Nachwuchs campus

Instructions for

KNIFFELIX Online Experiment Platform with Pizza-Riddle

www.kniffelix.de

&

Experiment Box
How does a researcher work using yeast as an example?

(Can also be used without KNIFFELIX)

www.kinderforscher.de

TUHH
Technische Universität Hamburg

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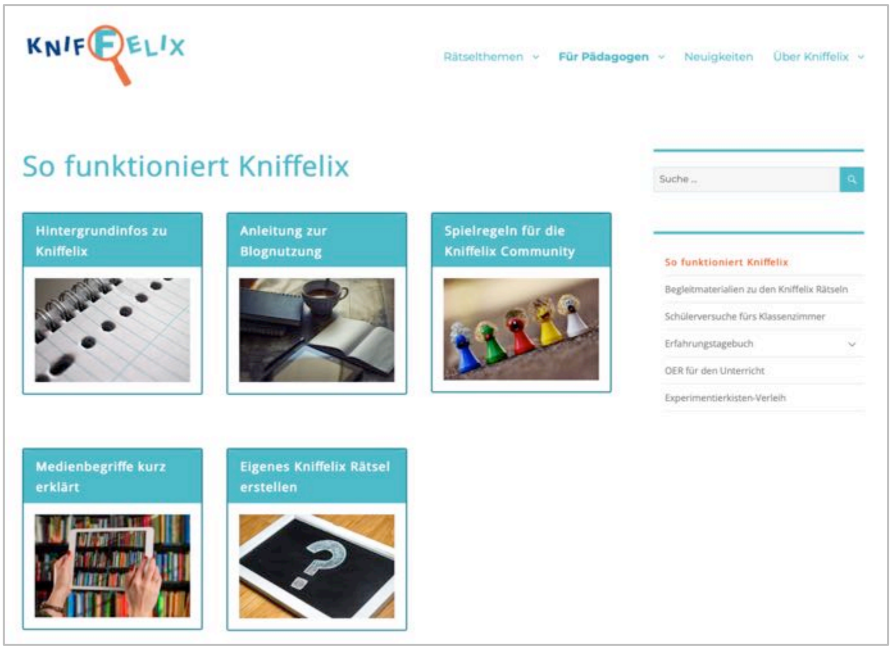
Introduction to the Kniffelix Platform

(Website can translate automatically, but videos & games in German)

With our hands-on experiment website Kniffelix, students can now report online on their experiment experiences in the KINDERFORSCHER course, repeat what they have learned, and deepen their knowledge in a playful way. At the same time, they acquire digital media skills such as responsibly dealing with other users and their own data on the Internet. The Kniffelix site strictly adheres to the German Youth Protection Law.

The Kniffelix website can be found at: www.kniffelix.de

Information about the Kniffelix offer can be found on the website page "How Kniffelix works" under the menu item "For educators". There you will also find the "How to use the blog", which explains how Kniffelix works.



Preparation for the course lesson:

If you use a KINDERFORSCHER experiment box without project participation, you can first do a pure experiment lesson with the box and in a separate lesson the Kniffelix riddle. Or, you can start with the Kniffelix riddle and let the pupils do the experiments as they appear in the riddle. You can display Kniffelix on a beamer or smartboard in the classroom, use a PC room, tablets or smartphones.

The schedule in KINDERFORSCHER projects is such that the Kniffelix lesson is preceded by an in-class lesson with the experiment that fits the Kniffelix riddle theme. In the Kniffelix lesson that follows, the students can then exchange their experiences within the Kniffelix online platform. It is advisable to take pictures of the student experiments (without people on them - see rules!). Pictures can (but do not have to) be uploaded to the Kniffelix website. These should be available to the students for the Kniffelix lesson (e.g. stored on USB sticks, tablets, smartphones or computers). It is great for students to be able to explore Kniffelix with their own devices (e.g. in the PC pool, their own smartphone, a tablet class set or at home).

