Instructions for

Experiment series
How does a researcher work on the example of yeast?

with or without

KNIFFELIX online experimentation platform
"Pizza Puzzle"
www.kniffelix.de

KINDERFORSCHER AN DER TUHH
www.kinderforscher.de

Nachwuchs campus
www.nachwuchscampus.de

Teacher's instructions for the "Yeast" series of experiments

Notes for understanding:

- Black text refers to suggestions of what you might say
- Red text marks the part of the experiment and provides information on the experimental setup and execution
- Blue text indicates comments, hints and possible answers from the young people
- Orange text indicates further or digital offers

Objectives of the teaching unit:

- Implement work instructions independently in small groups
- Introduce them to trying things out and thinking ahead with the help of the worksheet
- Get to know and carry out a series of experiments
- Getting to know the term "enzyme"
- Gain initial experience in working with microorganisms
- Encourage people to perceive, question and explore phenomena from everyday life

1. Introduction:

We eat baked goods almost every day. How are they actually made? And how did that come about? Let's take bread, for example: Originally, a porridge made of ground grain was baked with water on hot stones. Only flat breads were created: flatbreads. Which two inventions have changed bread baking decisively?

1. The construction of ovens, in which the dough is heated from all sides and baked evenly. (A physical/technical invention)

2. The discovery of raising agents such as yeast: If yeast is added to a grain-water porridge, a significantly looser, more flavorful bread is created than flatbread. (A Biological/Chemical Discovery)

What makes yeast in the dough "rise"? When a researcher wants to investigate a question in a laboratory, he/she often conducts a series of experiments. What is a series of experiments?

A series of experiments is several samples (experiments) that are all the same except for one change. This is an attempt to find out to what extent this one change influences the experiment.

However, be careful, many factors can influence a series of experiments! What is influenced by the choice of containers alone?

1. The shape (ratio of diameter to height) and size determine the possibility of exchange with the sample environment and/or how quickly gases can escape into samples, as well as whether and how contents can be mixed.

2. Whether it is a closed or open container determines whether e.g. anaerobic / aerobic test conditions are present (without or with oxygen).

3. The material (metal, ceramic, glass, wood) can cause interactions with the contents (e.g. silver & egg form silver sulfide and taste like spoiled eggs) or, depending on the surface condition (porous, smooth), lead to a different behavior of the processes in containers. Depending on whether the material is thermally conductive or insulating, tests can also vary greatly.

For example, what could a series of experiments to change the cocoa taste depending on the amount of cocoa powder used look like?

Example: You could fill 5 identical glasses with the same amount of the same type of milk. In the first glass, add a teaspoon of cocoa powder. In the second glass, put two spoonfuls of the same cocoa powder, and so on. In the fifth glass, put five spoonfuls of the same cocoa powder. Now stir each glass with its own spoon. In this experiment, of course, the taste test may be used as an exception!

Notes: The different spoons are necessary so that the more concentrated cocoa drink does not affect the less concentrated cacao drink. The same amount of the same type of milk is necessary so that the change in taste can really only come from the changed concentration of the cocoa powder.

In a series of experiments, a researcher systematically investigates a question. There must be a series of tests for each parameter. If several parameters are to be investigated, several series of tests must be carried out. We would like to carry out such a series of experiments today using yeast as an example.

What do you know about yeast? What foods do you know in which yeast is found?

Roast, pizza, cake, wheat beer, .

What is different about making yeast doughs compared to other doughs?

With fresh yeast you have to make a pre-dough, the dough has to be kept warm, he must have time to "walk".

Dough with track yeast is also warmed up for "rising".

How can we investigate what influences the "rising" of yeast dough? We want to try it out for ourselves. Considered in the implementation of the

Basic yeast experiment: How many parameters does the basic test have and how many test series does the basic test contain?

Answer: 2 parameters (temperature & with/without sugar) and 2 series of tests

2. Trials

As part of the Kniffelix mission **"Pizza Puzzle",** there are several attempts. The introductory experiment in **Pizza Mission 1** shows what distinguishes a dough with yeast from a dough without yeast. If there is little teaching time available, we recommend that you only carry out the **series of experiments from the basic experiment** (in **Pizza Mission 2 Part 2**), which examines which factors influence the rise of the yeast. In **Pizza Mission 4,** further series of experiments **with** yeast are encouraged. These will be discussed in more detail in the **additional series of experiments on the subject of yeast** in this teacher's manual. The Pizza Mission ends with a **pizza recipe** included in the accompanying material.

The materials required for the experiment **"Dough with and without yeast"** (Mission 1) per group can be found on the sheet "Basic Recipe for Yeast Dough", on which the implementation is also described.

Notes on the basic experiment: What causes yeast to rise? (Mission 2 Part 2):
(Duration : approx. 20-30 min. Notes on further experiments at the end of the debriefing.)

