Diploma Programme

Collaborative sciences project guide

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Diploma Programme

Collaborative sciences project guide

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Diploma Programme
Collaborative sciences project guide

Published February 2023
Published on behalf of the International Baccalaureate Organization, a not-for-profit educational foundation of 15 Route des Morillons, 1218 Le Grand-Saconnex, Geneva, Switzerland by the
International Baccalaureate Organization (UK) Ltd
Peterson House, Malthouse Avenue, Cardiff Gate
Cardiff, Wales CF23 8GL
United Kingdom
Website: ibo.org

The International Baccalaureate Organization (known as the IB) offers four high-quality and challenging educational programmes for a worldwide community of schools, aiming to create a better, more peaceful world. This publication is one of a range of materials produced to support these programmes.

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.

Contents

Introduction	**1**
Purpose	1
Aims of the CSP	2
Features of the CSP	3
Example CSPs	**4**
Example 1: An intensive in-school CSP	4
Example 2: A CSP over a longer time frame	8
Example 3: A CSP based on critical thinking/TOK	12
Example 4: A CSP based on an experiential field trip	16
Example 5: A CSP based on CAS/citizen science	20

Purpose

The collaborative sciences project (CSP) gives Diploma Programme (DP) and Career-related Programme (CP) students the opportunity to work together in an interdisciplinary team. They work towards a common goal related to a real-world issue, pursued through the lens of the scientific method.

Throughout the project, the emphasis is on the experience of collaborative problem-solving, the focus being the process rather than the product.

Real-world issues are inherently complex. The CSP explores a specific issue, giving students the opportunity to recognize some of the interrelated systems, mechanisms and processes connected to the issue they are investigating. These interconnected factors may include the environmental, social and ethical implications of science and technology.

Working collaboratively in a team requires a certain level of self-awareness and empathy with other team members. It also requires a high level of motivation and two-way communication. The opportunity to reflect on these factors, in terms of what went well and lessons learned, will be invaluable for future collaborations and the personal growth of each individual student. The CSP is a focused opportunity for students to develop a range of International Baccalaureate (IB) learner profile attributes.

International-mindedness is inherent to the CSP experience because it links to local manifestations of global issues. Some CSP experiences may lead students to create or engage with national or international projects. Examples of exemplary collaborative projects bringing together scientists from around the globe include:

- the Human Genome Project: www.genome.gov/human-genome-project
- the Intergovernmental Panel on Climate Change: www.ipcc.ch
- Panthera (project for biodiversity and conservation): panthera.org
- CERN (the European Organization for Nuclear Research): home.web.cern.ch
- SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East): en.unesco.org/courier/2018-4/sesame-scientific-excellence-middle-east
- the International Cancer Genome Consortium: dcc.icgc.org
- the International Space Station programme: www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-iss-k4.html
- the Millennium Seed Bank: www.kew.org/wakehurst/whats-at-wakehurst/millennium-seed-bank
- the Laser Interferometer Gravitational-Wave Observatory Scientific Collaboration: www.ligo.org/about.php
- the Human Cell Atlas: www.humancellatlas.org/learn-more
- the International Brain Laboratory: www.internationalbrainlab.com
- the CGIAR food security partnership: www.cgiar.org.

It is not expected that students will come up with solutions to major issues such as climate change or the energy crisis during the 10 hours of the CSP. Nevertheless, through the CSP, they may develop collaboration skills or find moments of inspiration that help them evolve into problem-solving global citizens of the future.

Aims of the CSP

Through studying any of the DP science subjects, students should become aware of how scientists work and communicate with each other. The scientific method can take a wide variety of forms, but it is the emphasis on a practical experimental approach that distinguishes the DP sciences from other subjects. The CSP provides an opportunity for students to focus on a wide range of aims, including the following.

In biology, chemistry, physics, sports, exercise and health science (SEHS), and computer science

- Making connections between different disciplines
- Developing the ability to approach unfamiliar situations with creativity and resilience
- Designing or modelling solutions to local and global problems in a scientific context
- Developing the ability to communicate and collaborate effectively
- Developing awareness of the ethical, environmental, economic, cultural and social impact of science

In environmental systems and societies (ESS)

- Valuing the combination of personal, local and global perspectives in making informed decisions, and taking responsibility for actions on environmental issues
- Developing critical awareness that environmental problems are caused and solved by decisions made by individuals and societies based on different areas of knowledge
- Creating innovative solutions to environmental issues by engaging actively in local and global contexts

In the revised course for first assessment in 2026, ESS will emphasize:

- understanding the complex nature of environmental and societal issues at a variety of scales
- analysing environmental issues through interdisciplinary perspectives
- understanding the need for creative and collaborative responses to environmental issues
- designing, modelling and evaluating sustainable solutions to environmental issues at varying scales
- taking action collectively and individually.

In design technology

- Developing a willingness to approach unfamiliar situations in an informed manner and explore new roles, ideas and strategies, through which students can articulate and defend their proposals with confidence
- Developing empathy, compassion and respect for the needs and feelings of others, through which students make a positive difference to the lives of others and to the environment
- Developing skills that enable reflection on the impact of design and technology on society and the environment, through which students develop their own learning and enhance solutions to technological problems

Features of the CSP

The table outlines essential and desirable features of the CSP.

