

Discipline Fisiche

Il metodo IBSE

Francesco Longo - 02/12/25





Perche' succede?? Perche' si scaricano?



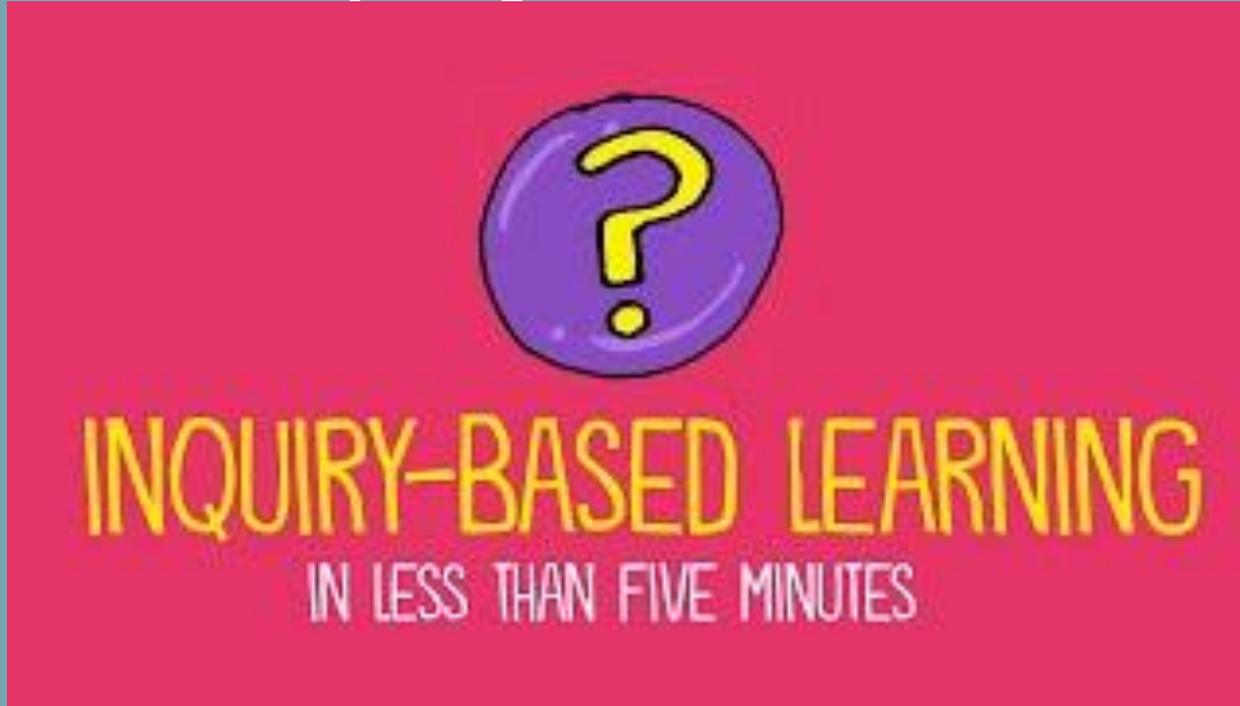
Inquiry Based
Science Education
(Approccio IBSE)



Inquiry is a multifaceted activity that involves: making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.

(National Research Council, 1996)

What is Inquiry-Based Learning?



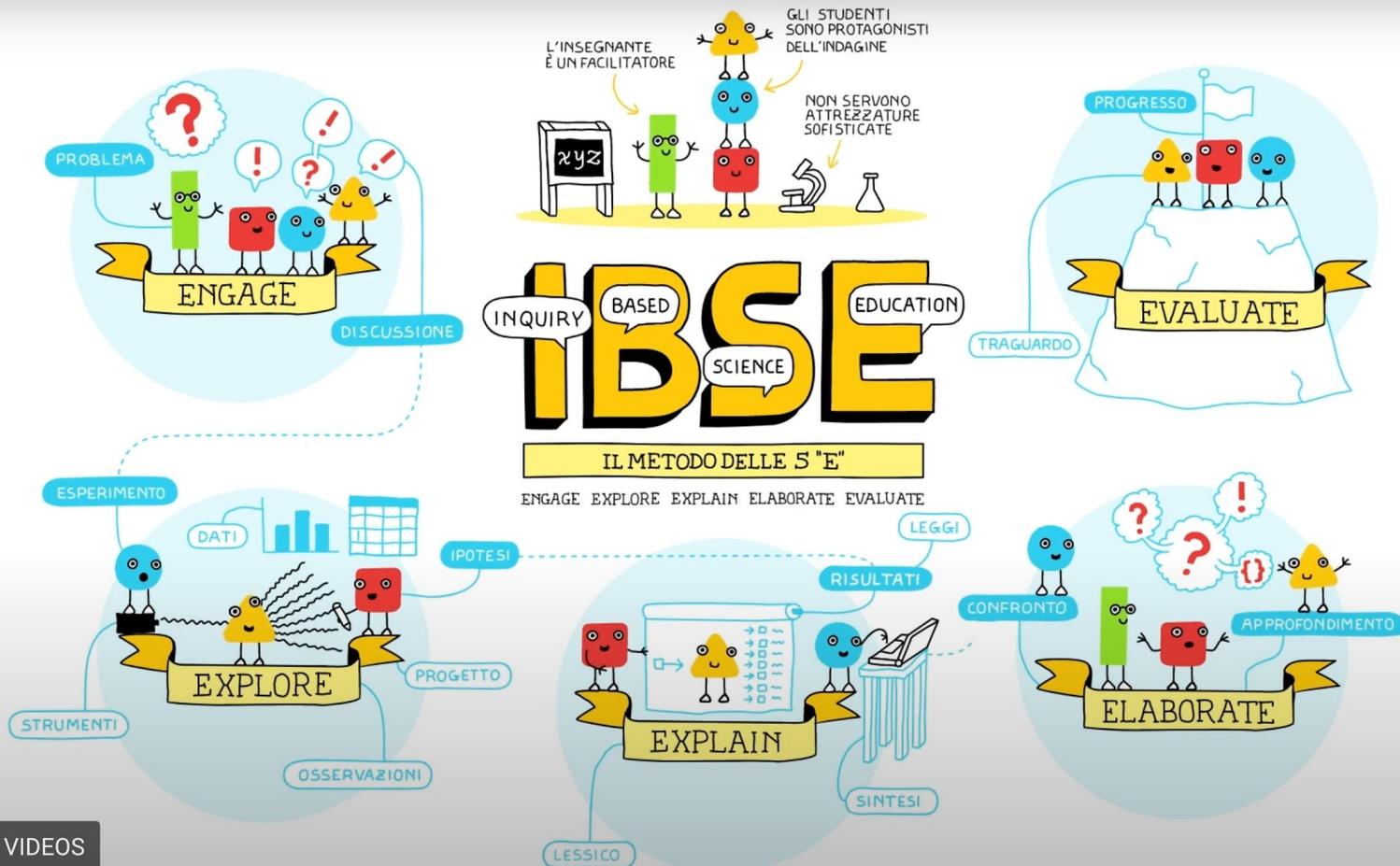
<https://www.youtube.com/watch?v=QlwkerwaV2E&list=RDCMU CRmWJULBr4CIP5xUucVgOvw&index=1>