- You can find the material yourself using the list of materials, or if you teach in the Hamburg metropolitan region, you can also borrow it from KINDERFORSCHER AN DER TUHH. The order form and further information can be found on the website www.kinderforscher.de at "Experiment box rental". The material in the experiment box is sufficient for a whole class or for an experiment of six groups.
- Since each group needs at least 200 ml of cold, warm and hot water, there is a second experiment box with six thermos flasks (2x cold, 2x warm, 2x hot), labels for labeling and a kettle. This box is included in the scope of delivery, or the material must be procured by yourself.
- The experiment works all the better the colder the cold water is. Optimal is refrigerator cold (approx. 5° C). The warm water should be lukewarm (approx. 30°-35° C). The hot water does not have to be completely boiling hot (> 70° C is enough for the enzymes to deactivate).
- Please note: Be careful with the hot water!
- The young people can carry out the experiment very well on their own.
- In the end, there is a lot to rinse!
- **IF THE EXPERIMENT IS DIVIDED INTO TWO DAYS:**

  On the first day: Let the students do the experiment themselves in 6 groups. **On the second day:** Set up the experiment only once as a demonstration experiment, observe exactly how and where gas bubbles form and use the knowledge box.

Furthermore, there are endless possibilities to think about and test further series of experiments from this subject area, as already indicated at the end of the debriefing.

3. Debriefing: (see also solution to the basic test - included in the rental box 6x laminated)

- What observations did you make?
  - The best way to try is with warm water and sugar.
  - A weak reaction can be seen in warm water without sugar.
  - Depending on how cold the cold water is, there is no reaction or a very slight reaction in the glasses with cold water.
  - No reaction can be observed in hot water. The yeast dies (deactivated) at a temperature above 45° C and the enzymes contained are destroyed. Many creatures die in very hot or boiling water. This fact is used in hospitals when sterilizing surgical tools or syringes, but also when preserving food, e.g. when preserving jam or sterilizing canned food (fruit, vegetables, fish, etc.)
- What happens in the jar with warm water, yeast and sugar, or if yeast dough "goes"?

  When the dough "rises", **alcoholic fermentation** takes place. In the process**, sugar is converted into alcohol and the gas carbon dioxide**, which is finely distributed in the dough and can increase its volume considerably. You could smell the alcohol when you tried it! You also know carbon dioxide, it is the gas that we humans exhale. There is an illustration of this in the knowledge box.
- What can you conclude from this, what you have to consider when making yeast dough?
  - The water or milk should be warm, but definitely not too hot.
  - You should definitely add some sugar with the yeast (even if you want the dough to be salty), otherwise the dough won't rise well. Later, you can simply add a little more salt if necessary.
- What makes this experiment a series of experiments?
  - All lenses are the same in terms of material, shape and size.
  - There is the same amount of yeast in each jar from the same manufacturer and the same expiration date.
  - Each jar contains the same solvent water.
  - Where sugar was added, it was the same amount of the same type of sugar. (Alternatively, there would be fructose, lactose, honey, artificial sweeteners such as Natreen, ...)
  - Strictly speaking, this experiment includes two series of experiments. It is said to be a two-parameter attempt):

1. The temperature parameter: There are three glasses without sugar, which differ only in the temperature of the water. Here we can see that the change in temperature alone does not make the yeast "go".
2. The parameter with/without sugar: There are three glasses of sugar, which differ only in the temperature of the water.

We can see that there are two conditions for yeast to "go": heat and sugar (food). Therefore, we also need these two series of experiments. (Here one could now go on and on, both experimentally and theoretically: What further series of experiments would be possible? A temperature measurement series in which there is sugar in each glass and determines exactly what the optimal temperature is. Once this has been determined, the amount of sugar could be changed in small steps at this constant temperature, and it could be determined exactly how much sugar is optimal for the experiment. Various types of sugar such as fructose, sugar sugar, could be examined. Various solvents, and, and, and,.) **See the worksheet "Additional series of experiments on the subject of yeast" in the teaching material. This leaf may have to be duplicated and the necessary consumables, including the other yeast, must be obtained by yourself. The solutions are not always clear, so there is no solution sheet.**

Why use a different spoon for stirring each glass?

Otherwise, the sugar, or, measured precisely, the temperature, would pass from one glass to the other and thus falsify the series of experiments. (Here one could also go into the fact that tests can have different accuracy requirements. The pupils know this from mathematics: Is the way to school measured in cm? The body length in mm? Here we only wanted to determine which factaries make the yeast "rise". If you have more precise questions, you have to make sure that the same amount of water was used or even use distilled water. This experiment can also be carried out quantitatively and evaluated.) **On request, we have specially prepared experimental material from the NachwuchsCampus for the upper school or very interested middle school students. You can also find the material in the "Further yeast experiments" section in the "For educators" section of the Kniffelix website.**

4. Distribute the knowledge box only after the experiment, possibly to explain the experiment.

For interested young people: The "Pizza Puzzle Topic" on our hands-on website www.kniffelix.de. Perhaps an apprenticeship as a baker, as a biological-technical assistant or a degree in bioprocess engineering (bio- and chemical engineering) would be interesting for them (see knowledge box).

List of materials for the basic yeast test

(If you want to do the additional experiments, you will need more yeast and the material on the page "Teacher Instructions for the Additional Experiments on the Subject of Yeast")

You can find the material yourself using this list of materials, or in the Hamburg Metropolitan Region you can borrow it for an entire class or for an experiment of six groups from www.kinderforscher.de under "Experiment Box Rental" against invoice. You will then receive the "Yeast/Enzymes" box and the "Thermos" box.