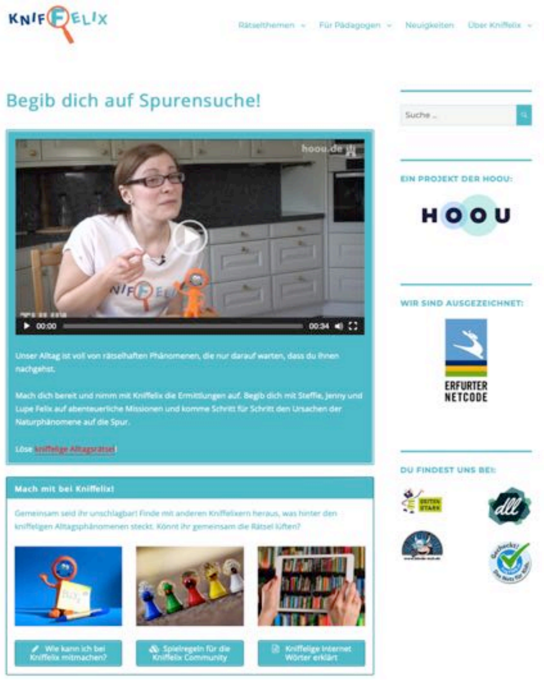
Most importantly, make sure that you have a stable connection to the Internet and that the website can be used without any problems!

Lesson design:

Module A: Media handling:
What is Kniffelix all about?

At the beginning of the course lesson, you can watch the welcome video on the start page with the children. This reveals what Kniffelix is all about.

On the website, below the welcome video, are buttons for the various topics followed by the "Join Kniffelix" box. Clicking on "How can I take part in Kniffelix?" opens a page with video instructions for Kniffelix. There you will find an explanation for pupils how the Kniffelix community works. Before the pupils get started in the community, you should address the "Rules for the Kniffelix Community". You can do this directly on the Kniffelix page or you can print out the German PDF in the educators' area (under "How Kniffelix works").



Module B: Sharing Experimental Experiences: The Kniffelix Community

Via the start-page buttons or menu item "riddle topics" you can get to the mission overviews of the individual riddles. We have the following suggestions for Kniffelix lesson design:

EXAMPLE-Riddle: (More topics exist)	**Pizza Riddle**	**Ketchup Riddle**	**Helicopter Riddle**	**Airplane Riddle**
Experiment box	How does a researcher work using the example of "yeast"?	Ketchup & Non-Newtonian liquids	Helicopter: From a model to a drawing	Why do airplanes fly? Center of gravity & flight behavior
Practice posting comments	Community Activity for Intro			
Uploading photos	Community Activity for Mission 2 (Job 2)	Community Activity for Mission 2	Community Activity for Mission 3	Community Activity for Mission 2 (Job 2)
Repeating lessons learned	Experiment explanation video & quizzes in Mission 3	Experiment explanation video & quizzes in Mission 3	Experiment explanation video & quizzes in Mission 1 (& 2)	Experiment explanation video & quizzes to Experiment in Mission 2 (Teil 1)
Completing lessons:	Community Activity for Mission 1, 3 & 5 (estimation questions, gap text, memory game)	Community Activity for Mission 1 & 3 (gap text, research assignment)	Community Activity for Mission 1 & 4 (Job 2) (leisure time reference, Memory)	Quizzes & Community Activity for Mission 2 & 3 (gap text, 2 quizzes)

Gradually, more riddle topics will be created at www.kniffelix.de, already, for example, an "Earth riddle" from the field of biology. You can choose a procedure like the one described here or simply just completely and chronologically do one riddle after the other. Riddles can of course be completed without writing comments or posting photos. All comments and photos will be checked by us for compliance with the rules of the game before publication.

If you have any questions, need support or if you want to give suggestions about Kniffelix you can also contact us at: 040-428784082 or gesine.liese@kinderfoscher.de

Teacher's Guide: How does a researcher work using the example of "yeast”?

Goals of the lesson:

- Independently implement work instructions in small groups
- Encourage experimentation and further thinking with the help of a worksheet
- Gain initial experience with setting up a series of experiments, the term "enzyme" and working with microorganisms
- Encourage students to perceive, question and explore everyday phenomena

NOTE ON KNIFFELIX: This experiment lesson can be conducted both as described in these instructions and as part of our free digital open-online experiment platform www.kniffelix.de If this experiment lesson is conducted first, have pupils take photos of the experiments without the pupils on them. On the digital experimentation website, pupils can then upload these photos and share their questions and observations with others if they want to.

1. Introduction:

- When a researcher works in a laboratory, he or she often makes a series of experiments. What is a series of experiments?
  A series of experiments is several experiments that are all the same except for one change. This is an attempt to find out to what extent this one change affects the experiment.