CSP features	Essential	Desirable
Involves all students enrolled in a DP sciences subject	√	
Lasts at least 10 hours	√	
Is an opportunity for students to inquire and problem-solve	√	
Develops students' collaboration skills	√	
Develops students' communication skills	√	
Allows students to engage with a local context	√	
Allows students to explore a global issue	√	
Focuses on process not product	√	
Is an opportunity for students to work with others in different science subjects		√
Links to theory of knowledge (TOK) or creativity, activity, service (CAS)		√
Involves students documenting their experience and learning using a medium of their choice (e.g. learning journal, podcast, poster, video, presentation, web page)		√
Contributes to the school's development plan		√

Documentation

Students will write a 100-word reflection on completion of the project. The most authentic and valuable reflections are written as genuine commentaries on the experience—how students felt about it and benefited from it—rather than as lists of what was done. Copies of these reflections must be saved (on paper or electronically) as evidence of completing the CSP. The school's experience with the CSP may also be discussed during programme evaluation visits.

Example 1: An intensive in-school CSP

Context

- At this school, students are taken “off timetable” for two days at the end of term 1 of DP year 1 to do their CSP.
- The school’s development plan aims to better integrate the DP core (extended essay, TOK, CAS) into subject teaching.
- Students are prompted to develop their project in the context of a specific local problem or issue that can be addressed using scientific knowledge and skills. For example, the instructions could be as follows.
  - Using your scientific knowledge, create a work of art.
  - Your piece could be:
    - visual art (e.g. painting, sculpture, installation)
    - performing art (e.g. theatre, film, music, dance)
    - literature (e.g. poetry, short story).
  - Your piece must connect both to the local community and to an issue of global significance. You will be asked to justify these connections in a written artwork description that will be exhibited along with your piece.
  - Your team must create a journal that documents your process through a medium of your choice (e.g. video, narrated presentation, booklet, website).
  - Your project will be shared with the school community at the CSP exhibition.
- On completion, the products of the CSP (e.g. artworks, artwork descriptions and process journals) are shared in a virtual space.
- Subject expertise could be incorporated in a variety of ways, for example:
  - a poem about a local endangered species, written in invisible ink (biology, chemistry)
  - designing a musical instrument that uses sustainable materials sourced locally (design technology, ESS, physics)
  - developing an app or program that toggles different visualizations of data related to the gender pay gap for local athletes (computer science, SEHS)
  - creating a painting of an iconic local spot using a pendulum to apply watercolour paint onto a surface, then adding texture by sprinkling salt crystals on top (chemistry and physics).

Description

The planning stage takes place over two weeks, during which the students are “on timetable”. The action and reflection stages take place over two days, during which students are “off timetable”.

Planning

Two weeks before: Introducing the CSP

- Students are introduced to the project, including the focus on approaches to learning skills, and the constraints on time and resources.
- A series of examples are shared, in which science is linked to a work of art. Examples might include:
  - Team building by drawing a picture (PDF)

    - Neighbourhood scavenger hunt (PDF)
    - School of Visual Arts: Bio Art Lab (bioart.sva.edu)
    - Xavier Cortada Studio (cortada.com)
    - SciStarter (scistarter.org/finder)

  Other examples could include the work of local artists.
- Students are put into interdisciplinary teams with students from other science subjects.
- Students are assigned a mentor who is a member of staff.
- Each team will:
    - develop a work of art using their scientific knowledge
    - document their process on an ongoing basis in a process journal
    - write a brief artwork description.

Over the next two weeks: Project proposals

- In their own time, teams arrange meetings to discuss their project and develop a project proposal. The proposal is then submitted to their mentor for approval, including:
    - a proposed project timeline
    - an outline of the method
    - a risk assessment
    - an equipment list and/or informed consent forms (if applicable).

Action

Day 1: Investigating, with periodic check-ins

- Students collect equipment and are assigned a space to work in.
- Students spend the day working on their investigation.
- At various points throughout the day, teams:
    - discuss progress with their mentor
    - share progress with the rest of the cohort
    - engage in ongoing reflection on their development of approaches to learning skills, focusing on collaboration and communication skills.

Day 2: Preparing for the exhibition and reflection

Part 1—Preparing for the exhibition

- Teams prepare to share their works of art and process journals with the rest of the group.
- Each team prepares a short written artwork description in which they:
    - summarize the aims, processes and outcomes of their project
    - justify the connection between their piece and the local context
    - justify the connection between their piece and a global issue
    - share one or two salient successes
    - share one or two challenges and how they overcame them
    - reflect on the development of their approaches to learning skills, focusing on collaboration and communication skills.

Part 2—Exhibition

- Teams take turns sharing their exhibition pieces and artwork description highlights with the group. They exchange questions. Larger cohorts may need to be split up into smaller groups.
- The CSP exhibition follows and is open to the school community. Teams exhibit their pieces and accompanying artwork descriptions.
- Certificates are given out for, for example:

  - best connection to local context
  - best link to a global issue
  - most original concept
  - judges' award for best-presented project.

Reflection

Day 2, Part 3—Writing reflections

- Staff mentors meet with their respective teams and provide constructive feedback.
- Students reflect on their CSP experience, focusing on:
  - challenges and successes in collaboration
  - challenges and successes in communication
  - examples of TOK aspects relevant to their experience.
- Students write their 100-word reflections. These are stored electronically as evidence of completing the CSP.

Comments

CSP features	Achieved?	Comments
Involves all students enrolled in a DP science subject	√	
Lasts at least 10 hours	√	Taking 2 days off from the normal school timetable is equivalent to around 14 hours, plus the time students spend preparing in the weeks leading up to the CSP.
Is an opportunity for students to inquire and problem-solve	√	
Develops students' collaboration skills	√	Students collaborate within their teams and with their mentors. They reflect on this skill development throughout the process and receive feedback on it at the final reflection session.
Develops students' communication skills	√	Students communicate within their teams, across teams, with their mentors and with the school community through a variety of media. They reflect on this skill development throughout the process and receive feedback on this at the final reflection session.
Allows students to engage with a local context	√	
Allows students to explore a global issue	√	
Focuses on process not product	√	
Is an opportunity for students to work with others in different science subjects	√	
Links to TOK and/or CAS	√	In this CSP, students explore the nature of art in knowledge transmission, as well as the ethical implications of scientific knowledge.