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SCUOLA

<https://www.youtube.com/watch?v=kYap39FNFv8>

IBSE DESCRIPTION



AL VIA LA SECONDA EDIZIONE DI HOP HANDS-ON PHYSICS. PROGETTO DI INFN, CERN E FONDAZIONE AGNELLI PER LE SCUOLE MEDIE



Dopo il grande successo dell'anno scorso, torna il progetto HOP Hands-On Physics con 18 giornate di formazione docenti tra ottobre e dicembre 2024.



Mettere le mani in pasta, sperimentare in prima persona, imparare divertendosi e partendo dalle domande e non dalle risposte sono gli ingredienti fondamentali di HOP Hands-On Physics (www.hopscuola.it), un progetto per le scuole medie che propone un kit didattico e un percorso di formazione per docenti di matematica, scienze e tecnologia. Il progetto è ideato, realizzato e promosso dal CERN di Ginevra, dalla Fondazione Agnelli, e dall'INFN Istituto Nazionale di Fisica Nucleare, con il sostegno di Intesa Sanpaolo e di Stellantis, completamente gratuito per docenti e scuole.

Dopo una fase pilota nella primavera 2023, HOP è stato avviato lo scorso autunno per proporre ai docenti delle scuole medie italiane un approccio didattico innovativo e coinvolgente per insegnare le discipline STEM e torna

quest'anno con la seconda edizione che accoglierà 650 docenti da tutta Italia.

I docenti partecipanti al progetto riceveranno il kit didattico e seguiranno la giornata di formazione per imparare a utilizzarlo in classe e approfondire il metodo di insegnamento su cui si basa, l'Inquiry based learning. Il kit contiene il materiale necessario per svolgere circa 20 esperienze laboratoriali, descritte in una guida pedagogica che suggerisce all'insegnante anche alcune modalità per condurre le attività in classe. Le tematiche delle attività, scelte in base al curriculum scolastico previsto per le scuole medie, sono il metodo scientifico, la pressione, la luce e l'elettricità. La giornata di formazione, condotta da ricercatori e ricercatrici INFN ed esperti in comunicazione e in didattica, è poi un'occasione per i docenti di entrare in contatto con il mondo della ricerca di CERN e INFN e di sperimentare in prima persona le attività e il metodo che potranno portare in classe grazie al kit.

A chi parteciperà alla formazione sarà rilasciato un attestato e saranno attribuiti crediti formativi riconosciuti dal MIM attraverso il portale SOFIA.

Per l'edizione 2024, 4 nuove sedi si sono aggiunte (Aosta, Cosenza, Matera e Perugia) a quelle dello scorso anno.

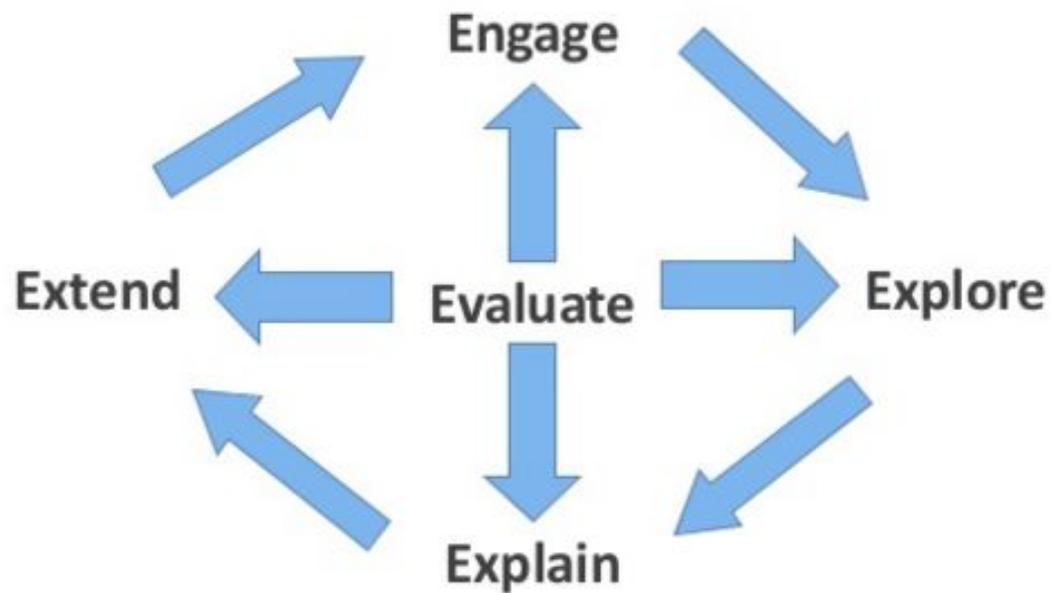
Le giornate di formazione si terranno a Torino (18 ottobre), Lecce (21 ottobre), Cosenza (25 ottobre), Aosta (30 ottobre), L'Aquila (4 novembre), Perugia (7 novembre), Genova (11 novembre), Ferrara (13 novembre), Trieste (15 novembre), Napoli (19 novembre), Roma (21 novembre), Matera (25 novembre), Catania (27 novembre), Milano (5 dicembre), Cagliari (6 dicembre), Bologna (9 dicembre), Firenze (11 dicembre), Padova (13 dicembre).