- For example, what could a series of experiments on the change in cocoa flavor depending on the amount of cocoa powder used look like?
  Example: You could fill 5 glasses with the same amount of the same types of milk. In the first glass you put one teaspoon of cocoa powder. In the second glass you put two spoonsful of the same cocoa powder, and so on. In the fifth glass put five spoonsful of the same cocoa powder. Now stir each glass with its own clean spoon. In this experiment, of course, the taste test may be used as an exception!

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

- In a series of experiments, a researcher systematically investigates a question. 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 that contain yeast?
  Bread, pizza, cake, hefeweizen beer, …

- What is different about making yeast dough from any other type of dough?
  The dough must be placed at a warm spot, and it must have time to "rise".

How can we investigate what influences the "rising" of yeast dough?
Let's try this out ourselves in a series of experiments like researchers.

2. **Experiment: The tables are prepared for six groups of 4-5 students each according to the material list.**

The pupils can perform the experiment on their own, but be careful with the hot water!

The experiment works better the colder the cold water is. Refrigerator cold (approx. 5° C) is optimal. The hot water should be at bathing temperature (approx. 35° C). The hot water does not have to be entirely boiling hot (about 80° C is enough for the enzymes to deactivate).

There are quite a few things to rinse afterwards. You can use a dishwasher since the experiments only contain edible materials.

IF THE EXPERIMENT IS DIVIDED ONTO TWO DAYS:
On the first day: Have 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 discuss with the help of the knowledge box. Furthermore, there are endless possibilities to create a series of further experiments from this topic. See the additional experiments on the supplementary worksheet. PLEASE NOTE: YOU MUST BUY THE SUPPLIES FOR THE SUPPLEMENTARY EXPERIMENTS YOURSELF.

3. Further discussion:

Which observations did you make?

- The experiment works best with warm water and sugar.
- Sometimes, a weak reaction can be seen in warm water without sugar.
- Depending on how cold the cold water is, no reaction or a very slight reaction is seen in the glasses with cold water.
- No reaction is seen in hot water. The yeast dies (deactivates) at a temperature above 45° C and the enzymes it contains are destroyed. Many living organisms die in very hot or boiling water. This fact is used in hospitals for sterilizing surgical tools or syringes, but also for preserving food, e.g. boiling down jam or sterilizing canned food (fruit, vegetables, fish, etc.).

What happens in the glass with warm water, yeast and sugar, or when yeast dough "rises"?
When the dough "rises", alcoholic fermentation takes place. Sugar is converted into alcohol

and carbon dioxide gas, which is finely distributed in the dough and can considerably increase its volume. You could smell the alcohol during the experiment! You are also familiar with carbon dioxide, the gas that we humans exhale. You will find more information in the knowledge box included in the material.

What can you conclude about what to consider when making yeast dough?

- The water or milk should be warm, but definitely not too hot.
- In any case, you should add a little sugar with the yeast (even if the dough is to be salty), otherwise the dough will not rise well. Later you can add a little more salt if necessary.

What makes this experiment to an experimental series?

- All glasses are the same.
- Each glass contains the same amount of yeast from the same company and same expiration date.
- The same solvent, water, is used in each glass.
- Strictly speaking, this experiment contains two series of experiments:
    1. There are three glasses without sugar, which differ only in the temperature of the water. Here we can see that the temperature change alone does not make the yeast "rise".
    2. There are three glasses with sugar, which differ only by the temperature of the water. Here we can see that there are two conditions for yeast to "rise": Heat and sugar. Therefore, we need both experiments.
    (Now one could go on and on here, both experimentally and theoretically: What other series of experiments would be possible? A series of temperature measurements in which there is sugar in each glass, and it is determined exactly what the optimum temperature is. Once this is determined, one could change the amount of sugar in small increments at this constant temperature and determine exactly how much sugar is optimal for the experiment. Different types of sugar such as fructose, cane sugar, ... could be studied. And, and, and, …)

Why should a different clean spoon be used for stirring in each glass?

- Otherwise, the sugar, or if measured very precisely, the temperature would pass from one glass to the other and falsify the series of experiments.
(Here, one could also address the fact that experiments can have different accuracy requirements. The students know this from mathematics: Is the way to school measured in cm? The body length in mm? Here we only wanted to determine which factors cause the yeast to "rise". If you have more precise questions, you also have to make sure, for example, that exactly the same amount of water was used or even that distilled water was used.)

4. Distribute the knowledge box after the experiment, possibly to explain the experiment. If there is still time left, the pupils can help clean up and wash up or you can discuss the knowledge box with the pupils.

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Material List for Teachers

How does a researcher work using yeast as an example?