CSP features	Achieved?	Comments
		In addition, this example provides a low-stakes team environment for students to experience some of the issues related to setting up and justifying an exhibition piece. Some of this experience could carry over into the preparation of the TOK exhibition (although this would depend on the timing of the exhibition).
Involves students documenting their experience and learning using a medium of their choice (e.g. learning journal, podcast, poster, video, presentation, web page)	√	
Contributes to the school's development plan	√	In this case, one of the aims in the school's development plan was to better embed aspects of the DP core in its subject teaching. This CSP example supports students in their application of TOK skills outside the TOK classroom.

Advantages

This CSP model:

- uses time at the end of the school year
- is fully complete by the end of the second day
- is an engaging and creative task that allows students to explore aspects of TOK and science subjects simultaneously.

Disadvantages

In this CSP model:

- students who are absent or who transfer into the DP later in the cycle will need to complete this requirement in some other way
- students are given little time to digest and process the project
- students need to plan for 8 hours of continuous work, which can be challenging. Close work with mentors is required to ensure students complete their artworks, descriptions and process journals in the allotted time.

Possible adjustments to this model

Depending on context and needs, the school could consider the following.

- **Very small cohorts**—Carry out the CSP every two years, at the start of the year, with year 1 and year 2 DP students mixed together. This would allow year 2 DP students to mentor the year 1 DP students informally at the beginning of the programme. It would also have the added advantage for staff of them only needing to organize the CSP once every two years.
- **Working remotely**—This model can be transferred to an online context, where all participants meet remotely for kick-off, check-ins and plenary sessions. Teams are put into "breakout rooms" for the duration of the project, with staff visiting the rooms to monitor student progress. Document sharing will allow synchronous monitoring of discussions, results and reflections.

Example 2: A CSP over a longer time frame

Context

- At this school, the science department wants to develop some of the technology skills that support the DP sciences (e.g. spreadsheets, sensors, data loggers).
- The school's development plan seeks to enrich its links with the school community and local context through student engagement with medium- and long-term projects. Year 1 DP students therefore dedicate 1 hour per week to this over a 10-week period in term 1.
- Students are prompted to develop their project in the context of:
  - at least one of the sustainable development goals (SDGs) of the United Nations (UN)
  - a specific local problem or issue that can be addressed using scientific knowledge.
- On completion, the products of the CSP (e.g. scientific posters, podcasts, videos, ePortfolios, web pages) will be shared in a mini science conference and kept in a virtual repository accessible by members of the school community.
- Example project topics include the following.
  - **Goal 3—Good health and well-being**. Exploring vaccine hesitancy in the region. Biology students research and present on how different vaccine technologies create immunity. Physics and computer science students model the spread of diseases at different vaccination thresholds in different scenarios.
  - **Goal 11—Sustainable cities and communities**. Creation of a ride-share app for students and parents to minimize the number of cars travelling to and from the school. Computer science students work on the app, while ESS and biology students quantify the possible carbon offsets, and impacts on local health and biodiversity.
  - **Goal 14—Life below water**. Reducing plastic waste in a local body of water. Students design a waste collection system that helps prevent plastic and other items from coming out of the waste containers along forest trails. An educational campaign and information signage to promote its use will also be included. Students quantify the amount of plastic they have prevented from entering the environment.

Description

Planning

Session 1: Introducing the CSP

- Students are introduced to the project, including the focus on the SDGs, approaches to learning and gaining familiarity with available technology.
- Students are put into interdisciplinary teams with students from other science subjects, and are assigned a mentor who is a member of staff.
- The onus is put on students to arrange meetings and liaise with their mentor.

Sessions 2 and 3: Planning the CSP

- In teams, students choose one or more SDGs and collaboratively design an investigation around the SDG(s). The focus of the investigation is open. It may take a number of forms: theoretical, or primary and secondary data collection, or development of an information resource.
- Students identify the local problem or issue they wish to explore. Examples of local contexts include:

    - school waste management
    - local charities
    - local environmental groups
    - primary school classrooms.
- Students keep a journal reflecting specifically on their collaboration skills and communication skills.
- Teams develop a project proposal and submit it to their mentor for approval, including:
    - the local problem or issue
    - links to SDGs
    - opportunities to incorporate technology
    - the proposed timeline of investigation
    - an equipment list and/or informed consent forms (if applicable).

Action

Sessions 4, 5 and 6: Investigating, with periodic check-ins

- Students collect equipment and are assigned a space to work in.
- Students spend the 3 sessions working on their investigation.
- Each week, in addition to carrying out the investigation:
    - teams discuss progress with their mentor
    - teams share progress with the rest of the cohort via a brief check-in or in a virtual environment
    - teams engage in ongoing reflection on approaches to learning, focusing on collaboration skills and communication skills.

Sessions 7 and 8: Preparing to communicate findings

- Students prepare to communicate their findings to their peers. This could be in the form of a video, podcast or scientific poster, in which they:
    - summarize the aims, processes and outcomes of their investigation
    - explain links to SDGs
    - share one or two salient successes
    - share one or two challenges and how they overcame them
    - reflect on their development of approaches to learning skills, focusing on collaboration skills and communication skills.

Session 9: Mini conference

- Students share work with their peers. In small cohorts, all teams present to all other teams. Larger cohorts may need to be split up.
- Digital versions of students' work are saved in an online CSP repository.

