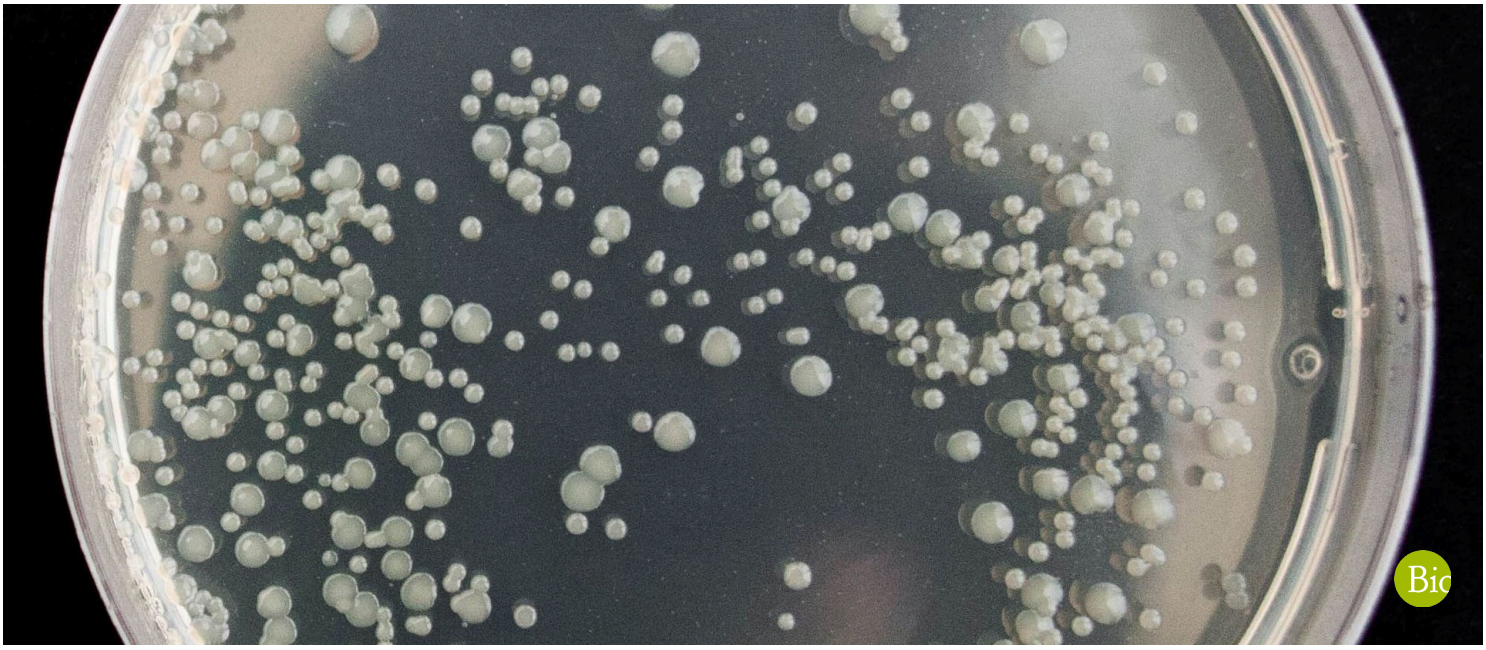
# Evidence of the spread of bacteria



Biology | Microbiology & genetics | Basics of microbiology

Applied Science | Medicine | Histology & Medical Microbiology

| Difficulty level | Group size | Preparation time | Execution time |
|---|---|---|---|
| hard | 2 | 30 minutes | 45+ minutes |

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# General information

## Application

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Bacteria on human skin

Microorganisms are ubiquitous, i.e. they are present everywhere around us. This fact can be proved by touching the objects that are to be examined in view of the presence of microorganisms against the sterile nutrient medium in a Petri dish and by incubating the plates afterwards. The easy working methods that are to be applied for this purpose are described based on the following examples. Evidence concerning the presence of microorganisms in soil and water can be provided most easily with the aid of the methods that are described afterwards. They also enable a quantitative analysis.



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## Other information (1/5)

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**Prior knowledge**

Students should know what groups of microorganisms there are, where they occur and how they can be transmitted.