Can be used with the “Pizza” topic on www.kniffelix.de

1 Box "How does a researcher work using yeast as an example?"

1 Box "Thermos jugs with electric kettle"

1x Teacher's manual with all documents in a folder

30x Kniffelix flyer for digital online program: www.kniffelix.de

25x Student worksheet: "Basic Experiment: When does yeast rise?"

1x Laminated solution to the student worksheet

25x Knowledge box: " Interesting Facts about Science, Yeast and Enzymes

Each of the six groups: (4 pupils):

4x student worksheets "Basic Experiment: When does yeast rise?"

6x clear glasses

6x bowls for under glasses

6x post-Its for labeling the glasses, self-adhesive or with clear tape

1x tablespoon for measuring sugar

6x clean teaspoons for stirring

6x packets of dry yeast from the same company and charge (expiration date)

1x container with sugar (at least 6 tablespoons)

Provide centrally for all: **(Groups should share the six supplied thermos water jugs and electric kettle)**

- clear tape
- Approx. 1.5 liters of hot water, min. 80° C (in thermos jug)
- Approx. 1.5 liters of warm water, approx. 35-45° C (in thermos jug)
- Approx. 1.5 liters of very cold water, approx. 5° C (in thermos jug)
- Detergent and towel for cleaning after experiments

Red text = Must still be prepared, not in supplied material!

Basic Experiment: When does yeast rise?

Yeast dough for pizza or bread - sometimes you´re successful, sometimes you´re not. 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 doing it alone, with your class, with family or friends! If all materials like these are used and rinsed with food only, the results can also be used in the kitchen to make pizza or bread. 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.

1. Discuss and note, what do you think is needed to make yeast rise?

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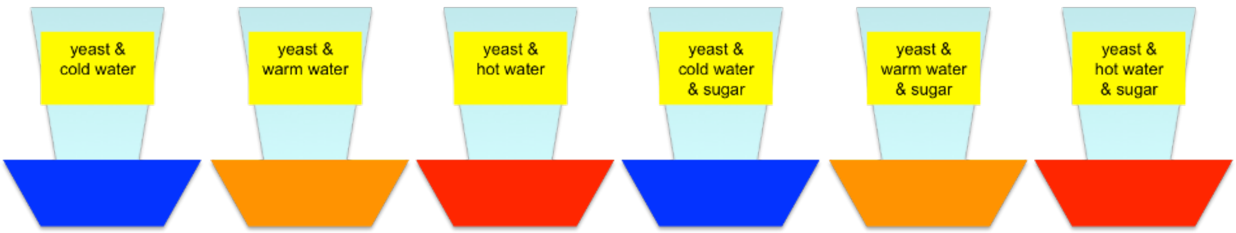
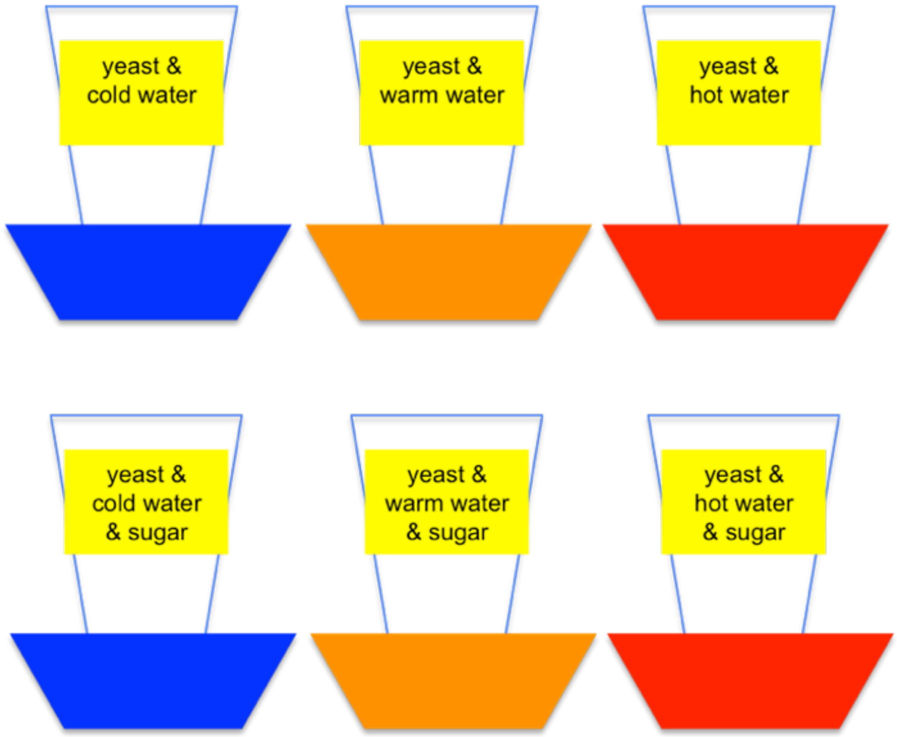
Material needed: 6 glasses, 6 bowls, 6 teaspoons, 1 tablespoon, 6 post-its, 6 packets dry yeast (from the same manufacturer with the same expiration date), 3 tablespoons sugar,
200 ml respectively of very cold, warm (ca. 35-40°C) und very hot (>80°C) water.