Reflection

Session 10: Writing reflections

- Staff mentors meet with their respective teams and moderate a discussion where students reflect constructively on their experience. Mentors also provide constructive feedback to the team.
- Students reflect on their CSP experience, focusing on:
    - challenges and successes in collaboration
    - challenges and successes in communication
    - understanding the focus of the SDGs
    - the use of relevant technology skills
    - opportunities for further growth and/or extension of their work.

- Students write their 100-word reflections. These are stored electronically as evidence of completing the CSP.

Comments

CSP features	Achieved?	Comments
Involves all students enrolled in a DP science subject	√	
Lasts at least 10 hours	√	
Is an opportunity for students to inquire and problem-solve	√	
Develops students' collaboration skills	√	
Develops students' communication skills	√	
Allows students to engage with a local context	√	
Allows students to explore a global issue	√	The focus on SDGs helps students explore examples of global issues.
Focuses on process not product	√	
Is an opportunity for students to work with others in different science subjects	√	
Links to TOK and/or CAS		Possibly. Depending on the natures of the projects, they may or may not lead to a CAS experience.
Involves students documenting their experience and learning using a medium of their choice (e.g. learning journal, podcast, poster, video, presentation, web page)	√	
Contributes to the school's development plan	√	This school's development plan seeks to develop links to the local context.

Advantages

This CSP model:

- gives students an opportunity to reflect on and digest the issues and perspectives brought up during the project
- provides the time and framework to explore a local problem or issue
- allows students to explore their learning in an authentic context.

Disadvantages

In this CSP model:

- a variety of possible local contexts should be identified beforehand. Prior contact with relevant local organizations may be required
- the time allocation needs to be built into student and teacher timetables.

Possible adjustments to this model

Depending on context and needs, the school could adjust the model in at least two ways.

- **Collaboration with schools in the area**—Invite other schools to take part in the CSP, enhancing opportunities for student collaboration, involvement of a greater range of DP subjects and highlighting connections with the local context.
- **Inviting younger students to participate**—The CSP could be set up as a school club, open to pre-DP students. Groups of DP students could lead the sessions and reflect on the development of their leadership skills, as well as collaboration skills and communication skills.

Example 3: A CSP based on critical thinking/TOK

Context

- A significant skill related to the nature of science (NOS) and the scientific method is questioning the validity of data.
- A "myth-busting" CSP—built on questioning common ideas about science that may actually be misconceptions—readily fits the scope of the DP science subjects.
- This CSP also provides opportunities to connect to the core concepts in TOK.
- For example, when students begin brainstorming ideas to test for validity, they may consider asking questions such as:
  - What "experts" have made these conclusions?
  - What "evidence" have the "experts" used to support their conclusions?
- The possibilities of this CSP model are broad and it can go in any direction students would like to take. For example, it could connect to the UN SDGs.
- The model could work as a shorter 2-day intensive project, be connected to TOK exhibition work or be linked to concept coverage within the sciences over a longer time frame.
- The model provides a clear opportunity for connections to design technology and the design cycle/scientific method. Students could conduct some preliminary investigative work and then further define the variables they want to investigate for effectiveness.
- An example CSP question students could explore would be: "To what extent would water filtered through a filter primarily made from sand, carbon and gravel be safe for human consumption?"
  - This question can be linked to water chemistry, such as testing nitrate levels.
  - This question is also connected to biology: for example, how effective would this filter be in reducing microbial contamination?
  - In ESS, this question could be used to:
    - examine the real-world circumstances where these filters may be beneficial (e.g. access to clean water in developing countries)
    - examine innovation opportunities (e.g. devices that condense water from air or that use solar purification methods).
  - In physics, students may want to examine the fluid dynamics and flow through the filter itself; computer science students may assist with modelling the designs.
  - Finally, related "umbrella" ideas CSP teams could explore include pseudoscience claims about health and nutrition, or marketing and branding that makes claims about scientific testing. For example:
    - Does bottled water really taste significantly different from tap water?
    - Do toothpastes containing sodium lauryl sulfate really clean teeth "better"?

Description

As mentioned above, a range of scenarios and time frames are all feasible. This description outlines sessions for a 2-day intensive CSP.

Planning

Two weeks before: Introducing the CSP

- Students are introduced to the project, including the focus on the approaches to learning and NOS, and a brief explanation of myth-busting.
- Numerous television shows and online videos have popularized the critical examination of myths and misconceptions about scientific principles. Showing sample clips from some of these may help inspire ideas.
- Students are put into interdisciplinary teams with students in other science subjects, and assigned a member of staff as a mentor.
- Each team will:
  - brainstorm ideas to decide on which myth to "bust"
  - discuss the format (e.g. video presentation, poster, podcast) they would like to use to share their progress with the other CSP teams and the wider school community.

Day 1—Session 1 (1 hour): Team building and collaboration

- Emphasize again to students that the main purpose of the CSP is collaboration.
- Consider running a simple team-building exercise, with students working in their mixed science teams. The team-building exercise "Building a team … by building a picture" is one such example.
- Include an opportunity for reflection and sharing afterwards: both reflection and communication are key aspects of the CSP.
- This may be a good opportunity to highlight again that this is a non-assessed project. Remind students they will be completing a 100-word reflection at the conclusion of the CSP. In this short piece, they will be asked to comment on how they contributed to collaboration on the project.

Day 1—Session 2 (1 hour): Project proposals

Teams develop a project proposal and submit it to their mentor for approval. This can be done verbally with quick oral feedback. The proposal should include:

- an outline of the method
- a risk assessment
- an equipment list and/or informed consent forms (if applicable).

Action

Day 1—Session 3 (3 hours): Collecting data … experimenting … myth-busting!