Con l'obiettivo di coinvolgere in totale circa 2.000 docenti, è già prevista una terza edizione nell'autunno 2025 le cui formazioni si terranno anche in nuove sedi in modo da estendere la diffusione del progetto.

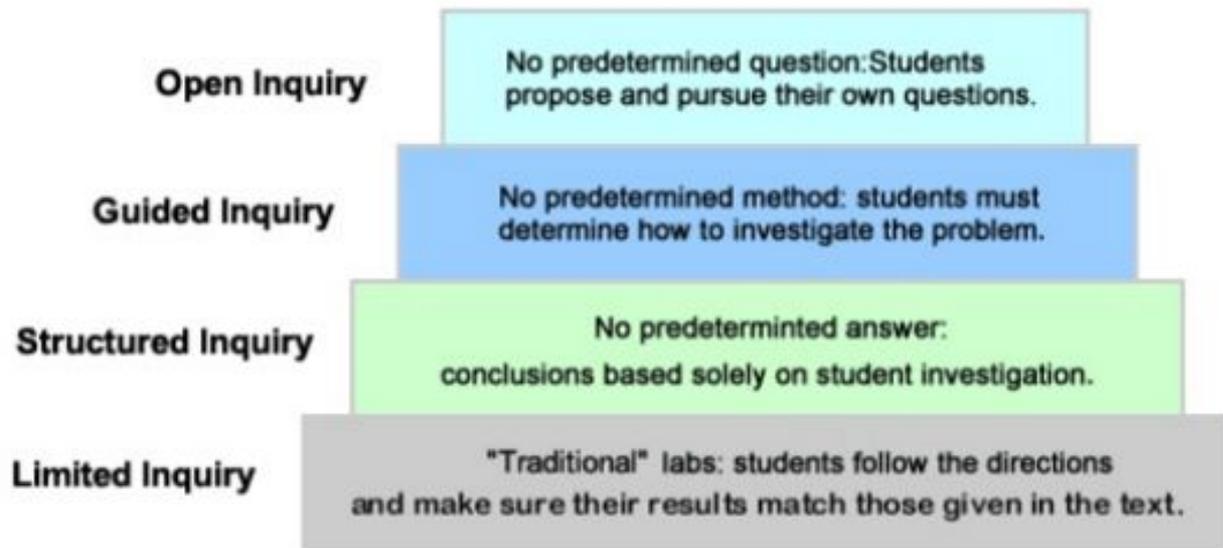


<https://www.youtube.com/watch?v=CwfVlym3wYs>

Learning Cycle



Inquiry Levels



Confirmation inquiry

Si basa sulla conferma o sulla verifica di leggi e teorie. L'indagine confermativa è appropriata all'inizio dell'attuazione dell'IBSE, quando l'insegnante mira a sviluppare le capacità di osservazione, sperimentazione e analisi degli studenti. Nel condurre gli esperimenti, gli studenti seguono le istruzioni dettagliate dell'insegnante sotto la sua guida.

Structured inquiry

A questo livello l'insegnante influenza in modo significativo l'indagine e aiuta gli studenti ponendo domande e fornendo indicazioni. Gli studenti cercano soluzioni (risposte) attraverso la loro indagine e forniscono una spiegazione basata sulle prove raccolte. L'insegnante definisce una procedura dettagliata per gli esperimenti, ma i risultati non sono noti in anticipo. Gli studenti mostrano la loro creatività nello scoprire le leggi. Tuttavia, la ricerca viene condotta seguendo le istruzioni dell'insegnante. Questo livello di indagine è molto importante per sviluppare le capacità degli studenti di svolgere indagini di alto livello.

Guided inquiry

Il terzo livello dell'IBSE cambia radicalmente il ruolo dell'insegnante. L'insegnante diventa una guida per gli studenti. Collabora con gli studenti nella definizione delle domande di ricerca (problemi) e dà consigli sulle procedure e sull'attuazione. Gli studenti stessi suggeriscono le procedure per verificare le domande di ricerca e le loro successive soluzioni. Gli studenti sono incoraggiati dall'insegnante molto meno che nei due livelli precedenti, il che aumenta radicalmente il loro livello di indipendenza. Gli studenti devono avere un'esperienza precedente nei livelli inferiori per essere in grado di lavorare in modo indipendente.

Open inquiry

Questo livello più alto dell'IBSE si basa sui tre livelli di indagine precedenti e assomiglia a una vera ricerca scientifica. Gli studenti devono essere in grado di impostare le loro domande di indagine, i metodi e le procedure di ricerca, di registrare e analizzare i dati e di trarre conclusioni dalle prove. Ciò richiede un alto livello di pensiero scientifico e pone agli studenti elevate richieste cognitive, quindi è applicabile agli studenti più grandi e/o formati.