Experimental setup:

1. Place one glass in each bowl.
2. Attach a post-it note to each glass, noting the contents of each glass on the note:
   - **Glass 1:** Yeast & cold water
   - **Glass 2:** Yeast & warm water
   - **Glass 3:** Yeast & hot water
   - **Glass 4:** Yeast & sugar & cold water
   - **Glass 5:** Yeast & sugar & warm water
   - **Glass 6:** Yeast & sugar & hot water
3. Empty one packet of yeast into each glass.
4. Add one tablespoon of sugar to each glass where the note on the glass states “sugar”.
5. Fill each glass **half full** with water of the temperature noted on the glass.
6. Stir each glass with a separate clean spoon. Remove the spoon and let the glass rest.
7. Observe the experiment for 5 minutes. Watch precisely. What happens in which glass?
   How do the glasses smell after 5 minutes? If time allows, continue observing the glasses while answering the questions on the next page.



2. What does the experiment look like after 5 minutes? (Complete the drawing.)
Also note, which glass smells like what?
(Why may you smell this experiment? When should you not smell experiments?)



3. Describe in words: What does yeast need to rise? What reaction happens while yeast rises?

4. How does the experiment change when the cold water gets warmer?
How does the experiment change when the hot water cools down?
Why?

5. What happens to yeast dough in a freezer? ... in a refrigerator? ... on a warm radiator?
... in an oven at which temperature?

Are you interested in this topic? Take a look at the topic "Pizza" on our interactive website **www.kniffelix.de**
Or maybe an apprenticeship as a baker, as a biological technical assistant or a bioprocess engineering degree (at the TUHH: Chemical and bioprocess engineering) is something for you → **www.stuhhdium.de**
Check out the “Knowledge Box” for explanations and further applications of bioprocess engineering!

Teacher´s Guide and Supplemental Needed Material for Supplementary Experiments with Yeast

In the box you will find supplementary experiment sheets with further ideas for series of experiments with yeast. The experiments are not fully described, but instead the students are supposed to transfer their experience they gained with the yeast experiment series "Basic Experiment: When does yeast rise?" Maybe the pupils will have these ideas without this supplementary worksheet. Ideally, each group should choose a different topic to examine further.

RED TEXT = NOT IN BOX, must be provided by teacher

BLACK TEXT = Material in provided box

The reaction vessels should be identical within a series of experiments. The supplied "Kölsch glasses" are good, since they are cylindrical. The foam height can be measured with a ruler to assess the reaction. The narrower the reaction vessel, the more precise the measurement. Alternatively, test tubes with smaller quantities or graduated cylinders can be used if available. We have found that keeping a steady temperature is more difficult with test tubes and that these should be just as warm as the liquid used when filling the test tubes (set in tempered water baths).

Accurate scales would be desirable and may be available in the school collection.

To carry out ALL of the following experiments simultaneously, you need 12 further glasses.

1. **At which temperature does yeast rise best?**
   Material from basic yeast experiment
   Yeast (6-12 pouches)
   6 Thermometers
   Ruler at least 5 cm taller than glass
2. **What is the best amount of sugar?**
   Material from basic yeast experiment
   Extra sugar
   Yeast (6-12 pouches)
   Ruler at least 5 cm taller than glass
   Scale
3. **Which solvent is best for the reaction?**
   Material from basic yeast experiment
   Yeast (6-12 pouches)
   Ruler at least 5 cm taller than glass
   Skim milk, whole milk, melted liquid butter and vegetable oil (max. 500 ml of each liquid), furthermore differences between UHT-milk/fresh milk can be examined
   (It is important that all these "solvents" have the same warm temperature and are used either all pure.)
4. **How much yeast is best for the experiment?**
   Material from basic yeast experiment
   Yeast (6-12 pouches)
   Ruler at least 5 cm taller than glass
   Scale

