Diploma Programme

IB sciences experimentation guidelines

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IB mission statement

The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.

To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.

These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.

IB learner profile

The aim of all IB programmes is to develop internationally minded people who, recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world.

As IB learners we strive to be:

INQUIRERS
We nurture our curiosity, developing skills for inquiry and research. We know how to learn independently and with others. We learn with enthusiasm and sustain our love of learning throughout life.

KNOWLEDGEABLE
We develop and use conceptual understanding, exploring knowledge across a range of disciplines. We engage with issues and ideas that have local and global significance.

THINKERS
We use critical and creative thinking skills to analyse and take responsible action on complex problems. We exercise initiative in making reasoned, ethical decisions.

COMMUNICATORS
We express ourselves confidently and creatively in more than one language and in many ways. We collaborate effectively, listening carefully to the perspectives of other individuals and groups.

PRINCIPLED
We act with integrity and honesty, with a strong sense of fairness and justice, and with respect for the dignity and rights of people everywhere. We take responsibility for our actions and their consequences.

OPEN-MINDED
We critically appreciate our own cultures and personal histories, as well as the values and traditions of others. We seek and evaluate a range of points of view, and we are willing to grow from the experience.

CARING
We show empathy, compassion and respect. We have a commitment to service, and we act to make a positive difference in the lives of others and in the world around us.

RISK-TAKERS
We approach uncertainty with forethought and determination; we work independently and cooperatively to explore new ideas and innovative strategies. We are resourceful and resilient in the face of challenges and change.

BALANCED
We understand the importance of balancing different aspects of our lives—intellectual, physical, and emotional—to achieve well-being for ourselves and others. We recognize our interdependence with other people and with the world in which we live.

REFLECTIVE
We thoughtfully consider the world and our own ideas and experience. We work to understand our strengths and weaknesses in order to support our learning and personal development.

The IB learner profile represents 10 attributes valued by IB World Schools. We believe these attributes, and others like them, can help individuals and groups become responsible members of local, national and global communities.

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Safe and ethical experiments

Purpose

The International Baccalaureate (IB) endorses safe and ethical behaviour in science experiments. This document is a summary of guidelines for all staff involved in organizing, supervising or delivering science experiments. The guidelines apply to all IB science-related experiments in IB World Schools, whether assessed or non-assessed, staged, in classrooms, laboratories or any other locations. It is recommended that all students undertaking science experiments are made familiar with the contents of this document. If available, local or national regulations should also be adhered to.

Practical work and fieldwork in schools reinforce concepts and processes, teaching practical skills and techniques. The purpose of experimentation is to advance the learning of an individual student rather than generate new scientific knowledge. No one should be at risk of injury or other health issues, and no harm should be caused to other life forms.

The guidelines in this document are based upon the principles of replacement, refinement and reduction. Experimentation involving animals should consider:

- **replacement** of the animals by using cells, plants or computer simulations
- **refinement** to the experiment to alleviate any harm or distress to the animal
- **reduction** in the numbers of animals involved.

Examiners who suspect these guidelines have not been observed are required to inform the Assessment Division in the IB Education Office.

Animal behaviour experiments

Any planned experimentation involving animals must be approved by the supervising teacher following discussions with the student(s). Furthermore, the following points apply.

- Experiments involving animals must be based on observing and measuring aspects of natural animal behaviour. This should be within the range of environments to which the animal would naturally be exposed.
- Experimentation should not compromise the health of an animal (vertebrate or invertebrate) in any way. This includes pain or undue physiological stress beyond that which would be expected within its natural habitat.
- Any animal removed from its natural habitat, for example for choice chamber experiments, must be safely returned unharmed and within a suitable time frame.
- Experiments that administer drugs or medicines or that manipulate the environment or diet beyond that of the natural tolerance range of the animal are not acceptable.
- Animals must never be deliberately euthanized for the sole purpose of an experiment.

Animal dissection

There is no requirement for teachers or students to carry out a dissection of any animal (vertebrate or invertebrate). If teachers believe that it is an important educational experience and wish to include dissections in the experimental programme, the following points apply.

- The reasons for animal dissections should be discussed with students.
- Any student who wishes to opt out of the dissection should be allowed to do so.

- An attempt should be made to reduce the number of dissections.
- Replacing animal dissection with computer simulations and/or use of animal tissue should be encouraged. This could include, for example, hearts and lungs obtained from a butcher.
- Live organisms must not be used for dissection.
- Animals to be dissected should be obtained from an ethical source only.
- Animals killed on the road should not be used.

Fieldwork

Impact

Fieldwork should be carried out with minimal impact on the environment and should adhere to rules and regulations relating to the site. Furthermore, the following points apply.

- Precautions should be taken to ensure the safety of all species when carrying out sampling techniques.
- Working in areas where protected and/or endangered species are present, or likely to be present, should not be permitted.
- All habitats investigated should experience minimal disturbance and be returned to their original condition.
- Delicate sites should not be trampled by repeated passage.
- Sites of special scientific interest should be avoided.
- The species sampled should be identified and counted in situ. If the sampled species are removed, they must be returned within a suitable time frame and safely to where they were collected.

Safety

Before using a fieldwork site, a risk assessment is required to identify any hazards and reduce potential risk. It is recommended that potential dangers are highlighted to students, for example on a map. Appropriate procedures should be in place for any student groups working away from supervision. Furthermore, the following points apply.