**Scientific principle**

Microorganisms cling to almost anything we can find. Therefore, they offer an interesting field of investigation.

## Other information (2/5)

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**Learning objective**

The students are to acquire the knowledge of the presence of microorganisms in their daily surroundings.

**Tasks**

The students are to provide evidence concerning the presence of microorganisms in the air, on objects of daily use, on the skin and on insects.



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# Other information (3/5)

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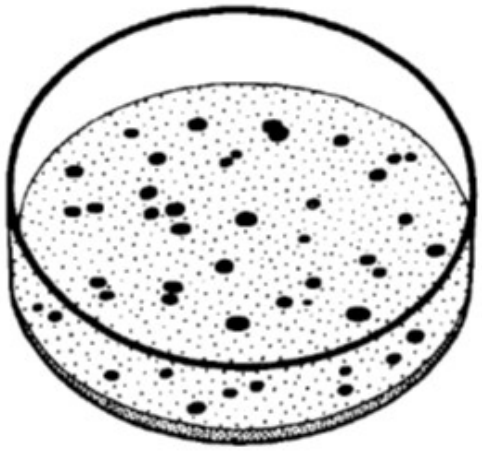
**On task 1: Evidence of the presence of bacteria in the air**

Within two to three days, colonies of various types of microorganisms develop on the nutrient media that had been exposed to the air. Their nature, i.e. their size, colour, shape, surface structure, limitation, etc. can vary to a high extent. Under otherwise identical experiment conditions, the number of colonies depends on the concentration of microorganisms in the air at the sampling location. Afterwards, you can perform a microscopic examination of the colonies under 400x or better 1000x magnification. The nutrient agar of the control plate that had not been exposed to microorganisms in the air should not show any microbial development.



Evidence of the presence of bacteria in the air

# Other information (4/5)

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**On task 2: Evidence of the presence of microorganisms on objects of daily use**

Within two to three days, colonies of microorganisms develop on the nutrient media that had contact with an object of daily use. These colonies may differ from each other, but it is also possible that all or nearly all of them look identical. Their number usually varies greatly in the case of comparative examinations of various objects. If the size of the contact surface is taken into consideration, it can provide an indication concerning the concentration of microorganisms on the surface of the examined object. Again, perform a microscopic examination. The nutrient agar of the unused control plate should not show any microbial development.



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# Other information (5/5)

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**On task 3: Evidence of the presence of microorganisms on the skin**

Within two to three days, bacterial and/or fungal colonies develop on the nutrient media that had been touched with the fingertips. The number of colonies depends on the microbial concentration on the skin. If an experiment is performed before and also after the test person has washed their hands, the results should show clear differences.
Again, perform a microscopic examination of the colonies. The nutrient agar of the unused control plate should not show any microbial development.

**On task 4: Evidence of the presence of bacteria on insects**
Within two to three days, microbial colonies develop on the nutrient medium that had been in contact with the insect. Perform a microscopic examination of the colonies. The nutrient agar of the unused control plate should not show any microbial development.

# Safety instructions

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For this experiment the general instructions for safe experimentation in science lessons apply.



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# Theory

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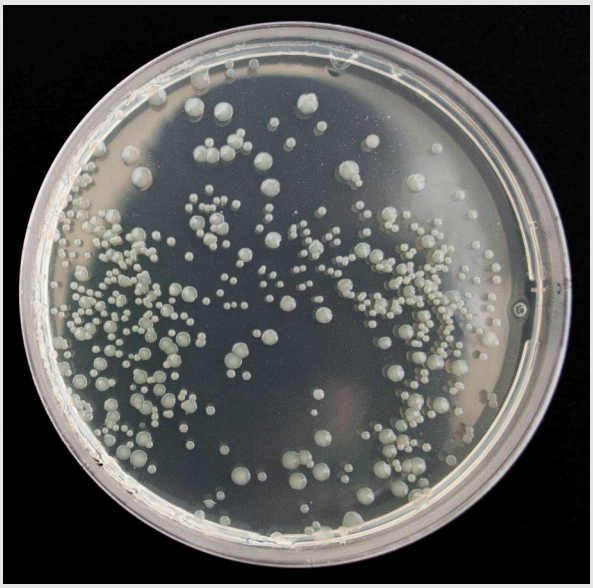

The history of microorganisms starts with the invention of the microscope, at the dawn of the 17th century. After that Louis Pasteur established the first important methods when working with bacteria. Robert Koch elevated the microbiology for medical usage. His methods are the basis of microbiological work today, for example the use of agar.