1x Teacher's instructions for the "Yeast" series of experiments

25x experimental worksheets: "What makes yeast rise"
25x Knowledge Box: "Yeast and Enzymes"

Each of the six groups: (4-5 young people):

- 4-5 experimental worksheets
- 6 clear lenses
- 6 bowls for water baths
- 6 signs to label the lenses, self-adhesive or with tape
- 1 tablespoon for measuring sugar
- 6 teaspoons for stirring
- 6 packets of dry yeast (all the same company and expiration date)
- 3 tablespoons sugar

Provide centrally for everyone: (otherwise too many thermos flasks)

- Tesa Tape
- Approx. 1.5 litres of hot water, above 70° C (in two thermos flasks)
- Approx. 1.5 litres of lukewarm water, approx. 30° C (in two thermos flasks)
- Approx. 1.5 litres of water as cold as possible, approx. 5° C (in two thermos flasks)
- 6x laminated solution sheet for the basic yeast test
- Signs for thermos flask labeling:
  2x "hot water", 2x "warm water", 2x "cold water"

- Dishwashing liquid and kitchen towel for rinsing at the end

Red text = Still needs to be obtained, not in the supplied material!

Basic experiment: What causes yeast to rise?

Yeast dough for pizza or bread - sometimes it succeeds, sometimes it doesn't. But why? Taking a scientific approach to cooking and baking can not only lead to better cooking and baking results, but you can also have a lot of fun alone, with your class, with family or friends! If all materials like these are used and rinsed exclusively with food, the results can also be processed into pizza or bread in the kitchen. If containers with chemicals come together and are washed in a laboratory machine, this is no longer possible, as chemical residues could contaminate the food.

Task 1: Think about it and exchange ideas, what do you think makes yeast rise?

_____

_____

_____

Materials needed: 6 glasses, 6 bowls, 6 teaspoons, 1 tablespoon, 6 post-its, 6 packets Yeast (from the same manufacturer with the same expiration date), 3 tablespoons of sugar, approx. 100 ml each of very cold, warm (approx. 30°C) and hot/boiling (>70°C) water.

Experimental setup:

1. Place a glass in each bowl.

Glass 1: Yeast & Cold Water

Glass 2: Yeast & warm water

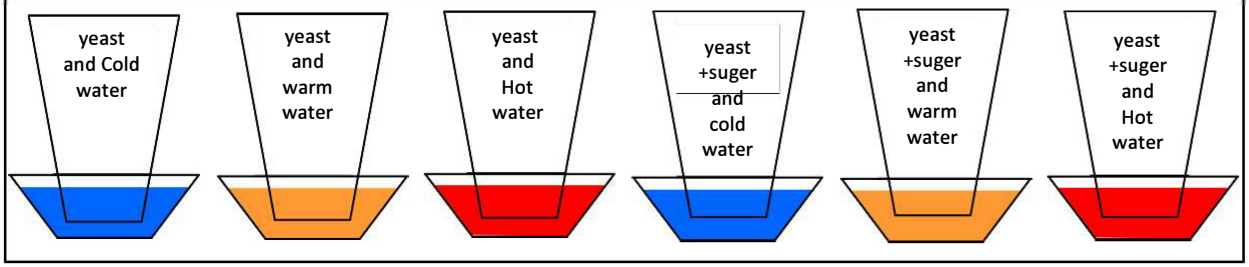
Glass 3: Yeast & hot water

Glass 4: Yeast & Cold Water & Sugar

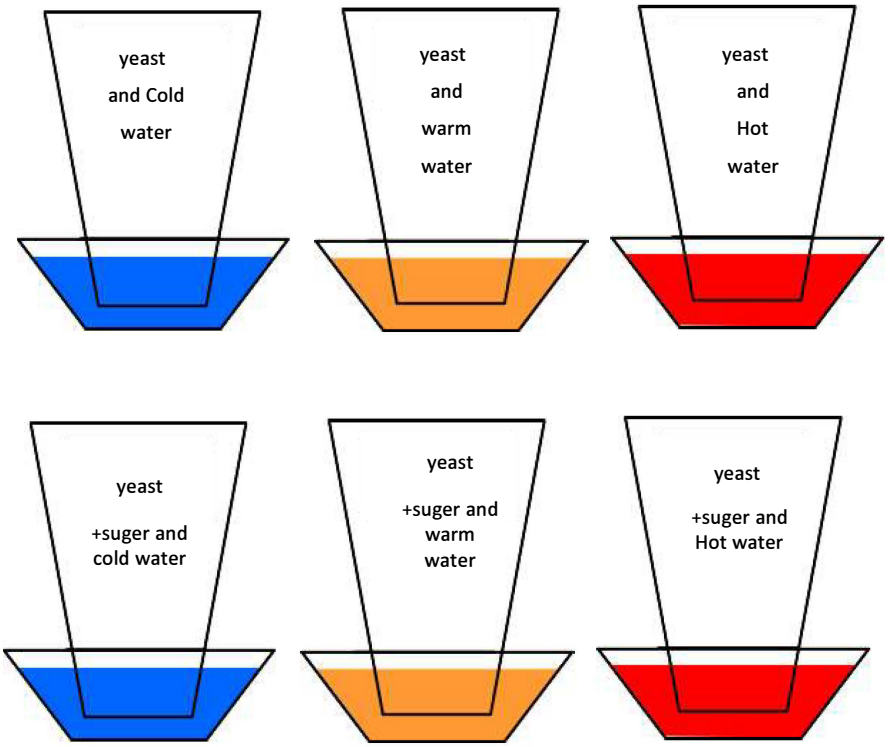
Glass 5: Yeast & Warm Water & Sugar

Glass 6: Yeast & Hot Water & Sugar

3. Put 1 packet of yeast in each jar.
4. In the jars that say "sugar," add a tablespoon of sugar.
5. Fill the glasses and bowls **halfway** with water at the specified temperature.
6. Stir each glass with its own spoon and then let the glasses stand still.
7. Watch the experiment for 5 minutes. Look closely. What happens in which glass? What does which glass smell like after 5 minutes? If you have the time, let the experiment sit longer while you work on the questions on the back.



2. What does the attempt look like after 5 minutes? (Complete the drawing)
Which glasses smell like what?
(Why is it permissible to smell this experiment? Which experiments should you generally not smell?)



3. Describe in words: What does yeast need to rise? What happens during the process?

4. What happens when the cold water gradually warms up and the hot water cools down?

5. From the freezer to the baked pizza: Where do the above observations play which role?

Are you interested in the topic? Take a look at the "Pizza Puzzle Topic" on our hands-on website www.kniffelix.de . Or maybe an apprenticeship as a baker, as a biological technical assistant or a bioprocess engineering degree (bio and chemical engineering) is something for you (see knowledge box)!

Basic experiment: What causes yeast to rise?

SOLUTION

Yeast dough for pizza or bread - sometimes it succeeds, sometimes it doesn't. But why? Taking a scientific approach to cooking and baking can not only lead to better cooking and baking results, but you can also have a lot of fun alone, with your class, with family or friends! If all materials like these are used and rinsed exclusively with food, the results can also be processed into pizza or bread in the kitchen. If containers with chemicals come together and are washed in a laboratory machine, this is no longer possible, as chemical residues could contaminate the food.

Task 1: Think about and exchange ideas, what do you think makes yeast rise? For the explanation, see the back page & knowledge box. Additional knowledge: Yeast is used to make bread, pretzels, cakes or other baked goods "rise". (Baking powder and baking soda are also "raising agents", but have a different effect and taste.) Yeast is used in beer production and is visible, for example, in cloudy wheat beer.

Materials needed: 6 glasses, 6 bowls, 6 teaspoons, 1 tablespoon, 6 post-its, 6 packets of yeast (from the same manufacturer with the same expiration date), 3 tablespoons of sugar, approx. 100 ml each of very cold, warm (approx. 30°C) and hot/boiling (>70°C) water.

Experimental setup:

1. Place a glass in each bowl.
2. Stick a piece of paper with its contents on each glass:

Glass 1: Yeast & cold Water

Glass 2: Yeast & Warm Water

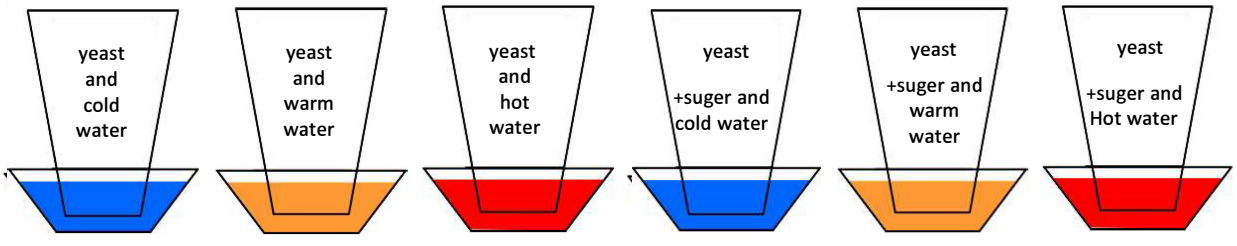
Glass 3: Yeast & Hot Water

Glass 4: Yeast & cold Water & Sugar

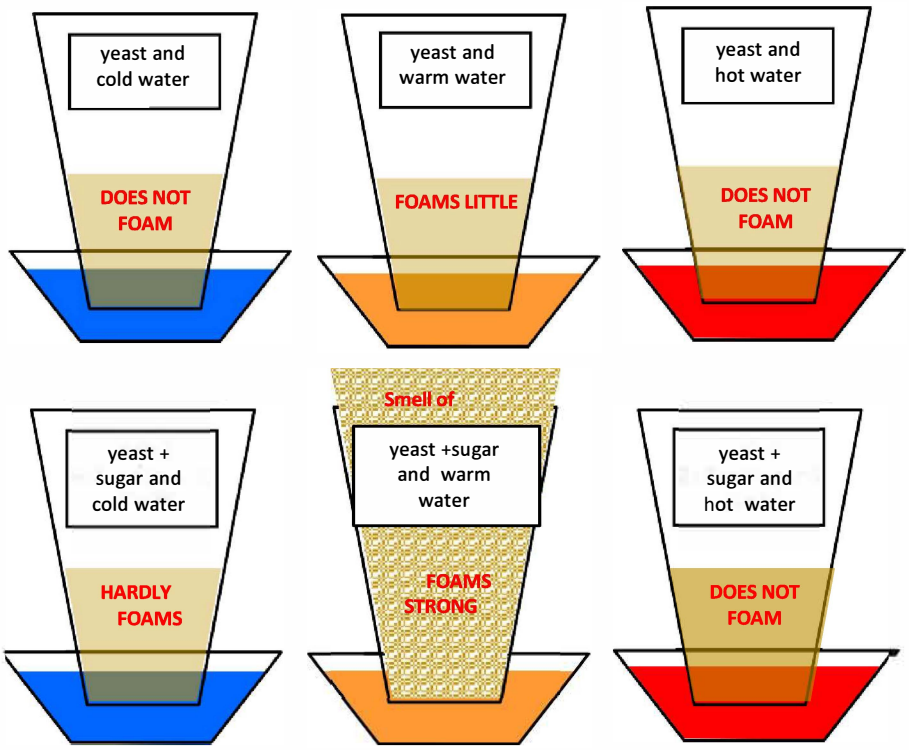
5 Glass: Yeast & Warm Water & Sugar

Glass 6: Yeast & Hot Water & Sugar

3. Put 1 packet of yeast in each jar.
4. In the jars that say "sugar," add a tablespoon of sugar.
5. Fill the glasses and bowls **halfway** with water at the specified temperature.
6. Stir each glass with its own spoon and then let the glasses stand still.
7. Watch the experiment for 5 minutes. Look closely. What happens in which glass? What does which glass smell like after 5 minutes? If you have the time, let the experiment sit longer while you work on the questions on the back.



2. **What does the attempt look like after 5 minutes? (Complete the drawing) Which glasses smell like what?**
   (Why is it permissible to smell this experiment? Which experiments should you generally not smell?)
   It is food. (DO NOT smell chemical experiments directly!)



3. **Describe in words: What does yeast need to rise? What happens during the process?**
   Yeast needs sugar and heat to rise.
   The sugar is broken down by the enzymes in the yeast into alcohol and the gas carbon dioxide (CO_2). The gas CO_2 formed causes the mixture to foam.
4. **What happens when the cold water gradually warms up and the hot water cools down?**
   When the cold water heats up with the sugar, the enzymes in the yeast begin to convert the sugar into alcohol and the gas carbon dioxide (CO_2) and the mixture begins to foam and rise.
   When the hot water cools down, nothing happens. The yeast is irreversibly killed by boiling water and is destroyed.
5. **From the freezer to the baked pizza: Where do the above observations play which role?**
   Yeast dough can be frozen or refrigerated. Then the yeast stops working or works very slowly. When the dough is heated, the yeast begins to work again as the heat increases. If the yeast is heated further and further, it is completely destroyed. It cannot be reactivated by anything. Baked pasta therefore does not rise further after baking. They retain their size and shape. (Heating pasta often makes it taste nice and fresh again, which has another explanation.)

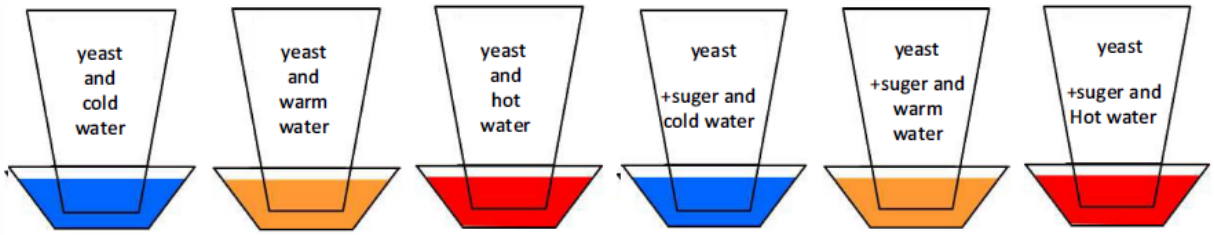
Knowledge Box: Yeast and Enzymes

We eat baked goods almost every day. How are they actually made? And how did that come about? Let's take bread, for example: Originally, a porridge made of ground grain was baked with water on hot stones. Only flat breads were created: flatbreads. Two inventions have changed bread baking decisively:

1. The construction of ovens, in which the dough is heated from all sides and baked evenly. (A physical-technical invention)
2. The discovery of raising agents such as yeast: If yeast is added to a grain-water porridge, a significantly looser, more flavorful bread is created than flatbread. (A Biological/Chemical Discovery)

What makes yeast in the dough "rise"? When a researcher is faced with a certain question, he usually tries to solve the problem with the help of an experimental series of experiments. He carries out several experiments under the same conditions. It changes only one condition per experiment and then observes and records the different results – just like you did in your yeast experiments!

