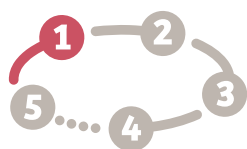


IBSE (Inquiry-Based Science Education)

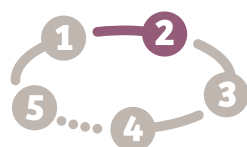
IBSE focuses on inquiry as the core of science, combining the learning of key concepts with the methods of scientific research. It emphasizes active learning, where students engage in experiments, problem-solving, and critical thinking, guided by teachers who act as facilitators. The approach mirrors the real scientific process, encouraging students to formulate their own research questions and take responsibility for their learning, ultimately fostering deeper understanding, self-reliance, and skills for solving real-world problems.

Teaching according to IBSE can be divided into five basic steps:



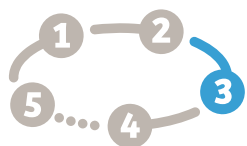
1. MOTIVATION, POSING QUESTIONS, FINDING INFORMATION

In this first step, it is important to engage students and start a train of thought, such as "why it is like that?" or "what if..." in a student's mind. If the student develops an intrinsic motivation to investigate a topic, their interest in learning increases.



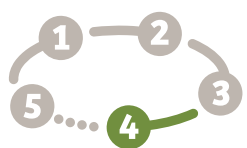
2. PREDICTING – HYPOTHESIS

Based upon a clearly formulated research hypothesis, a suitable research method can be selected. Likewise, students' experiments or observations should confirm or reject a hypothesis. Thus the original research question is addressed through accepting or rejecting the hypothesis. While the scientific term "hypothesis" may be paraphrased by words such as **assumption, prediction, result-estimation** or in another way appropriate to students' age, the process which leads to a research method based upon an assumption is key to understanding "how science is made".



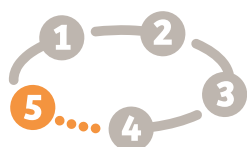
3. EXPERIMENT – PLANNING, PREPARING AND CONDUCTING AN EXPERIMENT, OBSERVATION AND RECORDING

A hypothesis can be verified by the study of information about the topic, consultation with an expert who should provide understandable and verifiable evidence rather than just an expert opinion, by observation or by experiment.



4. RETURN TO HYPOTHESIS, CONCLUSION, PRESENTATION, CONTEXT-FINDING, NEW QUESTIONS

The last steps complete a research cycle, but can also be the beginning of a further inquiry process. The important part of these steps is an evaluation of the inquiry and assessing whether the assumption was proven. What new questions and doubts appear during the inquiry? How can I or other people use the obtained results and knowledge in real life? How will others learn about the inquiry? How can I present information about the inquiry in an interesting and clear way?



5. ACTIONS USING THE OBTAINED RESULTS

The **optional** fifth step leads to problem-solving and active efforts to improve the situation—whether it's the local environment where students are conducting their research or another issue they've encountered. It's important to naturally motivate students to use their findings for active engagement, such as presenting them to environmental protection authorities or their classmates, organizing a campaign, or otherwise contributing to the solution of the problem they've researched.

Recommendations on how to start with Inquiry-Based Science Education

- a) Open communication
Development of IBSE is limited by many conditions, determined by each school, class, student or teacher. Therefore, it is important to set up a safe environment in the class where open communication and respect for others prevails and where students feel safe and comfortable. It is very difficult to apply IBSE in a class where students do not trust each other or their teacher, where they are afraid to communicate and to share their opinion.
- b) Cooperation prevails over competition
In IBSE, an atmosphere of cooperation, rather than of a competition, should be supported. The aim is not to get the correct result for an experiment as quickly as possible, but to have one's own method and achieve a result, which can differ from the results of others. What is important is to realize that the goal is to develop all students' skills, not only the skill of the fastest and most competent ones.
- c) Tools and equipment – keep it simple
IBSE certainly requires some supportive equipment and sometimes technical devices. However, IBSE can be applied even without expensive equipment such as microscopes or pH meters. In many lessons, plastic bottles, scissors and a ruler are sufficient.
- d) Do not give answers to all the questions
The principle of IBSE is not to reply to all questions posed by students (even if the teacher knows the answers). Instead it aims at motivating students to search for answers individually by asking parents, through their own research and experiments, through literature reviews in books or on the Internet. In a proper inquiry lesson, students get interested in many new questions and their motivation to find the answers increases. Continuing the quest for the answers outside the school with parents, friends or on their own strengthens particularly the self-reliance and confidence to address scientific questions. In this way, the interest in the topic is kept high and students look forward to future lessons.
- e) Teachers act as researchers
Teaching IBSE in class certainly places considerable demands on the teacher. They should be able to turn into a researcher themselves, to pose questions, to investigate and be enthusiastic about students' discoveries. IBSE is based on instigation of students' natural curiosity and on the development of their creativity and fantasy. IBSE is skill- and competence-oriented, thus an output approach should be used rather than an input-oriented approach such as lectures. Integrating IBSE into the curriculum and thereby utilizing the motivational potential of the approach therefore poses a particular challenge. IBSE should not be perceived as just another method as part of the curriculum.



How to start with IBSE – tips from teachers:

1. Alternate IBSE and common (regular) teaching practices.
2. Choose diverse lessons (e.g. do not to have two lessons focused on reading in a row).
3. Adapt lessons to the needs and aims of teaching and to the age of your students.
4. Start with individual inquiry steps. Thanks to gradual training, students master inquiry skills step-by-step and thus focus better on topics with which they are working for the first time.
5. Swap experiences with your colleagues. It is very helpful if multiple teachers use IBSE at one school so that they can discuss the progress of their approaches, results and obstacles that they have encountered.

Texts used mostly from: https://mass4education.gridw.pl/images/final_version/WG2/WG2_Tutorial_EN.pdf
More about the project MASS: Motivate and Attract Students to Science <https://mass4education.gridw.pl/>
(materials also in other languages).