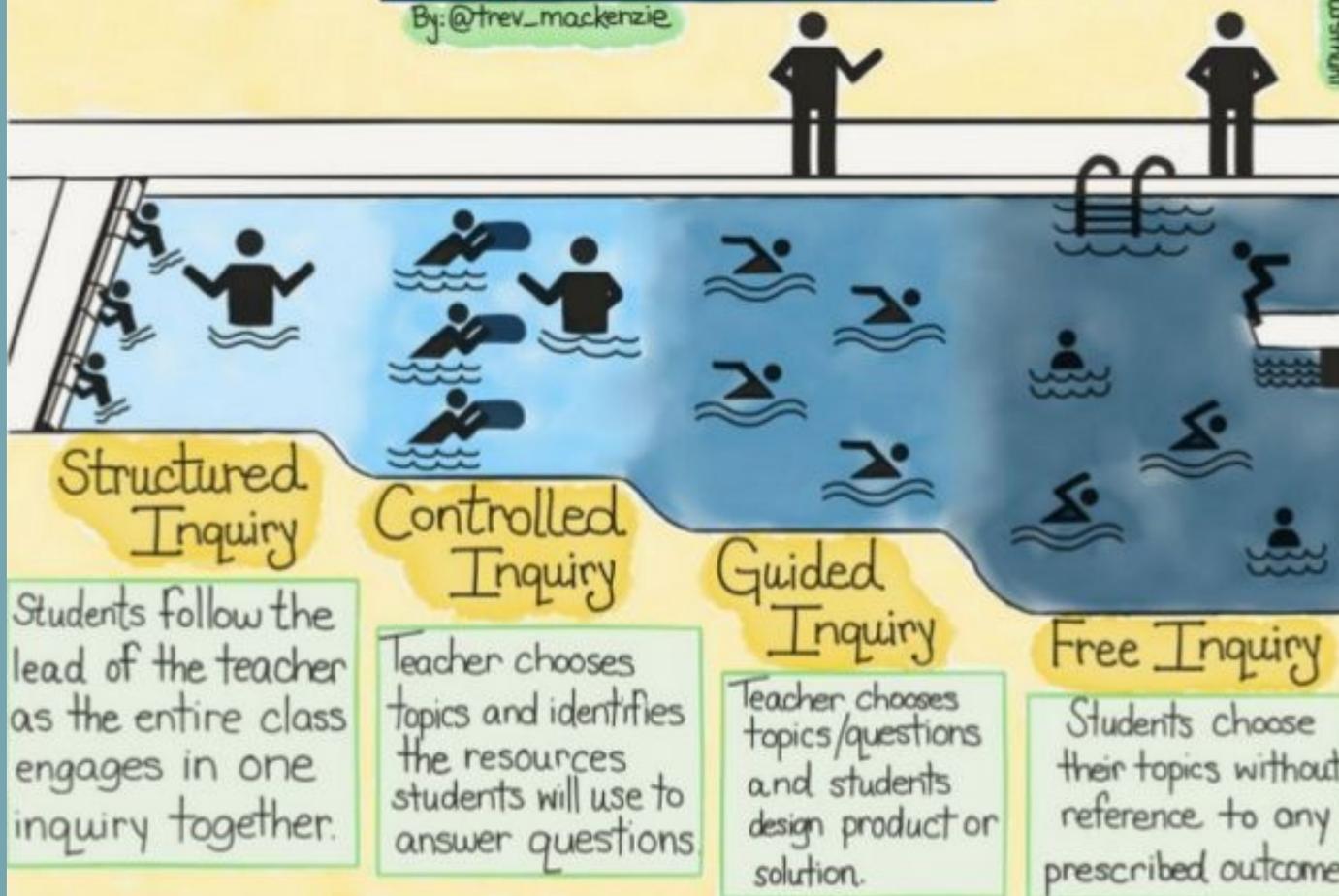
Inquiry Levels

	Traditional Hands-on	Structured Inquiry	Guided Inquiry	Student Directed Inquiry	Student Research Inquiry
Topic	Teacher	Teacher	Teacher	Teacher	Teacher/Student
Question	Teacher	Teacher	Teacher	Teacher/Student	Student
Materials	Teacher	Teacher	Teacher	Student	Student
Procedures/ Design	Teacher	Teacher	Teacher/Student	Student	Student
Results/ Analysis	Teacher	Teacher/Student	Student	Student	Student
Conclusions	Teacher	Student	Student	Student	Student

Types of Student Inquiry

By: @trev_mackenzie

@trev_mackenzie





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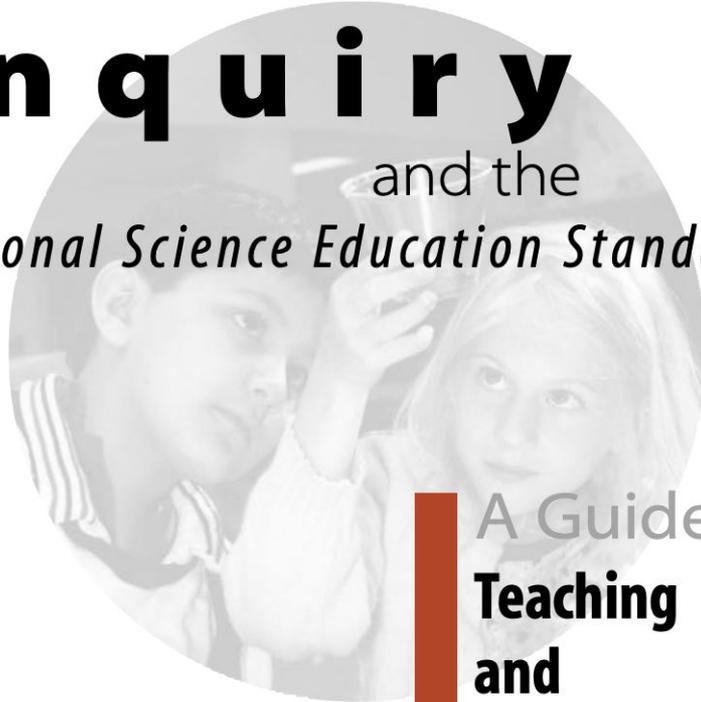
About the project