The purpose of this experiment is to acquire the basic knowledge for working with microorganisms.

Since microorganisms cling to almost anything we can find, in this experiment we look at some everyday objects that we examine for microorganisms.



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# Equipment

| Position | Material | Item No. | Quantity |
|---|---|---|---|
| 1 | Beaker, Borosilicate, tall form, 600 ml | 46029-00 | 1 |
| 2 | Tripod,ring d=140 mm, h=240 mm | 33302-00 | 1 |
| 3 | Tweezers, l = 130 mm, straight, blunt | 64610-00 | 1 |
| 4 | Wire gauze with ceramic, 160 x 160 mm | 33287-01 | 1 |
| 5 | Universal oven, 32 liters, 230 V | 49559-93 | 1 |
| 6 | Safety gas tubing, DVGW, sold by metre | 39281-10 | 1 |
| 7 | Bunsen burner, natural gas,w.cock | 32167-05 | 1 |
| 8 | Petri dish, d 100 mm | 64705-00 | 10 |
| 9 | Compact Balance, OHAUS TA 302, 300 g / 0.01 g | 49241-93 | 1 |
| 10 | Graduated cylinder, Borosilicate, 100 ml | 36629-00 | 1 |
| 11 | Microscopic slides, 50 pcs | 64691-00 | 1 |
| 12 | Graduated pipette 10 ml | 36600-00 | 1 |
| 13 | Test tube rack for 12 tubes, holes d= 22 mm, wood | 37686-10 | 1 |
| 14 | Erlenmeyer flask, Duran®, narrow neck, 500 ml | 36121-00 | 2 |
| 15 | Test tube, 160 x 16 mm, 100 pcs | 37656-10 | 1 |
| 16 | Meat extract 10 g | 31521-03 | 1 |
| 17 | Peptone,dry,from meat 50 g | 31708-05 | 1 |
| 18 | Spatula, double blade, 150 mm | 33460-00 | 1 |
| 19 | Glass rod,boro 3.3,l=300mm, d=7mm | 40485-05 | 1 |
| 20 | Sterile stoppers f. id 15mm, 250 | 39266-00 | 1 |
| 21 | Sterile stoppers f. id 29mm, 100 | 39267-00 | 1 |
| 22 | Pipettor | 36592-00 | 1 |
| 23 | Autoclave with insert | 04431-93 | 1 |
| 24 | Heating + cooking hotplate,230V | 04025-93 | 1 |
| 25 | pH test sticks 6.5-10, 100 sticks | 30301-04 | 1 |
| 26 | Sodium hydroxide, pellets, 500 g | 30157-50 | 1 |
| 27 | Water, distilled 5 l | 31246-81 | 1 |
| 28 | Agar-agar, powdered 100 g | 31083-10 | 1 |
| 29 | Ethyl alcohol, absolute 500 ml | 30008-50 | 1 |



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## Additional Requirements

| Position | Art. Nr. | Bezeichnung |
|---|---|---|
| 1 | | Diverse objects |
| 2 | | Insects |


# Setup and Procedure



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# Setup and Procedure (1/4)

**Evidence of the presence of microorganisms in the air**
Evidence of the presence of microorganisms in the air that surrounds us can be provided by exposing sterile nutrient media in Petri dishes to an infection with microorganisms from the air and by incubating the plates afterwards. This method is particularly suitable for comparing the concentration of microorganisms in the air in different places, e.g. in the classroom, in a room that is only rarely used, next to a road with a lot of traffic, in a crowded leisure area, on a calm forest track, etc. Pour plates with standard nutrient agar for bacteria. After the solidification of the nutrient medium in the plates, place the open plates for approximately 30 minutes in the places to be examined in order to expose the nutrient agar to microorganisms that fall down from the air. During this time, the covers of the plates are placed in a slanted manner on the rim of their respective lower parts. Position at least two plates in every place that is to be examined in order to ascertain the results for the comparison of examinations of different places. After the intended time, close the dishes and incubate them at 30 °C in an incubator. For every series of experiments, one additional plate whose nutrient agar had not been exposed to microorganisms in the air must also be incubated in order to verify the sterility of the nutrient medium prior to the start of the experiment.