(See other side of page)

5. **Which type of sugar is best for the reaction?**
   Material from basic yeast experiment
   Yeast (6-12 pouches)
   Ruler at least 5 cm taller than glass
   Scale
   1 teaspoon each of:
   Dextrose (glucose= single sugar), white sugar (sucrose, dual sugar from glucose and fructose), milk sugar (lactose, other dual sugar), sprinkle sweetener (sugar substitute/sweetener sorbitol and saccharin) and
   liquid sweetener (sweetener/fructose mixture).
6. **Which type of yeast is best: Fresh yeast or dry yeast?**
   Material from basic yeast experiment
   Yeast (6-12 pouches)
   Ruler at least 5 cm taller than glass
   Fresh yeast (3-6 cubes)

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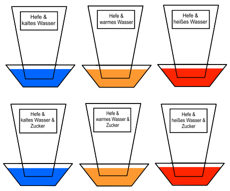
Further Yeast Experiments

When researchers investigate something new, they set up experimental series. For each series of experiments, one may only change one parameter. When trying out the “Basic Experiment: When does yeast rise?" There are two parameters

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



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

1. **At what temperature does yeast react best?**
   With fixed amounts of water, yeast and sugar, only the water temperature should be changed. This water temperature can vary between 5 and 80 ° C in 10 ° steps. In a second series of experiments, the temperature range can be reduced and for this purpose for example be measured in 5 ° steps.
2. **How much sugar is necessary for an ideal reaction?**
   With a fixed amount of water, water temperature (about 35 ° C) and amount of yeast, only the amount of sugar is varied.
3. **Which solvent is most suitable for the reaction?**
   With fixed amounts of water, yeast and sugar, as well as liquid temperature, the solvent (previously always water) is varied. In addition to water, fresh low-fat milk, fresh whole milk, liquid butter and cooking oil can be compared. It is important that all these solvents have the same warm temperature (about 35 ° C) and are used pure or in the same dilution.
4. **What amount of yeast should be used in the experiment?**
   With a fixed amount of water, water temperature (about 35 ° C) and amount of sugar only the amount of yeast is varied.
5. **Which type of sugar is most suitable for the reaction?**
   With fixed amounts of water, yeast and sugar as well as water temperature (about 35 ° C), the sugar type is changed: glucose (glucose = simple sugar), white sugar (sucrose, double sugar from glucose and fructose), lactose (lactose, other double sugar), sweeteners (sugar substitute / sweetener sorbitol and saccharin) and liquid sweetener (sweetener / fructose mixture).
6. **Which type of yeast is the most suitable: Fresh yeast or dry yeast?**
   With fixed amounts of water, yeast and sugar, as well as with three warm water temperatures (about 25 ° C, 30 ° C and 35-40 ° C), the yeast type is changed. In Germany: One packet of dry yeast is equivalent to half a cube of fresh yeast. Choose comparable amounts of fresh and dry yeast for in your country.

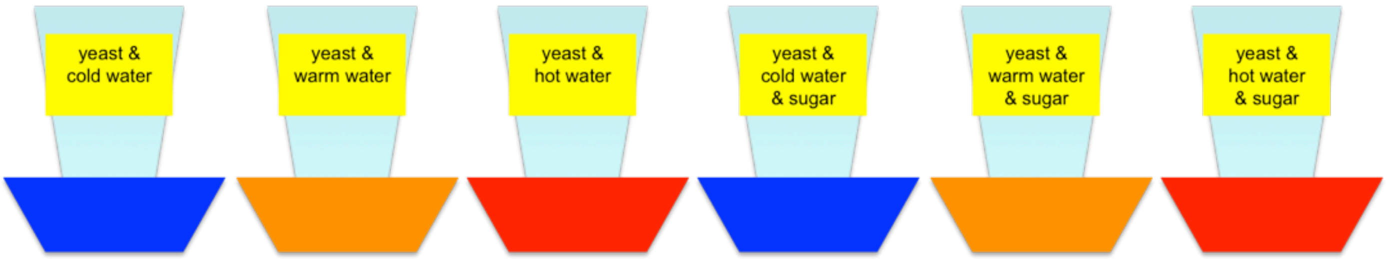
The reaction vessels should be identical within a series of experiments. The foam height can be measured with a ruler to assess the reaction. The narrower the reaction vessel, the better this is possible. Alternatively, graduated cylinders can be used if there are enough available.