In the series of experiments, you carried out on the subject of yeast, there was always the same amount of dry yeast in six jars of the same size.



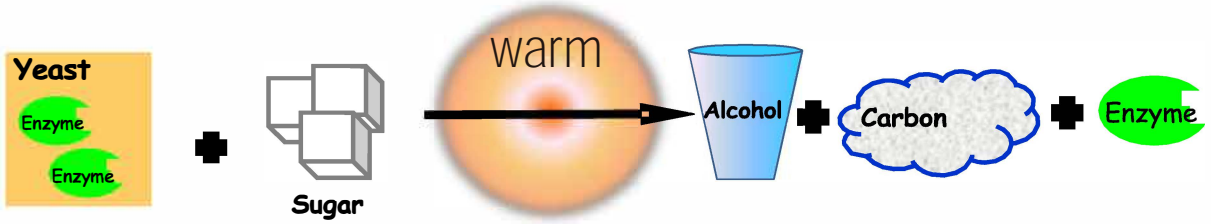
Three glasses of water were added to each, which differed only in temperature. There was no significant reaction in any of the three glasses. Three other glasses with the same experimental setup were now each added a teaspoon of sugar, i.e. only one condition was changed. In the glass with yeast, warm water and sugar, you could observe the strongest reaction. Through the direct comparison with the first experimental setup, you were now able to come to the conclusion that on the one hand the sugar and on the other hand the warm water must be responsible for this stronger reaction, because in the glasses with yeast, sugar and cold or hot water there were hardly any or no reactions to be observed in the same period.

What does the yeast actually do in the dough?

If you've ever made a yeast dough, you've probably noticed that the dough becomes very big if you let it rest for a while. But you must be careful: As you found out in the experiment, yeast only unfolds its "magical" powers under very specific conditions. The enzymes in the yeast are responsible for this.

These enzymes don't like cold, fat or salt at all, but when it's cozy and warm and they are mixed with sugar They are "fed", they can work best and the dough puffs up significantly. In baking, it is also said: The dough "rises".

The enzymes in the yeast break down the sugar into alcohol and carbon dioxide. Carbon dioxide is the gas we exhale. This fluffs up the dough of cakes, bread and rolls during baking and makes the pastries nice and fluffy, as the gas is finely distributed in the dough. The alcohol evaporates during baking.



What happens if a different solvent or sugar is used?

In the basic experiment, water was added to the yeast in all glasses. However, some recipes call for milk, cream or the addition of oil or butter. How does the yeast behave then? Repeat the experiment with the same amount of yeast, temperature and sugar added in all glasses, but vary the liquid in each glass: e.g. whole milk, low-fat milk, cream, oil, butter or water. Fill each glass to the same fill level and measure the foam height with a ruler during the experiment. Is it always the same?

Repeat the basic experiment with the same amount of yeast, temperature and water in all jars, but vary the type of sugar in each jar: e.g. table sugar, fructose, lactose, honey, sweetener, ... Fill each glass to the same fill level and measure the foam height with a ruler during the experiment. Is the foam height always the same?

Likewise, in further series of tests, it can be determined at what temperature the basic test works best or what the optimal amount of yeast is in the basic test.

Ideas, explanations and examples of what other young people have tried out can be found on our hands-on experiment website www.kniffelix.de under the "Pizza Puzzle Topic". The more "missions" you try, the more challenging the experiments and explanations become. In the information "For Educators", exactly these further yeast test series are described and explained. Do you enjoy this topic? Perhaps a degree in the "Bioprocess Engineering" or Chemical and Biological Engineering something for you? (See the last page of this knowledge box and the "career orientation" at www.kniffelix.de.)

What are enzymes?

Enzymes are something like special tools that serve to build up and break down substances in the cells of all living beings. The little helpers from nature are found in the tiniest bacteria, in plants, in animals and in humans. Each enzyme can only change a substance in a certain way, e.g. break it down at a certain point. Also, it can usually only change a certain substance. That's why it's structured in such a way that the substance fits the enzyme like the key to a lock. Since an enzyme is unchanged again at the end of its "work", it is not consumed and can be used for a very long time. Such a substance is called **a catalyst**. To give you a better idea of what enzymes do exactly, you will find some examples on the next page.

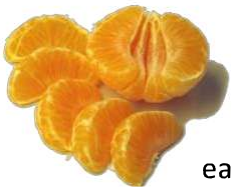
Other interesting everyday knowledge about enzymes:

What do enzymes do in detergents?

Grass stains on jeans, chocolate ice cream on your favorite shirt - this is clearly a case for the washing machine. But how do you clean the laundry there? In the washing machine, enzymes help to get stains out of clothes if the dirt is not easy to remove with water. Every detergent contains enzymes: These dissolve dirt such as egg, fat, milk, sauces or blood. In a chemical process, they split the dirt. Enzymes can be used to save energy because dirt is removed with their help even at low temperatures.