<http://www.establish-fp7.eu/home.html>

I n q u i r y

and the

National Science Education Standards



A Guide for
**Teaching
and
Learning**

Table 2-2. Content Standard for Science as Inquiry: Fundamental Abilities Necessary to Do Scientific Inquiry

Grades K-4

- Ask a question about objects, organisms, and events in the environment.
- Plan and conduct a simple investigation.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

Grades 5-8

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

Grades 9-12

- Identify questions and concepts that guide scientific investigations.
 - Design and conduct scientific investigations.
 - Use technology and mathematics to improve investigations and communications.
 - Formulate and revise scientific explanations and models using logic and evidence.
 - Recognize and analyze alternative explanations and models.
 - Communicate and defend a scientific argument.
-

The IBSE method

Table 2-3. Content Standard for Science as Inquiry: Fundamental Understandings About Scientific Inquiry

Grades K-4

- Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
- Scientists use different kinds of investigations depending on the questions they are trying to answer.
- Simple instruments, such as magnifiers, thermometers, and rulers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).
- Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations.
- Scientists review and ask questions about the results of other scientists' work.

Grades 5-8

- Different kinds of questions suggest different kinds of scientific investigations.
- Current scientific knowledge and understanding guide scientific investigations.
- Mathematics is important in all aspects of scientific inquiry.
- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.
- Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.
- Science advances through legitimate skepticism.
- Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data.

Grades 9-12

- Scientists usually inquire about how physical, living, or designed systems function.
- Scientists conduct investigations for a wide variety of reasons.
- Scientists rely on technology to enhance the gathering and manipulation of data.
- Mathematics is essential in scientific inquiry.
- Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions on possible modification; and it must be based on historical and current scientific knowledge.
- Results of scientific inquiry — new knowledge and methods — emerge from different types of investigations and public communication among scientists.

Table 2-3. Content Standard for Science as Inquiry: Fundamental Understandings About Scientific Inquiry

Grades K-4

- Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
- Scientists use different kinds of investigations depending on the questions they are trying to answer.
- Simple instruments, such as magnifiers, thermometers, and rulers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).
- Scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations.
- Scientists review and ask questions about the results of other scientists' work.

Table 2-5. Essential Features of Classroom Inquiry

- ✎ Learners are engaged by scientifically oriented questions.
 - ✎ Learners give priority to **evidence**, which allows them to develop and evaluate explanations that address scientifically oriented questions.
 - ✎ Learners formulate **explanations** from evidence to address scientifically oriented questions.
 - ✎ Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding
 - ✎ Learners communicate and justify their proposed explanations.
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Table 2-6. Essential Features of Classroom Inquiry and Their Variations

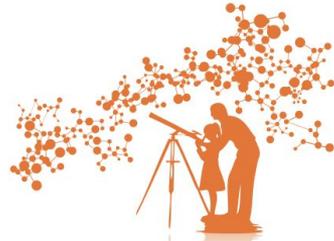
Essential Feature	Variations			
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source
2. Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3. Learner formulate explanations from evidence	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence and how to use evidence to formulate explanation
4. Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use sharpen communication	Learner given steps and procedures for communication

More ————— **Amount of Learner Self-Direction** ————— **Less**
Less ————— **Amount of Direction from Teacher or Material** ————— **More**