- Students work in their teams, with mentor supervision, to collect data to bust a myth or to assess the validity of a claim made by an expert.
- The teams should consider the safety, ethical and environmental aspects of their work throughout the process.
- Where possible, students should work to investigate variations of an independent variable and complete repeated trials.
- Students should document their evidence and work to develop their own expertise. They will then present their data to peers on day 2.
- Those who finish their data collection early can begin working on their presentations.

Day 2—Session 4 (2–3 hours): Developing presentations

- Students work collaboratively within their mixed science CSP teams to develop a presentation of their findings. The presentations should clearly describe the myth they are working to bust.
- Students should also share their evidence-gathering process and a summary of their evidence, either to support or refute the claim made.
- This can be connected to TOK in terms of assessing the claims and possible counterclaims students have identified through their research.

- A probing question session, involving both teacher mentors and student peers, could examine the evidence to determine whether or not the myth has been busted. The mentors' expertise could then be used for constructive criticism. There could also be a voting process. Overall, this may make for a more interesting and engaging way to develop the presentations.

Day 2—Session 5 (1–2 hours): Delivering presentations

- The logistics of the presentations will vary from school to school. If there is a smaller cohort of students, presentations could be relatively long. However, if there is a larger cohort, keeping the presentations concise will suffice.
- Encouraging students to make their presentations interactive will help to increase engagement.
- Ideally, the wider school community could be involved by making the presentations public. For example, if students create posters, these could be displayed in a science hallway. If the CSP is done in year 2 of the DP, year 1 DP students can be invited to observe some of the process. A simple website could be set up to catalogue the CSP presentations from year to year.

Reflection

Day 2—Session 6 (1 hour): Writing reflections

- Students write their 100-word reflections.
- Reflections should be individual and genuine. They should comment specifically and concisely on how well the student progressed in constructively contributing to the project's development, as part of a team.
- Students should also comment on any obstacles and/or opportunities they found in communicating within a team setting. The most authentic reflections are not lists of what was done, but a genuine commentary on what students felt and how they grew through the experience.
- The reflections are stored electronically as evidence of completing the CSP.

Comments

CSP features	Achieved?	Comments
Involves all students enrolled in a DP science subject	√	
Lasts at least 10 hours	√	
Is an opportunity for students to inquire and problem-solve	√	
Develops students' collaboration skills	√	
Develops students' communication skills	√	
Allows students to engage with a local context		Possibly. This CSP could encourage students to look at local myths, but this may narrow their options significantly.
Allows students to explore a global issue	√	
Focuses on process not product	√	
Is an opportunity for students to work with others in different science subjects	√	
Links to TOK and/or CAS	√	
Involves students documenting their experience and learning using a medium of	√	

CSP features	Achieved?	Comments
their choice (e.g. learning journal, podcast, poster, video, presentation, web page)		
Contributes to the school's development plan		Possibly. This might make for some interesting myth-busting, particularly if students examine school facilities and resources.

Advantages

In this CSP model:

- students are provided with significant flexibility to create research questions and explore areas of inquiry of their choosing
- students are given the opportunity to connect their understanding of the scientific method and the NOS to TOK concepts, reflecting on what "expertise" and "evidence" (for example) mean to them. As these concepts invite differences of opinion, they can help develop the communication skills aspect of approaches to learning
- there are opportunities to connect to the UN SDGs. For example, students could create a model to mimic the greenhouse effect, by testing whether increasing the amount of carbon dioxide in a bottle increases the temperature within the bottle
- students could use databases to explore myths or misconceptions, and complete this CSP in an online format if needed.

Disadvantages

In this CSP model:

- it may be challenging to examine the "myth" to the fullest and most critical extent within a 10-hour project time frame
- the connections with a global issue and/or a local context may not be as obvious here as in other CSPs, or they may be more limited.

Possible adjustments to this model

Depending on context and needs, the school could:

- complete the CSP over a 2-day intensive session
- split the 7 sessions over a longer time frame; however, in terms of data collection, this may be less efficient if equipment needs to be set up multiple times.

Example 4: A CSP based on an experiential field trip

Context

- In this CSP, DP science students will have the opportunity to:
  - explore the local context of an issue, potentially with connection(s) to broader global issue(s)
  - inquire about and be inspired by their surroundings to develop innovative, authentic questions for collaborative research.
- The field trip may be scheduled at a time of year when other classes are also engaging in "classrooms without walls". This facilitates the ethos of the CSP being a non-assessed piece of work. There is also the flexibility to combine this format for the CSP with a CAS trip, making it multifunctional. To minimize disruption to class time, these trips are often planned at the end of year 1 of the DP, or before, after or during a calendared holiday.
- On completion, the products of the CSP (e.g. posters, podcasts, videos) could be shared on a field-trip website as well as in the school itself. If the same website is available, visited and updated year after year, long-term studies that look at changes over time will be possible. Once the initial trip has been completed, this type of field research experience may therefore become part of the culture and tradition of the school. It could be something students genuinely look forward to.
- Examples of locations that may work well for a CSP field trip include conservation areas, local parks, theme parks and amusement parks.
- In a conservation area or park, students from each of the DP sciences have multiple opportunities to connect their learning to real-world issues. For example, imagine that the main line of inquiry for a CSP is: "To what extent does the design of this space contribute to positive interactions between human society and the environment?" In this case, the following opportunities might arise.
  - Computer science students could explore how artificial intelligence is being used in conservation and biodiversity work.
  - Biology students could explore any of the numerous interactions between abiotic and biotic factors.
  - ESS students might examine how different stakeholders' awareness of and attitudes towards issues in the park influence its operation.
  - SEHS students could examine how the park can be used for different types of exercise.
  - Physics students could examine how alternative energy systems might power some of the park's systems, and/or how light and sound pollution influence the park.
  - Chemistry students could examine air or water pollution in the park, or the effects of ultraviolet radiation (e.g. sunscreen, fading of natural dyes).
  - Design technology students could examine the park's technological systems and consider how to engineer greater efficiencies in these.