# Setup and Procedure (2/4)

**Evidence of the presence of microorganisms on objects of daily use**
Evidence concerning the presence of the microorganisms on objects of daily use can be provided by touching the sterile nutrient medium in Petri dishes against the objects and by incubating the plates afterwards. Interesting objects for examination are, for example, coins, bank notes, unused towels, various parts of the handset of a telephone, and door handles.
Pour plates with standard nutrient agar for bacteria (see P4140100). After the solidification of the nutrient medium in the dishes, touch its surface slightly against the object to be examined. In order to avoid an infection with microorganisms from the air when opening the dish, hold the cover of the plate so that it covers the lower part of the dish as completely as possible. Ensure that the inside of the plate and the nutrient agar come into contact only with the object to be examined and not with your fingers. Hold small objects, e.g. coins, with a pair of tweezers, but you must sterilise the tweezers beforehand. Close the plates and incubate them at 30 °C in the incubator. In order to verify the sterility of the nutrient medium prior to the experiment, incubate an additional, unused plate with the same nutrient agar for every series of experiments.



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## Setup and Procedure (3/4)

Perform experiment with clean and dirty hands to compare

**Evidence of the presence of microorganisms on human skin**
Evidence of the presence of microorganisms on human skin can be provided by touching the sterile nutrient media in Petri dishes with the tips of one's fingers and by incubating the plates afterwards. For comparison, the effectiveness of hygienic measures, e.g. washing one's hands, can also be demonstrated. Pour plates with standard nutrient agar for bacteria (see P4140100). After the solidification of the nutrient medium in the dishes, touch it slightly with several fingertips. Lift the cover of the plates only as much as absolutely necessary and hold it so that it covers the nutrient medium as completely as possible in order to prevent it from being contaminated with microorganisms from the air. Close the plate and incubate it at 30 °C in the incubator. In order to verify the sterility of the nutrient medium prior to the experiment, incubate an additional, unused plate with the same nutrient agar.

## Setup and Procedure (4/4)

**Evidence of the transfer of microorganisms by insects**
Evidence concerning the transfer of microorganisms by insects can be provided by bringing the sterile nutrient media in Petri dishes into contact with living insects and by incubating the plates afterwards. Pour plates with standard nutrient agar for bacteria (see P4140100). After the solidification of the nutrient medium, place a living insect, e.g. a housefly (Musca domestica) or blowfly (Calliphora erythrocephala) into the closed plate with a pair of tweezers. Ensure that any other infection of the nutrient medium except for by the insect is made impossible. After 5 minutes, let the insect escape by briefly lifting the cover. Then, incubate the plate at 30 °C in the incubator. In order to verify the sterility of the nutrient medium prior to the experiment, incubate an additional, unused plate.

Use live insects



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# Protocol

## Task 1

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Drag the words into the correct boxes

Microorganisms are [ ], i.e. they are present [ ] around us. Within two to three days, [ ] and/or fungal colonies develop on the nutrient media on [ ] sample that has been taken.
The [ ] of the unused control plate [ ] show any microbial development.

- everywhere
- nutrient agar
- should not
- bacterial
- ubiquitous
- every

Check



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## Task 2

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Which of the statements is correct?

- [ ] There are no bacteria on insects.
- [ ] The number of colonies depends on the concentration of microorganisms in the air at the sampling location.
- [ ] When 2 tests are carried out, one with hands that have been washed immediately before and one with unwashed hands, there are clear differences between the tests.

Check

## Task 3

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Why is agar used, instead of gelatine?

- Gelatine degrades when heated and does not solidify afterwards.
- Agar is porous and thus microorganisms can move through it.
- Unlike agar, gelatine can be processed by many microorganisms.
- Agar is derived from algae and is thus vegan.



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| Slide | Score/Total |
|---|---|
| Slide 18: Microorganisms | 0/6 |
| Slide 19: Bacteria | 0/2 |
| Slide 20: Agar-agar | 0/1 |

**Total Score** 0/9

Show solutions Retry



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