Interesting Facts about Science, Yeast and Enzymes

Why do scientists run series of tests?

If a scientist is faced with a particular question, he usually tries to solve the problem using an experimental test series. The scientist conducts several experiments under the same conditions. He then changes only one of the conditions per experiment and observes precisely. During his experiments he writes down all of the different results and observations of each given experiment, just the way you did in your yeast experiments.

In the yeast experiments, the same amount of dry yeast was added to each of the six identical glasses.

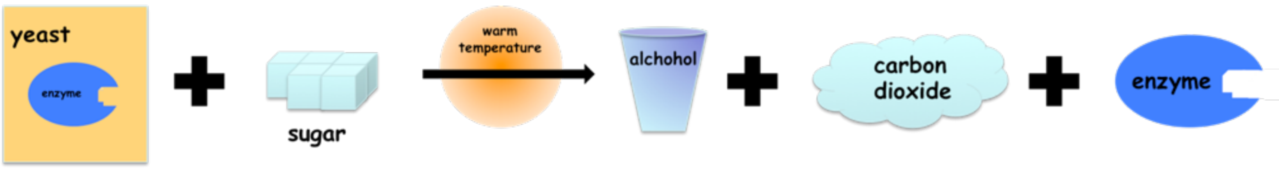


The first three glasses were all filled with the same amount of yeast and water. The only difference between the content of the glasses was the water temperature: cold, warm and hot. In none of these glasses a strong reaction took place. A teaspoon of sugar was added to each of the further three glasses with the same experimental setup otherwise. A strong reaction could only be observed in the glass with yeast, warm water and sugar. If the cold water wasn´t very cold, or the hot water was not hot enough, reactions could be observed there due to these reasons. No matter what the temperature, water alone does not let yeast rise. Yeast needs nourishment, for example sugar. Sugar alone does not let yeast rise, since neither in cold nor in hot water with sugar the yeast rose. Therefore, you have proven, that warm water and sugar are needed to make yeast rise.

What does yeast do in the dough? If you have ever made yeast dough yourself, you have surely noticed that the dough gets quite large if you let it rest in a warm place for a while. But, yeast dough doesn´t always rise well! The experiment has already proven, that yeast dough only rises under certain conditions. The enzymes in yeast are responsible for this. They are microscopic small biological catalysts.

Enzymes don´t like too cold or too hot temperatures, fats or salt. Therefore, yeast dough only rises if it is kept warm and yeast is fed with sugar (or starch as is found in wheat flour).

How do the enzymes in yeast let the dough rise? The enzymes divide the sugar molecule into two smaller molecules: alcohol and carbon dioxide gas. (You know carbon dioxide as the gas we breathe out.) The carbon dioxide gas distributes itself finely in the dough and fluffs the dough when baking cakes, pizza and bread. The alcohol evaporates during baking. Once the temperature of the dough rises above 65°C, the yeast dies and the dough stops rising. As dough bakes it stops rising, just as the yeast in our experiment did not rise in hot water.



What is an enzyme? Enzymes are like special tools that are used in the cells of all living beings to assemble and disassemble molecules. These little helpers from nature occur in the tiniest bacteria, in plants, in animals, in yeast and in humans. Each enzyme can change a substance only in one specific manner, for example split a molecule at one specific location.

Enzymes usually can only change one type of substance. The enzyme fits to the substance in the same way as a key fits to a lock. Enzymes do not change as they are "working", so they do not get used up and can be used over and over again. Such a substance is called a "catalyst". We use enzymes in many products every day! Here are some examples:

How do enzymes in detergents work? Grass stains on jeans, chocolate ice cream on your favorite shirt - this is clearly a case for detergents in a washing machine. But how do detergents help get things clean? Enzymes in detergents help to get the stains out of your clothes, if the dirt is not easily removed by water. Each detergent contains various enzymes. Some loosen the stains coming from eggs, some from fat, milk, sauces or blood. In a chemical process, the enzymes cling to the dirt and help in saving energy by removing these stains at low temperatures. Washing clothes at high temperatures nowadays isn´t good, because heat kills most enzymes. Clothes shouldn´t be washed warmer than at 60°C.