Description

Planning

Logistical organization in advance

- This CSP model will require significant advance planning and potential collaboration. It will also need approval from the school leadership team and possibly the school board.

- A research trip should be conducted by science teachers in advance of the actual CSP field-trip date to complete a risk assessment and to assist with organizational details.
- There is an opportunity in this model to connect to a CAS trip and/or enhance the trip experience by bringing in other interdisciplinary work.

Halfway through DP year 1

Session 1 (1 hour): Introducing the CSP

- Students are introduced to the CSP field trip and are provided with the logistical details regarding timing, cost, location and itinerary.
- Students are put into interdisciplinary teams with students in other science subjects, and assigned a mentor who is a member of staff.
- Each team will:
  - brainstorm ideas they may choose to research at the field-trip site
  - discuss the format (e.g. video presentation, poster, podcast) they would like to use to share their process with the other CSP teams and the wider school community.

Two weeks prior to the field trip

Session 2 (1 hour): Project proposals

This session needs to occur in advance of departure to the field-trip location, so that any equipment required on-site can be organized well in advance.

- Teams develop a project proposal and submit it to their mentor for approval. This can be done verbally with quick oral feedback. The proposal should include:
  - an outline of the method
  - a risk assessment
  - an equipment list and/or informed consent forms (if applicable).
- The questions students may choose to investigate in this CSP model will vary greatly depending on the location of the field trip. For example, in an amusement park:
  - physics students could explore the motion of roller coasters from different perspectives (e.g. speed, force)
  - chemistry students could investigate the chemistry of water in pools or water rides
  - ESS students could examine how on-site waste is managed
  - design technology students could explore the design of the rides, games and other merchandise
  - computer science students could investigate the effectiveness and efficiency of IT interfaces used by park visitors
  - biology students could explore the park's plants, their resilience and adaptability (e.g. how their needs are met, either naturally or through human intervention)
  - SEHS students could examine the influence of different rides and games on heart rate.

Starting the field trip

Session 3 (1 hour): Team building and collaboration

- Emphasize again to students that the main purpose of the CSP is collaboration.
- Consider running a simple team-building exercise, with students working in their mixed science teams. For example, at the location of the field trip, the exercise Neighbourhood scavenger hunt (PDF) will help students familiarize themselves with the site and with each other.
- Include an opportunity for reflection and sharing afterwards: both reflection and communication are key aspects of the CSP.
- Remind students they will be completing a 100-word reflection at the conclusion of the CSP. In this short piece, they will be asked to comment on how they contributed to collaboration on the project.

Action

Session 4 (3–4 hours): Collecting data

- Students work in their teams to collect data. Staff mentors can either accompany their teams or be stationed in areas throughout the site location known to students to provide support if needed. Field-trip site location staff will need to be aware of the trip in advance and be partners in moderating the safety and well-being of trip participants.
- Students should consider the safety, ethical and environmental aspects of their work throughout the process.
- Where possible, students should work to investigate variations of an independent variable and complete repeated trials.
- Students should document their evidence and work to develop their own expertise for presenting their data to their peers.
- Those who finish their data collection early can begin working on their presentations.

Session 5 (2 hours): Developing presentations

- Students work collaboratively within their mixed science CSP teams to develop a presentation of their findings. The presentations should clearly outline the lines of inquiry pursued through their research.
- Students should also share their process of gathering evidence, as well as a summary of their evidence in response to their line of inquiry.
- Students should evaluate the challenges encountered during data collection in a field-site location and make suggestions for how these could be overcome in the future.

Session 6 (1 hour): Delivering presentations

- The logistics of the presentations will vary from school to school. If there is a smaller cohort of students, presentations could be longer; however, if there is a larger cohort of students, keeping the presentations concise will suffice.
- Encouraging the students to make the presentations interactive will help to increase engagement.
- Ideally, the wider school community could be involved by making the presentations public. For example, if students create posters, these can be displayed in a science hallway. If the CSP is done in year 2 of the DP, year 1 DP students can be invited to observe some of the process. A simple website could be set up to catalogue the CSP presentations from year to year.

Reflection

Session 7 (1 hour): Writing reflections

- Students write their 100-word reflections.
- Reflections should be individual and genuine. They should comment specifically and concisely on how well the student progressed in constructively contributing to the project's development, as part of a team.
- Students should also comment on any obstacles and/or opportunities they found in communicating within a team setting. The most authentic reflections are not lists of what was done, but a genuine commentary on what students felt and how they grew through the experience.
- The reflections are stored electronically as evidence of completing the CSP.

Comments

CSP features	Achieved?	Comments
Involves all students enrolled in a DP science subject	√	
Lasts at least 10 hours	√	

CSP features	Achieved?	Comments
Is an opportunity for students to inquire and problem-solve	√	
Develops students' collaboration skills	√	
Develops students' communication skills	√	
Allows students to engage with a local context	√	
Allows students to explore a global issue	√	
Focuses on process not product	√	
Is an opportunity for students to work with others in different science subjects	√	
Links to TOK and/or CAS		Possibly. If the site location is a local park or conservation area, there may be opportunities to explore environmental sustainability or biodiversity, for example, which may relate to CAS.
Involves students documenting their experience and learning using a medium of their choice (e.g. learning journal, podcast, poster, video, presentation, web page)	√	
Contributes to the school's development plan	√	Development of approaches to teaching.

Advantages

In this CSP model:

- the emphasis is on experiential education, actively in the real world, potentially facilitating correspondingly high levels of student engagement.