- The specific hazards of the habitat being visited should be considered, for example water currents, mud, cliffs or rocky terrain.
- The avoidance of any potentially hazardous organisms, for example ticks, venomous plants and animals.
- Participants should be advised to wear appropriate clothing and footwear.
- Forecasts for changing local conditions should be observed, for example the weather or tides.
- Contingency planning should be undertaken if work needs to be cancelled.

Handling of equipment, chemicals and waste disposal

Students should be trained in standard laboratory practice and made aware of particular risks associated with handling the different equipment and compounds being used. Furthermore, the following points apply.

- Teachers should consult safety information on compounds and materials (e.g. CLEAPSS, ACS Institute, 2022).
- When required, students must wear appropriate protective clothing and eye protection.
- The working environment must be safe; for example, fume hoods should be present if appropriate.
- Students must not carry out work in a laboratory unsupervised.
- Consumption of materials must be kept to a minimum to prevent unnecessary waste.

- The disposal of waste material, including biological material, should adhere to local regulations and aim to cause minimum environmental impact and to encourage recycling.
- Carcinogenic substances must not be handled by students and, when possible, toxic substances should be replaced by less harmful ones.
- Low-level radioactive sources that do not pose an external hazard to students can be used.

Human physiology experiments

Any planned experimentation involving human subjects must be approved by the supervising teacher following discussions with the student(s). Furthermore, the following points apply.

- Written permission from each participant must be obtained. Confidential informed consent forms are mandatory.
- The investigation must not use participants under the age of 16 without the written consent of their parents or guardians.
- A written declaration ensuring that each participant is of good physical health, such as a physical activity readiness questionnaire (PAR-Q), must also be obtained if the investigation includes moderate to vigorous intensity physical activity.
- Experiments that administer substances, including but not limited to alcohol, drugs, medicines or dietary supplements (including beverages containing caffeine and energy drinks), are not acceptable and must not be carried out.
- Experiments involving any body fluids (such as sweat, blood, urine and saliva) must not be performed due to the risk of the transmission of pathogens.

Microbiological studies

Experiments involving any body fluids of an animal (such as sweat, blood, urine and saliva) for microbial investigations must not be performed due to the risk of the transmission of pathogens. The use of raw (untreated) milk is not permitted. Furthermore, the following points apply.

- Known non-pathogenic cultures from reputable specialist suppliers must be used.
- The incubation temperatures for these must be maintained at or below 25°C.
- Aerobic conditions must be maintained by ensuring containers are not completely sealed. Edges should not be taped shut so an aerobic environment inhibits the growth of human pathogens that may contaminate the cultures.
- Once closed, containers must not be reopened.
- The handling of the microbes should be carried out using standard aseptic techniques.
- The culturing of organisms from the environment or from human body surfaces, such as hand swipes, must not be carried out.
- Disposal of microbial cultures must meet local safety requirements.
- The testing of antibiotic resistance in bacteria, even non-pathogenic strains, must not be carried out.

Risk assessment

A risk assessment must be conducted by both students and teachers prior to carrying out experiments both in the laboratory and in the field.

Risk assessment requires four steps.

- Identify the hazards.
- Recognize and assess the potential risks of the hazards.
- Minimize the risks of the hazards by identifying and implementing appropriate and effective control measures.
- Prepare for emergencies from unexpected events.

(ACS Institute, 2022)

Hazards may take the form of items in the laboratory equipment, field conditions, health conditions, substances, sources of energy, condition of the working environment or organisms under observation or encountered.

Local policies should be adhered to and regarded as a minimum standard. Personal and environmental safety are the priority and steps should be taken to ensure risk assessments are as comprehensive as possible.

This table illustrates how risk assessments may be approached. Note that this list is not prescriptive or exhaustive.

Type of hazard	Example of hazard	Potential risk	Example of control measure
Object	Scalpel	Cut	Cut against suitable cutting surface and away from body.
Substance	Hydrogen peroxide	Burns to skin, damage to eyes	Wear appropriate personal protective equipment (such as safety glasses, gloves and lab coat).
Source of energy	Ultraviolet source	Eye damage	Wear appropriate eye protection and position ultraviolet light source to ensure it is not directly viewed.
Terrain	Slippery rocks	Injury due to slipping and falling	Wear appropriate footwear with sufficient grip.
Organism	Microbe	Infection	Follow appropriate aseptic protocols.

(based on American Chemical Society, 2016)

References

The following resources are available in English.

ACS Institute (2022). *Ways to conduct a hazard assessment*. ACS Center for Lab Safety. Retrieved October 25, 2022, from https://institute.acs.org/lab-safety/hazard-assessment/ways-to-conduct.html

American Chemical Society (2016). *Guidelines for chemical laboratory safety in secondary schools*. American Chemical Society. Retrieved October 25, 2022, from https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/acs-secondary-safety-guidelines.pdf

CLEAPSS. https://science.cleapss.org.uk/

Updates to the publication

This section outlines the updates made to this publication over the past two years. The changes are ordered from the most recent to the oldest updates. Minor spelling and typographical corrections are not listed.

Changes for November 2023

Safe and ethical experiments

"Handling of equipment, chemicals and waste disposal"

Amendment in response to stakeholder feedback.

The restriction on radioactive sources has been altered to allow the use of low-level radioactive sources that do not pose an external hazard to students.