TEACHER TRAINING AND IBSE PRACTICE IN EUROPE

A European Schoolnet overview



PATHWAY



**Un percorso verso l'insegnamento scientifico
basato sull'indagine**

**Linee guida per
insegnanti**



EUROPEAN
COMMISSION

Community research

$$f(x) = \cos(x^2) + 1$$

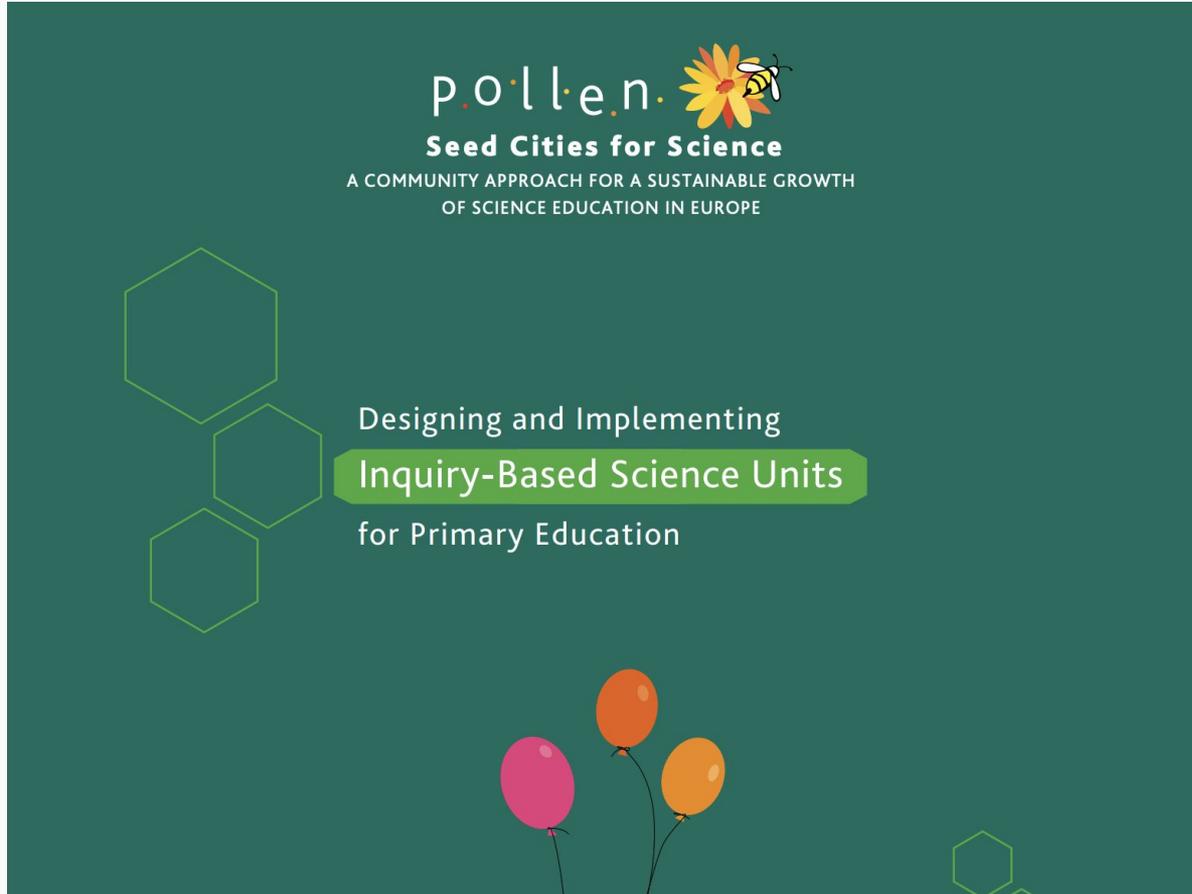


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Science Education **NOW:**

A Renewed Pedagogy for the Future of Europe

The IBSE method



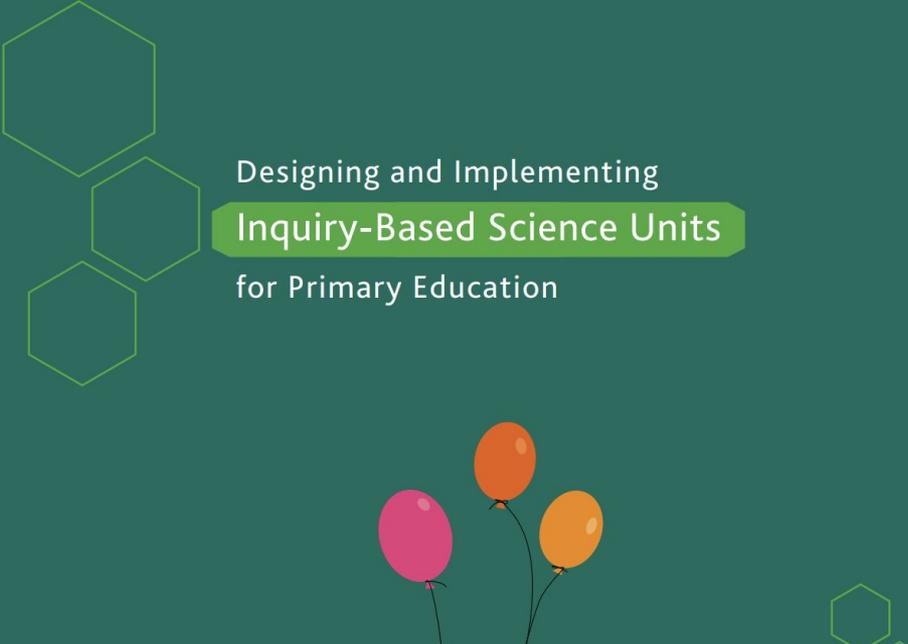
The image shows the front cover of a book. The background is a dark teal color. At the top center, the word "pollen." is written in a white, lowercase, sans-serif font, with a yellow and orange flower and a bee illustration to its right. Below this, the text "Seed Cities for Science" is written in a bold, white, sans-serif font. Underneath that, the subtitle "A COMMUNITY APPROACH FOR A SUSTAINABLE GROWTH OF SCIENCE EDUCATION IN EUROPE" is written in a smaller, white, all-caps, sans-serif font. On the left side, there are three light green hexagons of varying sizes and orientations. In the center-right, the title "Designing and Implementing Inquiry-Based Science Units for Primary Education" is displayed. "Designing and Implementing" is in white, "Inquiry-Based Science Units" is in white text inside a light green rounded rectangle, and "for Primary Education" is in white. At the bottom center, there are three colorful balloons (pink, orange, and yellow) with black strings. In the bottom right corner, there are two small, light green hexagons.

pollen. 