Disadvantages

In this CSP model:

- significant advanced planning and logistical work is necessary, not just to ensure student safety and well-being, but to check that the site or sites visited will provide meaningful educational opportunities
- in terms of budgeting, the school will need to make a decision as to whether the students will pay partially or in full for the CSP field trip, and if this is reasonable. Every effort should be made to make the trip as accessible and affordable as possible. If students are unable to attend due to budgeting constraints, then an alternative CSP model/option will need to be arranged for them.

Possible adjustments to this model

- The duration of the field trip can be adjusted based on the needs of the students and the school. For example, if the plan is to visit a local park or nearby conservation area, it may be possible to complete the CSP as an intensive activity over 2 or 3 days. Programming would need to allow extra time for travel to and from the location.
- The 10-hour timeline for the CSP is the suggested minimum. Schools can decide to provide additional time for the project if they wish.
- If the field trip is conducted over a week-long period, the CSP sessions can be interwoven into the agenda, interspersed with other enriching and educational activities. Examples may include team-building activities, cultural visits, service work, hiking and exploring, or guest lectures.

Example 5: A CSP based on CAS/citizen science

Context

- In this model, students connect the CSP to their CAS projects. Collaboration is key to both, therefore linking the two can increase both efficiency and student engagement.
- The CSP in this model can be completed intensively over 2 days or over a longer time frame. CAS projects generally take place over at least 1 month. As an example, the minimum 10 hours required for a CAS-based CSP could therefore be used to collect data that will better inform the service learning cycle. Alternatively, the time could be used to research the efficiency and effectiveness of solutions already being put in place. Both the CSP and CAS projects would benefit mutually in either scenario.
- A CAS-based CSP also offers opportunities for students to connect local contexts and global issues, as well as potentially connecting with the UN SDGs.
- CAS project teams typically comprise 3–5 students, as do CSP teams. With some advanced planning, it should therefore be possible to build CAS project teams with a balance of DP science students in them too.
- Examples of CAS projects that could be enhanced through collaborative scientific research are innumerable. A few examples include:
    - research around testing the insulating capacity of ecobricks when filled to varying masses with single-use plastic
    - cataloguing local biodiversity using an app
    - testing water quality in different urban areas
    - assessing food waste in the school cafeteria.
- If a school wanted to include aspects of service learning in the CSP without integrating the CSP into a full CAS project, there are other ways to connect to CAS experiences. These could include opportunities for students to engage in citizen science.
- The *Oxford Dictionary of English* defines citizen science as: "The collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists." Examples of citizen science projects that might provide a foundation for a CSP include:
    - identify and catalogue local biodiversity by conducting an intense, short-term biological census (BioBlitz) or participating in a photography competition. For example:
        - www.inaturalist.org/pages/bioblitz+guide
        - www.nationalgeographic.org/projects/bioblitz
        - www.projectnoah.org
    - SciStarter: scistarter.org/finder
    - Project BudBurst: budburst.org
    - Zooniverse: www.zooniverse.org/projects
    - EarthEcho Water Challenge: www.monitorwater.org
    - NASA Citizen Science Projects: science.nasa.gov/citizenscience
    - Global light pollution: www.globeatnight.org/downloads
    - Vigie Cratère: www.vigie-cratere.org
    - Galaxy Zoo: www.zooniverse.org/projects/zookeeper/galaxy-zoo

- Butterfly citizen science projects, for example, eButterfly: www.e-butterfly.org
- Monitor birds, for example:
  - Great Backyard Bird Count: www.birdcount.org
  - eBird: ebird.org
  - Project FeederWatch: feederwatch.org
- Eyewire: eyewire.org
- Foldit: fold.it
- Aurorasaurus: aurorasaurus.org

Description

Planning

Pre-planning: Connections to CAS

This CSP model would ideally require significant pre-planning and collaboration with the school's CAS coordinator and service learning team.

When CAS projects are introduced to year 1 DP students, the idea of connecting the CSP and CAS projects could be presented to students at the same time. Typically, schools allocate specific meeting times for CAS project development. Therefore, timetabling the minimum 10 hours required for CSP work into this CAS project time frame would be optimal. Ideally, this would occur in the early stages, when completing the investigation and preparation phases of the service learning cycle.

Two weeks before: Introducing the CSP

- Students are introduced to the project, including the focus on the approaches to learning skills and NOS, and given a brief explanation of citizen science. Highlighting some of the successful citizen science projects linked in the above "Context" section may provide helpful examples for students.
- Students are put into interdisciplinary teams with students in other sciences subjects, and assigned a mentor who is a member of staff.
- Each team will:
  - brainstorm ideas for a CAS project and/or experience that would link comprehensively to a CSP
  - discuss the format (e.g. video presentation, poster, podcast) they would like to use to share their process with the other CSP teams and with the wider school community.

Session 1 (1 hour): Team building and collaboration

- Emphasize again to students that the main purpose of the CSP is collaboration.
- Consider running a team-building exercise, with students working in their mixed sciences CSP teams, for example, a simple "globe at night" campaign: www.globeatnight.org/downloads (website in English but with resources in multiple languages). Since collaboration is so central to both the CSP and CAS projects, it is essential to encourage each student to reflect on the unique contributions and skills they bring to their team dynamic.
- Include an opportunity for reflection and sharing afterwards: both reflection and communication are key aspects of the CSP.
- This may be an ideal opportunity to highlight to students that this is a non-assessed project. Remind students that they will be completing a 100-word reflection at the conclusion of the CSP. In this short piece, they will be asked to comment on how they contributed to the collaboration on the project.