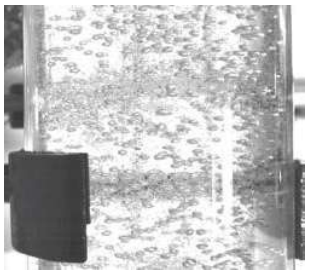
How do enzymes help in fruit processing?

Surely you know that you can make apple juice from apples by squeezing them. However, this can only be done with a lot of effort, and unfortunately the conventional presses also return a lot of solid apple components from the skin and pulp. But in order to get as much juice as possible out of the apples, add enzymes. The enzymes partially dissolve the apples, after which the apple is much easier to press and almost only the juice remains.



The capabilities of enzymes are also practical in the preparation of canned tangerines. If you peel off the peel of tangerines, a white skin still sticks to the flesh, which is very difficult to remove. But certain enzymes can! The enzymes "digest" this white skin, so to speak. After that, the tangerines look smooth and clean and can be preserved in the can. Pretty amazing what such an enzyme can do, isn't it?

At the Hamburg University of Technology (TUHH), researchers at the **Institute of Technical Biocatalysis** are looking for new ways to use enzymes. For example, they are working on processes for the production of skin cream additives. For this purpose, the researchers have developed a so-called bubble column reactor, which makes the use of potentially harmful solvents, e.g. in the production of cosmetics, superfluous. The reactor uses nitrogen or air to mix viscous compounds in cosmetics without destroying the enzymes involved as in conventional stirring processes. Other research topics include producing bioplastics from algae or new animal feed so that our groundwater is not contaminated with manure when fertilized.



On our Instagram account @mint_nachwuchscampus or on our homepage www.nachwuchscampus.de under "Career Orientation" you will find some video interviews with students in which they tell you personally what they are currently working on!

Teacher advice for the Additional series of experiments on the subject of yeast

In the teacher's materials there is a reproducible optional test sheet with further ideas for series of experiments with yeast. The experiments have not been worked out, but the young people are to transfer the experience they have gained in the implementation of the basic experiment to further series of experiments. Ideally, each group chooses a different topic.

If you have borrowed the experiment kit for the basic experiment from us, you only need the additional materials marked in red. Otherwise, here are a few aspects of the material composition: The reaction vessels should be identical within a series of experiments. In the "yeast/enzymes" box are 36 "Kölsch glasses". To quantify the reactions, the foam heights can be measured with a ruler or a ruler with tesa tape can be glued to each glass. Alternatively, test tubes with smaller quantities or measuring cylinders can be used if there are enough. In the case of these smaller test vessels, the tests must be tempered in water baths, as a large vessel surface relative to a small test volume leads to large distortions in the results.

List of materials for the additional series of experiments on the subject of yeast

RED TEXT = NOT IN BOX WITH THE BASIC EXPERIMENT, must be obtained by the teacher BLACK TEXT = material in the "Yeast/Enzymes" box or in the "Thermos" box Experiment 1: At what temperature does the yeast react best?

- Test material from the yeast experiment
- Yeast (6-12 packets)
- 6 thermometers
- Ruler

Experiment 2: How much sugar is necessary for an optimal reaction?

- Test material from the yeast experiment
- Yeast (6-12 packets)
- Ruler
- Scales for the amount of sugar
- additional sugar

Experiment 3: Which solvent is best suited for a reaction?

- Test material from the yeast experiment
- Yeast (6-12 packets)
- Ruler
- low-fat milk, whole milk, cream, melted butter and cooking oil (max. 500 ml per liquid), the difference between UHT milk and fresh milk could also be investigated
  (It is important that all these "solvents" have the same warm temperature)

Experiment 4: How much yeast should be used in the experiment?

- Test material from the yeast experiment
- Yeast (6-12 packets)
- Ruler
- Scale for the yeast quantities

Experiment 5: Which type of sugar is best suited for the reaction?

- Test material from the yeast experiment
- Yeast (6-12 packets)
- Ruler
- possibly scales, otherwise 1 teaspoon per species
  - **glucose** (glucose = simple sugar),
  - **white sugar** (sucrose = disaccharide of glucose and fructose),
  - **Lactose** (lactose = other disaccharide),
  - **Sprinkle sweetener** (sugar substitute/sweetener, sorbitol and saccharin)
  - **liquid sweetener** (sweetener/fructose mixture, see table of contents)

Experiment 6: Which type of yeast is best suited: fresh yeast or dry yeast?

- Test material from the yeast experiment
- Yeast (6-12 packets)
- Fresh yeast (3-6 cubes)
- Ruler

You and/or the young people can find ideas, explanations and examples of what other young people have tried out on our hands-on experiment website www.kniffelix.de under the "Pizza puzzle topic". The "missions" tell a "story" and gradually become more sophisticated in their explanations.

For high school students:
In the information "For Educators", it is precisely these further yeast test series and explained at upper school level.

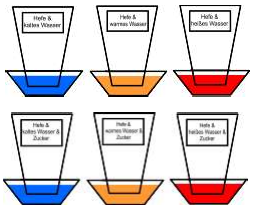
Do your students enjoy this topic? Perhaps a degree in bioprocess engineering or chemical and biological engineering would also be something for them? (Information can be found on the last page of the knowledge box, in the "Study and Career Orientation" at www.kniffelix.de, on our homepage www.nachwuchscampus.de at the "Career Orientation" and on our Instagram account for 14-25 year olds @mint_nachwuchscampus).