Seed Cities for Science

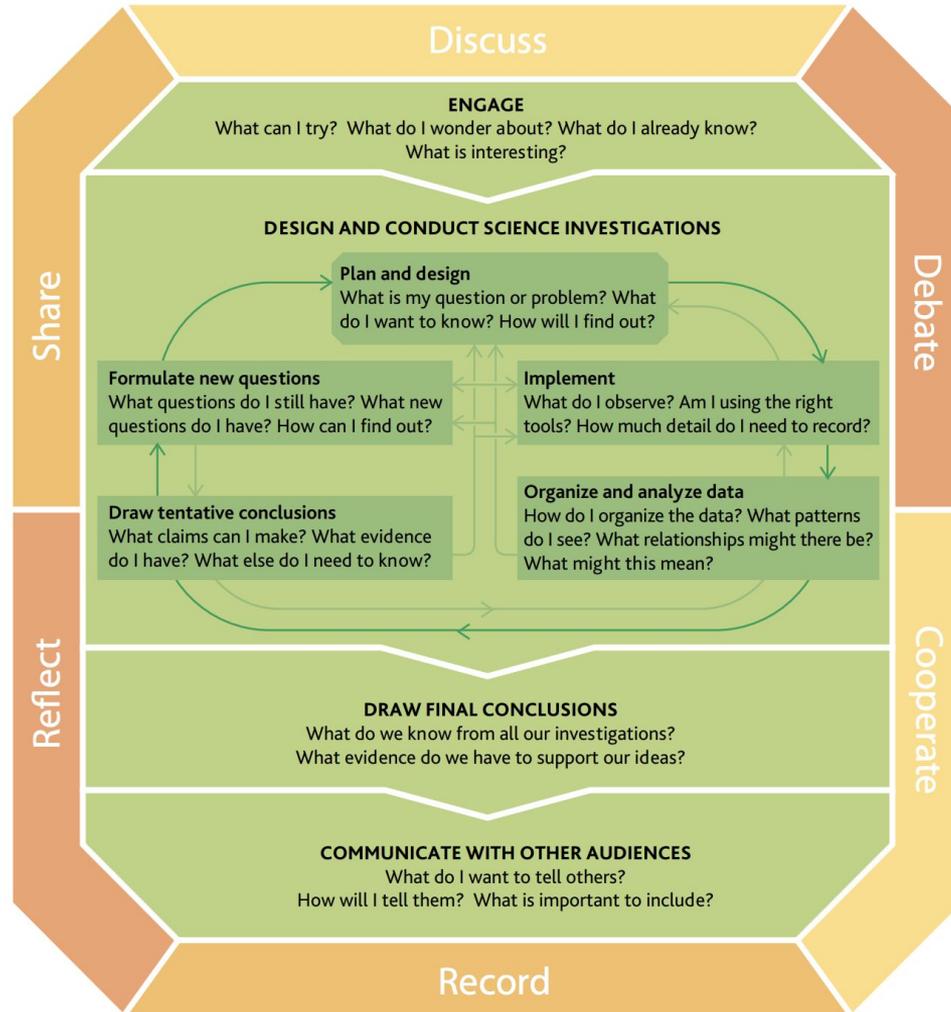
A COMMUNITY APPROACH FOR A SUSTAINABLE GROWTH
OF SCIENCE EDUCATION IN EUROPE

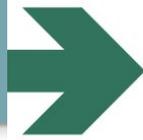
Designing and Implementing
Inquiry-Based Science Units
for Primary Education



The IBSE method

A framework for science inquiry





Summary

Inquiry-based science education (IBSE)

inquiry-based science education is grounded in the belief that it is important to ensure that students truly understand what they are learning, and not simply memorize content and information.

It is an approach to teaching and learning science that comes from :

1. An understanding of student learning

- Students attempt to make sense of the world around them - to make it predictable - by looking for patterns and relationships in their experiences and through interaction with others.
- Students construct their understanding through reflection on their experiences.

2. The nature of science inquiry

The process of science inquiry can be represented here as a set of 4 stages:

- Explore: students become familiar with the phenomenon they will study
- Investigate: students plan and carry out investigations
- Draw final conclusions: students synthesize what they have learned and come to some final conclusions.
- Communicate: students communicate their new understanding to a wider audience.

It is important to note that: **1** the process of inquiry is not a linear process or set of steps to be followed; **2** depending on the content, and the nature of the investigation, the teacher may emphasize different stages; and **3** a single session almost never includes all of the stages.

3. A focus on content

An overview of important concepts often appears in country or district frameworks and standards. But the specifics depend heavily on the local context and the interests of students and teachers.

Important principles of the inquiry-based approach

Direct experience is at the core of learning science.

Students need to have direct experience with the phenomena they are studying because:

- direct experience is key to conceptual understanding
- students build their understanding of the world around them, naïve or accurate, from their experiences;
- words alone often have little power to change these ideas.

Students must own and understand the question or problem that is the focus of their work.

For students to become engaged and invested in science investigations they must understand the question or problem they are working on and it must be meaningful to them.

Doing science inquiry requires that students be taught many skills.

There are many important science inquiry skills including making observations, asking questions, making predictions, designing investigations, analysing data and supporting claims with evidence. Of these many skills, one of the most fundamental is observing closely and determining what is important to observe.

Learning science is not only acting on and with objects, it is also reasoning, talking with others, and writing both for oneself and for others.

In order for direct experience to lead to understanding, students need to think about their hands-on work, discuss and debate it thoughtfully with others, and write about it.

The use of secondary sources complements direct experience.

Students will not and cannot discover all they need to know through inquiry. The use of secondary sources in IBSE is important in the service of students' explorations, not as a substitute for them.

Science is a cooperative endeavour.

Science investigation is usually collaborative. When students work together in small groups or teams, they are sharing ideas, debating, and thinking about what they need to do and how to do it.

Some important pedagogical considerations in IBSE

Organizing the classroom

If students are to engage in hands on investigations in teams, the classroom must be set up to make this possible with appropriate materials accessible to students and adequate space. If students are to work and learn together, all must feel comfortable and have the opportunity to participate in all aspects of the science work - the hands on, thinking, talking and writing.

Creating and asking questions

The questions teachers ask play a very important role in IBSE. Productive questions move a group of students to a deeper level of work and reasoning. Unproductive questions often call for a short verbal response and nothing more.

Using students' prior experiences and ideas

Students generally have ideas about the phenomena they encounter in their day to day lives, some of which are incomplete or contradict scientific ideas. Teachers need to take these ideas seriously and adapt classroom activities to allow new and more coherent explanations to emerge.

Holding group discussions

Discussion amongst students provides opportunities to make ideas explicit; hear, discuss and debate the ideas of others; and agree on conclusions. They take place throughout the inquiry process between pairs, among team members, and as a whole class.

