2. COMPETENCE: EXPERIMENTATION

The Bachelor of Science conducts experiments within the Applied Science domain in order to obtain demonstrably reliable results.

	Level I	Level II	Level III	Level IV
	The student *conducts an experiment according to the approach/ protocol provided and obtains replicable results.* He demonstrates this by:	The student *chooses a protocol/approach, adjusts it if necessary, implements it and obtains reproducible and reliable results.* He demonstrates this by:	The student *sets up experiments under supervision and conducts them unsupervised in a systematic way and obtains reproducible and reliable results.* He demonstrates this by:	Experienced professional (see description of competence above). He demonstrates this by:
a. Objective and design	Explaining the objective of the experiment.	Choosing an approach and explaining why it is a suitable way of achieving the objective.	Formulating, without assistance, an approach to achieving the objective of the experiment.	Translating a research question into objectives by means of a suitable experimental design.
b. Methods and techniques (conceptual)	Explaining the principle of the method and technique provided.	Having sufficient knowledge and understanding of available methods and techniques to assess their suitability and choose the right equipment and/or device settings.	Choosing or developing suitable methods and techniques and anticipating possible experimental problems.	Demonstrating such knowledge, insight and skill as makes it possible to carry out the work in a responsible, safe and critical way using the correct methods, techniques and equipment.
c. Equipment/ setups/ instruments/ hardware and software* (use)	Becoming proficient in the correct handling of the equipment.	Becoming so skilled in operating the available equipment that adjusting the settings leads to desired effects.	Being capable of learning independently about the possibilities and limitations of the equipment to be used in order to recognise experimental problems and be able to act accordingly.	Being capable of learning about the possibilities and limitations of the equipment in order to be able to deal with experimental problems.
d. Preparation and implementation	Properly preparing an experiment on the basis of a protocol/approach provided, conducting it and obtaining replicable results within the specified time and maintaining accurate and clear documentation.	Preparing a schedule for implementing a protocol/ approach, conducting the experiment and obtaining reproducible results within the specified time and maintaining accurate and clear documentation.	Preparing a schedule for a number of experiments, conducting them and obtaining reproducible results within the specified time and maintaining accurate and clear documentation.	Drawing up and implementing work instructions so that demonstrably reliable and reproducible results can be obtained and maintaining accurate and clear documentation.
e. Health, safety, environment (HSE) and sustainability	Working according to HSE standards and taking ethical and sustainability standards into account when preparing and conducting the experiment.	Assessing whether the approach can be implemented according to HSE, ethical and sustainability standards.	Assessing the approach and adapting it if necessary in accordance with HSE, ethical and sustainability standards.	Designing an approach in accordance with HSE, ethical and sustainability standards, assuming responsibility for the local environment.
f. Reliability of results	Processing measurement results properly and correctly and estimating whether a result obtained is realistic.	Assessing the reliability of a result on the basis of an (e.g. statistical) analysis provided.	Choosing a statistical or other analysis for assessing the reliability and validity of the result obtained.	Using (statistical) techniques to process/validate the results and ensure their quality.
g. Critical review	Giving reasons to establish whether the approach to the experiment has been followed correctly.	Giving reasons to establish whether the approach to the experiment requires improvement.	Making proposals, where necessary, to improve the approach and propose additional experiments.	Taking a decision on the follow-up, based on the results.

* Where 'equipment' is mentioned in the level descriptions, this can be read as including setups/instruments/hardware and software.

Definitions Competence Experimentation (page 81)

- Where **documentation** is mentioned, this can also be read as: 'lab journal, logbook, technical manual or any other type of documentation used in the professional field'.
- Where **experiment** is mentioned, this can also be read as 'analysis'.
- Here, **replicability** means that the experiment produces the same results if it is carried out again by the same person under as equal conditions as possible.
- Here, **reproducibility** means that the experiment produces the same results if it is carried out again by another person under as equal conditions as possible.
- The **reliability** of the results can be derived from statistical calculations, but also from other calculations, literature or additional experiments.

Definitions Competence Development (page 83)

- **Developing** can also be 'designing', 'improving', 'optimising' or 'up- or downscaling' a process.
- We call it a **process** when a 'component' undergoes a treatment in a 'device' or other item of equipment, e.g. a distillation column, a reactor or a heat exchanger.
- An **instrument** is a 'device' or other item of equipment that has a physical, chemical or biological function, e.g. a magnet, an analytical instrument or a booster.
- A **component** is a material or intermediate product that undergoes a process.
- A situation is **complex** as a result of a large number of concepts, a significant correlation between concepts or a correlation with another discipline.
- **Or** is the 'inclusive or', that is 'and/or'.
- **Discipline-specific** is an adjective used within the context of Applied Science, e.g. relating to chemistry, physics, biology, engineering.
- A **discipline-specific concept** is a subject from the discipline for which a theory or models have been described, e.g. reaction kinetics (chemistry), distillation (physics), increase of biomass (biology) or electromagnetism (engineering).
- A **discipline-specific model** is a model of a discipline-specific concept or a combination thereof.
- **Discipline-specific feasibility** is feasibility in terms of chemistry, physics, biology or engineering, but not economic feasibility. Economic feasibility is defined separately.
- The **result** is the developed product, process, instrument or material or the scaled process.
- The **development** is the entire process undergone to achieve the result.