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How do enzymes help in processing fruit? Surely you know that you can make apple juice from apples when you squeeze them. This will only work with a lot of effort. Unfortunately, the solid constituents (pulp) from the apple peel remain back in conventional presses. If you want to get as much juice as possible from apples then add enzymes! The enzymes partially dissolve apple-pulp, which makes it easier to squeeze the apples.

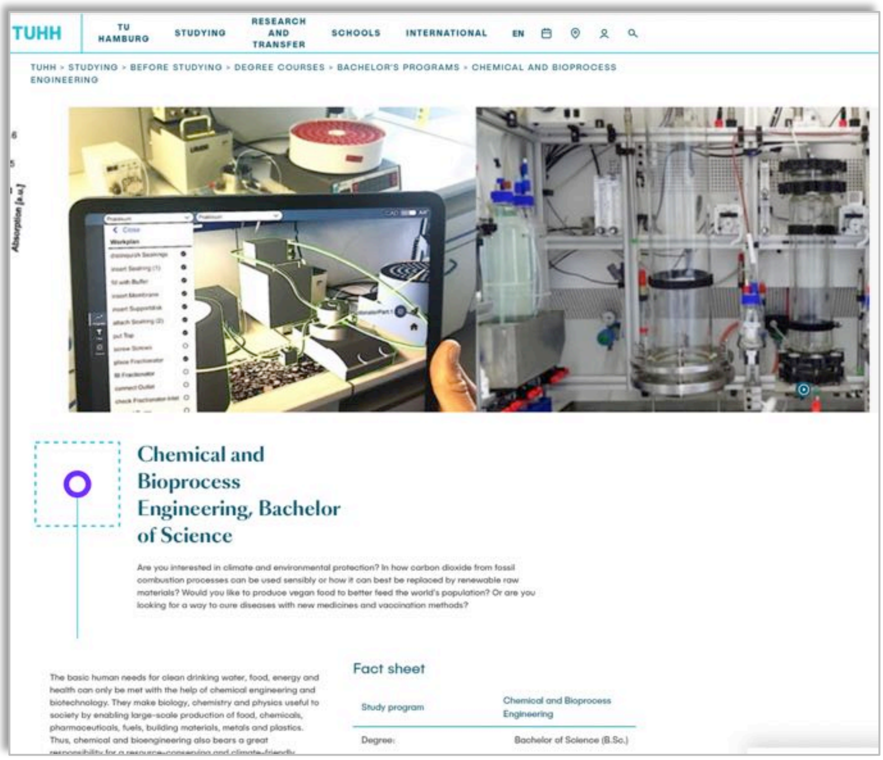
When you try to peel mandarin oranges, a white skin adheres to the segments, which is difficult to completely remove. Certain enzymes can do that job perfectly! The enzymes “digest” the white skin of mandarin oranges and make them smooth as well as easy to preserve in cans.

Aren´t enzymes amazing?!

At the Hamburg University of Technology (TUHH) you can study Chemical and Bioprocess Engineering. If you want to find out more, read the reverse side of this page and check out

https://www.tuhh.de/tuhh/studium/vor-dem-studium/studienangebot/bachelorstudiengaenge/chemie-und-bioingenieurwesen.html

and click on “EN” for English.



At the Hamburg University of Technology (TUHH) researchers at the **Institute of Technical Biocatalysis (ITB)** are always looking for new possibilities for using enzymes to improve our world.





As stated before, enzymes are added to detergents where they disassemble dirt particles into smaller, more dissolvable molecules. Clothes can therefore be washed at lower temperatures, saving a lot of energy worldwide. Recall from your biology class: How do enzymes act in the digestion process in the intestine? Enzymes break down molecules!

One researcher at the institute is working on a process for the production of skin cream additives. This new process is currently being tested by a large company.

The researchers have also developed a bubble column reactor, which will perhaps soon eliminate the use of potentially harmful solvents in the manufacture of cosmetics. The reactor mixes its contents by passing gas (such as nitrogen) through the viscous liquid it contains. This bubble column reactor is used when manufacturing cosmetics, so that the enzymes involved are not destroyed in the same way as with the conventional stirring procedures.

Other researchers are working on methods to produce precursors of drugs to lower the blood pressure or are trying to make enzymes more stable, so that they can be used in acids or caustic solutions, as well as at high or low temperatures. Probably, there will be a day, when yeast dough no longer needs to rest at a warm place and can be baked immediately!

Visit the website of the institute with a video giving insight into the research done at the institute: https://www2.tuhh.de/itb