it was possible with this therapy to reestablish a typically intact diversity in the intestinal microbiota.

The incidence of infections with *Clostridium difficile* (CDI) has risen in recent years, particularly in industrial nations like Germany and the US. CDI can occur as a result of previous antibiotic therapy, as frequent treatment with antibiotics can lead to major disturbances in the intestinal flora.

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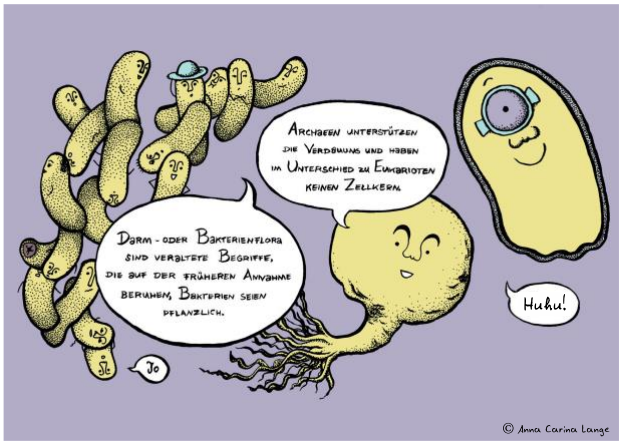
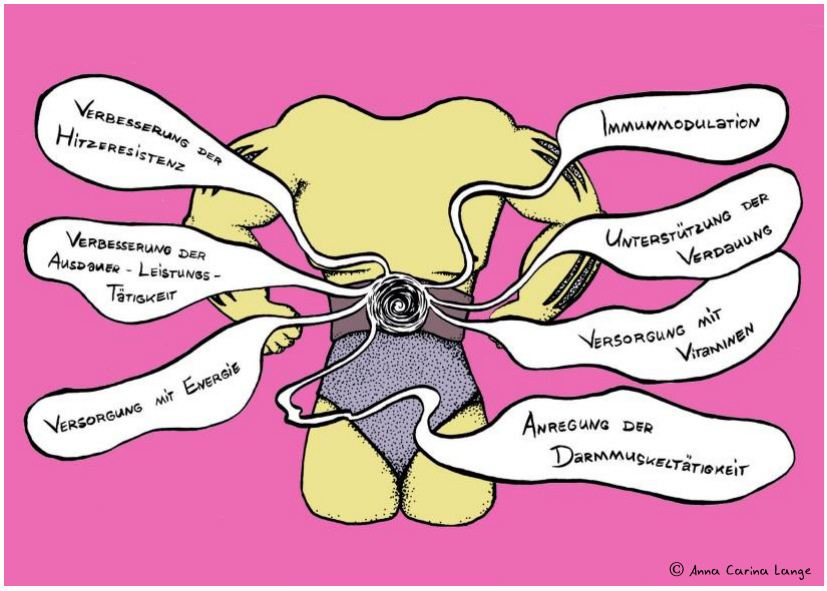
Extreme proliferation of the bacterium in the intestines can result in severe diarrhea or even life-threatening conditions such as toxic megacolon[1]. The standard therapy for diarrhea caused by CDI is renewed treatment with antibiotics. However, the chances of success sink with every additional round of antibiotics, since each dose can lead to renewed breakdown of the intestinal flora. As a result, therapy based on various antibiotic treatments is unsuccessful in 10-30% of patients. In such cases fecal transplant is a promising alternative, since it is capable of transferring a healthy intestinal flora to the patient and the rate of healing lies between 60 and 90%. At the same time, however, the transfer of feces to a patient whose intestinal microbiota is not intact carries significant risks. A multitude of microorganisms in the human intestine, as well as long-term side effects such as possible weight gain, have until now not been sufficiently recognized and researched. Also, fecal transplant is not yet an approved treatment method in Germany. Instead it is considered to be an 'individualized treatment' when all other traditional treatments fail to bring healing. By establishing the National Stool Transplant Register, however, an attempt is being made in Germany to standardize this therapy. One of the scientists who is dealing with this type of therapy in depth is Dr. Felix Sommer at IKMB – the Institute of Clinical Molecular Biology in Kiel. Together with his team he is conducting experiments on mice, among other subjects, to determine to what extent fecal transplant may contribute to possible changes in patient weight.





Info: The source of the illustrations is a comic on fecal transplant by the artist Anna Carina Lange. You can follow this link to view more of her work: carinalange.myportfolio.com

[1] **Toxic megacolon**: life-threatening, acute dilation of the colon (longest portion of the large intestine), generally accompanied by infection as a result of impaired water reabsorption, and typically treatable only with surgery.

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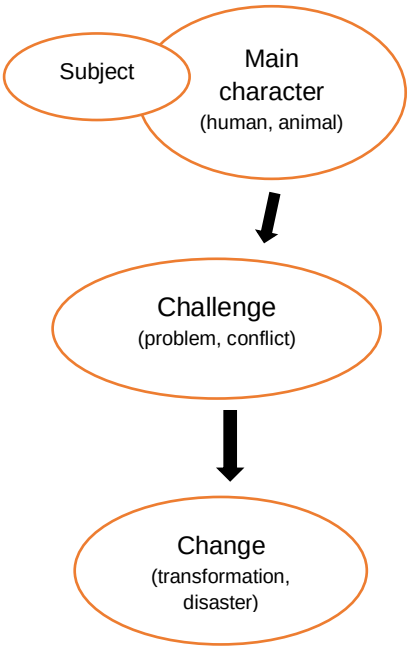
Infobox: Stop-motion films using the storytelling method

A good story can change the world – the history of human evolution has proven it. This is true thanks to the doorkeeper to our long-term memory, the *amygdala*. It decides whether we commit something to memory or not. This is because the *amygdala* is in direct contact with the *hippocampus*, which plays a crucial role in memory formation. Not every story makes its way into our long-term memory bank, however, because over the course of human development only exciting stories had the potential to secure our survival.

Tips for creating a film:

- Limit the content of your story to the essentials
- Stories arouse emotions – they are easier to remember than disjointed fact
- The first sentence / introduction is crucial and should arouse curiosity (to get past the doorman)
- Create an arc of tension
- A good story engages the audience (listening is fun) and generates enthusiasm (for the idea or process)
- The listener identifies with the story and is better able to absorb information
- Story = character (hero/heroine) + predicament + desire/attempt to escape (see illustration)

The framework of a story



This is an example of a **storyboard**. The important thing is to prepare the template before you start shooting the film by entering the title, image and content into each frame! Enjoy making your film!