Additional series of experiments on the subject of yeast

THE MATERIAL IS NOT INCLUDED IN THE EXPERIMENT BOX & THERE IS NO SOLUTION

When researchers investigate something new, they set up a series of experiments. Only one parameter may change in each series of tests. In the experiment "What makes the yeast in the dough rise?" there are two parameters:

1. Temperature: cold, warm and hot
2. Composition: with or without sugar



Further series of tests are possible, in which either the parameters of the basic test are examined in more detail or other parameters. Different teams should each carry out one of the following series of experiments and present the results in writing, as well as in a suitable diagram if necessary:

1. **At what temperature does the yeast react best?**
   If there is a fixed amount of water, yeast and sugar, only the water temperature is changed, e.g. between 5°C and 75°C in 10°C increments. In a second series of experiments, the temperature range can be reduced and measured in 5°C steps, for example.
2. **How much sugar is necessary for an optimal reaction?**
   In the case of fixed water volume, water temperature (approx. 30°C) and yeast quantity, only the amount of sugar is varied.
3. **Which solvent is best suited for a reaction?**
   In the case of a fixed amount of water, yeast and sugar as well as liquid temperature, the solvent (previously always water) is varied. In addition to water, low-fat milk, whole milk, UHT milk, cream, melted butter and cooking oil can be compared. It is important that all these solvents have the same warm temperature (approx. 30°C).
4. **How much yeast should be used in the experiment?**
   With a fixed amount of water, water temperature (about 30°C) and sugar quantity, only the amount of yeast is varied.
5. **Which type of sugar is best suited for the reaction?**
   At a fixed amount of water, yeast and sugar as well as water temperature (approx. 30°C), the type of sugar is changed: glucose (glucose = simple sugar), **white sugar** (sucrose = disaccharide of glucose and fructose), **lactose** (lactose = other disaccharide), **sprinkle sweetener** (sugar substitute/sweetener sorbitol and saccharin) and **liquid sweetener** (sweetener/fructose mixture, see table of contents)
6. **Which type of yeast is best suited: fresh yeast or dry yeast?**
   At a fixed amount of water, yeast and sugar, as well as at three warm water temperatures (approx. 25°C, 30°C and 35-40°C), the type of yeast is changed. Half a cube of fresh yeast corresponds to about one packet of dry yeast.

The reaction vessels should be identical within a series of experiments. Foam height can be measured with a ruler to quantify the reaction. The narrower the reaction vessel, the better this succeeds. Alternatively, graduated cylinders can be used if there are enough. When using test tubes as vessels, they must be tempered in a water bath.

Basic recipe for yeast dough

You will need the following ingredients:

- 2x 150ml water
- 2x 300g flour
- 10g fresh yeast **OR**
- 1 packet dry yeast
- 1 tsp sugar

This is how you prepare the yeast dough:

1. Put warm water, yeast (in crumbs) and sugar in a container. Stir until the yeast has dissolved.

2. Now add half of the flour while stirring. Cover the dough and let it rest in a warm place for 30 minutes.

3. Now knead in the remaining flour. Then knead the whole dough well with your hands for about 5 minutes.

4. Cover the dough again and let it stand again for 30 minutes in a warm place.

Mix the dough again without yeast. What difference can you tell between a dough with yeast and one without yeast?

Pizza Recipe

You need the following ingredients for the dough:

- 300ml Water
- 600g flour
- 20g yeast
- 1 pinch Salt
- 2 tablespoons Oil

For the topping you still need:

- 1 can Tomato sauce
- Grated cheese
- Others Ingredients

First we follow the basic recipe for yeast dough again:

1. Put lukewarm water in a container and crumble the yeast into it. Stir until the yeast has dissolved.

2. Add most of the flour to the liquid. Start mixing the ingredients. Gradually add the remaining flour. Tip: Add another teaspoon of sugar to the dough, then it rises faster.

3. Knead the dough well with your hands for about 5 minutes. The warmth of your hands is good for the yeast and also helps it walk.

4. Cover the dough and let it sit in a warm place for 30 minutes. Tip: In winter, you can place the dough next to a heater. Make sure that the dough is not near a door. It can pull here.

This is how it continues:

1. When the dough has risen, add the salt and oil and stir in well.

2. Then knead the dough well for 5 minutes until it is soft and smooth. Tip: If the dough remains too firm, add a little lukewarm water. If it gets too soft and sticky, knead in some flour.

3. Cover the dough again and let it rise again for 30 minutes.

4. Knead the dough again before rolling it out.

Now you can top the pizza:

1. Roll out the dough with a rolling pin. Place baking paper on an oven tray and place the dough on top.

2. First, brush the dough with tomato sauce. Now you can top the pizza with other ingredients of your choice. Finally, sprinkle the cheese over the pizza.

3. Now the pizza just has to go into the oven. First, preheat it to 200 degrees (convection: 180 degrees). Then let the pizza bake for about 20 minutes.

Done! Enjoy it!