Session 2 (1 hour): Project proposals

- Teams develop a project proposal and submit it to their mentor for approval. This can be done verbally with quick oral feedback. The proposal should include:
  - an outline of the method

- a risk assessment. Since CAS projects and experiences often involve engaging with local communities, extra attention should be paid here to child protection policies. The health and safety of students outside of a school or in a laboratory environment is also paramount.

- Many projects related to service learning are well intentioned, but may not have the sustainable impact desired. There can be numerous causes, such as a lack of advance research or inadequate follow-up afterwards.
- Here are two ideas for a service learning activity.
  - Students complete a beach, road or hiking trail "clean-up". This may have some positive impact on the local community. The downside is that this may be temporary. With no further research or follow-up, it is likely the activity will have treated a symptom and not the cause. To be meaningful, it will need to be repeated regularly in the future.
  - As a service learning activity, students might research and collect data on the types of solid domestic waste found in the area. They could investigate:
    - who produces and releases this waste
    - what waste-management receptacles are being used
    - how long it takes for items to biodegrade
    - what education, legislation and campaigns already exist to remedy this situation
    - what possible impacts there are on the health of local species.
- In activities related to service learning, there are many opportunities to incorporate the scientific method into planning, through the lenses of the various IB sciences. This can help to create more meaningful, sustainable and positively impactful solutions to local issues in the wider global contexts.
- An equipment list and/or informed consent forms (if applicable) should also be part of the project proposal.

Action

Session 3 (3 hours): Experimenting and collecting data

This session may be completed as a block or broken into smaller sessions as required. This will depend on the time spent in the communities being assisted.

- Students work in their teams to collect data to assess.
- Students should consider the safety, ethical and environmental aspects of their work throughout the process.
- Where possible, students should work to investigate variations of an independent variable and complete repeated trials.
- Students should document their evidence and work to develop their own expertise for presentation of their data to their peers.
- Students who finish their data collection early may begin working on their presentations.

Session 4 (2–3 hours): Developing presentations

- Students work collaboratively within their mixed sciences CSP teams to develop a presentation of their findings. The presentations should clearly outline how their project progressed through the stages of the service learning cycle and how it used the scientific method.
- Students should also share the process by which they gathered evidence, and a summary of the evidence that informed their service learning.
- The presentation should have strong CAS links, and ideally should be shared on the citizen science platform if done online and/or with the local community being served.
- If, for example, students discover that most waste found on a local beach comes from a particular set of restaurants/businesses/industries, students may choose to approach those businesses and share their findings with suggestions of how the pollutant being released could be reduced.

Session 5 (1–2 hours): Delivering presentations

- The logistics of the presentations will vary from school to school. If there is a smaller cohort of students, presentations could be relatively long. However, if there is a larger cohort, keeping the presentations concise will suffice.
- Encouraging the students to make the presentations interactive will help to increase engagement.
- Ideally, the wider school community could be involved by making the presentations public. For example, if students create posters, these can be displayed in a science hallway. If the CSP is done in year 2 of the DP, year 1 DP students can be invited to observe some of the process. A simple website could be set up to catalogue the CSP presentations from year to year.

Reflection

Session 6 (1 hour): Writing reflections

- Students write their 100-word reflections.
- Reflections are an essential part of CAS as well as the CSP: they are used to demonstrate progress in the CAS learning outcomes. Discussing CAS learning outcomes that highlight personal growth, collaboration, dealing with global issues or engaging with ethics within students' CSP may assist in producing some powerful, concise reflections.
- Reflections should be individual and genuine. They should comment specifically and concisely on how well the student progressed in constructively contributing to the project’s development, as part of a team.
- Students should also comment on any obstacles and/or opportunities they found in communicating within a team setting. The most authentic reflections are not lists of what was done, but a genuine commentary on what students felt and how they grew through the experience.
- The reflections are stored electronically as evidence of completing the CSP.

Comments

CSP features	Achieved?	Comments
Involves all students enrolled in a DP science subject	√	
Lasts at least 10 hours	√	
Is an opportunity for students to inquire and problem-solve	√	
Develops students’ collaboration skills	√	
Develops students’ communication skills	√	
Allows students to engage with a local context	√	
Allows students to explore a global issue	√	
Focuses on process not product	√	
Is an opportunity for students to work with others in different science subjects	√	
Links to TOK and/or CAS	√	
Involves students documenting their experience and learning using a medium of their choice (e.g. learning journal, podcast, poster, video, presentation, web page)	√	

CSP features	Achieved?	Comments
Contributes to the school’s development plan	√	

Advantages

In this CSP model:

- students’ engagement may increase. Not only is a clear purpose and impact for their research identified within real-world issues, but they will also achieve efficiencies by linking their CSP to CAS
- there is a win–win impact on both the CSP and CAS. Students’ service learning work is enhanced by emphasizing the investigation and preparation stages, which are sometimes overlooked.

Disadvantages

In this CSP model:

- the CAS coordinator or service learning team would need to participate actively, to integrate the CSP into the time frame for CAS projects and experiences
- some students may feel restricted if they need to complete the CSP in connection with a CAS project. For example, the team they might choose to work with for their CAS project may not be the same as the one they would choose to work with for their CSP. The school could consider how to provide some flexibility to mitigate this
- some students may struggle to see how their CAS project could be connected to or enhanced by scientific research.

Possible adjustments to this model

- This CSP model could be completed in an online format, especially if facilitated by apps based on citizen science. The model would also work well in face-to-face learning formats.
- This CSP model could be completed as a 2–3 day intensive workshop with looser links to CAS. For example, the CSP could be linked to the CAS project’s timeline, with aspects of the CSP incorporated into a CAS field trip.
- The minimum 10-hour requirement for the CSP could be split across several sessions, and over a longer time frame if required.