Guiding student recording

When students record their work they learn, realise the progress they have made, remember what has been accomplished, and note the development of their thinking. Records of science work include text, drawings, flowcharts, graphs, charts, posters, etc., Students keep science notebooks, produce written documents for presentation, and prepare reports. Teachers, as they read students' work, can assess their development and note the nature of their thinking.

Pedagogical strategies for specific stages of inquiry

Guiding students as they design an investigation

Learning to design an investigation is an important part of understanding the nature of science. The process often begins with a full class discussion to clarify the question or problem and determine what elements of the phenomenon are important to study. In an experimental investigation, the next step is to discuss how to test the factors, one after another, using the equipment available. If the investigation is observational rather than experimental, students discuss what would be important to observe, how they will observe, and how they will collect their data.

Helping students analyze their results to reach valid conclusions

Analysis of the findings from investigations and the drawing of valid conclusions are critical for students to build reliable and meaningful knowledge from their investigations. This process occurs at the class level following each investigation and at the end of a part or the whole of a unit.

Comparing and contrasting with "established fact"

As students investigate natural phenomena, they develop and compare their conclusions amongst themselves and construct new understanding. But unlike scientists, students are not discovering new phenomena and laws; rather what they learn in school is established scientific knowledge. Therefore they need to compare and contrast their work with the known by referring to other sources such as books, the internet or local scientists.

Formative assessment

Formative assessment goes on continuously throughout a unit of study. It is a tool for both teachers and students whose purpose is to guide teaching and learning. It is different from "summative" assessment that takes place at the end of a unit or year.

Selecting the content

The starting point is to think about the basic content of a unit in relation to the students for whom it is designed. Questions to consider include the following:

- What phenomena and basic science concepts will be the foci of the unit?
- What are likely prior ideas and experiences students will bring to this unit?
- What level of understanding of the selected concepts do we expect students to achieve? What are possible assessment questions and tasks we might use and what outcomes would we anticipate?
- What science inquiry and/or technology design skills will be emphasized?
- What attitudes about science should be identified?

Selecting the context

Once the concepts are clear, the next step is to decide the context in which they will be explored. For example, a unit on levers and other simple machines might have as a context the construction of a local building, the pyramids of Egypt, or a study of playground equipment. Some phenomena are intrinsically interesting in and of themselves, and need no other context (e.g. the study of the properties of water, the systems of the human body). The context can influence how meaningful the unit is to the students as well as the kinds of connections and applications they will make to their daily lives or to other areas of study.

In selecting a context or theme, some questions to consider include the following:

- Where in the day-to-day world of the students are the phenomena, objects, and materials through which the concepts might be addressed to be found?
- What context allows for significant investigation, in-depth and over time?
- What is likely to be engaging and/or of particular interest to the students?
- What materials and resources are available?

Developing the storyline

The progression of ideas and learning experiences in a unit is very important. A unit cannot simply be made up of sets of activities on a topic. Learning experiences must follow one another in a carefully ordered sequence that is organized to allow the students to construct particular understandings. This is not to say that there is only one sequence or one best one. Nor does this mean that one should not spend time on a student-generated question that may arise during the unit. But for the teacher and student alike it should be clear why one learning experience comes before or after another and how students are developing their understanding and skills. Questions to consider include the following:

- What is the progression of learning for each concept?
- What misconceptions might students have?¹
- How will each learning experience build on what came before it and lead to the following learning experiences?
- What do we assume has been experienced/understood at the end of each learning experience that will inform the next?
- How is understanding deepened as the learning experiences progress?

Designing the end-of-unit assessment

Given a clear set of goals (concepts, skills, and attitudes,) a context, and the storyline, we strongly suggest that there be a return to the consideration of how student progress will be assessed. The assessments designed at this stage may need revision later in the development process, but they are an essential part of the early development process as they insist on an understanding of exactly what is meant by the major goals of the unit and the level of anticipated understanding.

Many final assessments include both a written component and a performance component. This provides students with at least two ways to demonstrate what they have learned, one of which is less language-dependent. In addition performance assessments are often far better at assessing student skills than paper and pencil ones.

The final assessment does not stand on its own as a strategy for looking at student progress. The information it provides is simply added to the information collected by the teacher and students through the on-going formative assessment process. In many instances, IBSE units include a pre-assessment similar or identical to the final assessment so that the teacher and the student can reflect on progress made.

Assessments are difficult to develop and this brief section is designed simply to raise awareness of this component of unit design and to suggest that thinking about assessment can help the process of developing or adapting a unit. Following are a few questions to think about in the development of unit assessments:

- What are the main ideas of the unit to be assessed? What are the skills?
- What questions and tasks will allow students to demonstrate their understanding rather than what they remember or have memorized?
- How will the task or question differentiate between students' language skills and their understanding of science?
- Do the tasks or questions allow for responses at different levels rather than simply a right or wrong answer?
- Do the questions or tasks deal with experiences that are accessible to all students?
- How will the results be analyzed and evaluated?

Identifying the learning experiences

Once all of the above has been accomplished, or analyzed in the case of an adaptation of a unit, the next step is to determine the individual learning experiences – the specifics of what the students will actually do. A learning experience will usually take place over more than one session depending on what it is about and the length of the session.

The starting point of the unit is critical. Whether it is a question or a problem, it needs to capture the students' interest and set the stage for the work to come. It is more than a quick motivator or "magic trick" as it will be a continuous point of reference as the unit proceeds. In some cases, a new but related question, challenge, or problem may initiate a new part of the unit.

Questions to think about when selecting or designing the activities include the following:

- What will engage and motivate the students?
- How will the unit begin?
- What types of experiences allow them to investigate as independently as possible?
- How many learning experiences might be needed to address a concept?
- How does the experience focus students' attention on the important concepts and illuminate them most effectively?
- What materials will be needed?

Developing the structure of the learning experience

Clearly it is important to describe in some detail the overall structure of the learning experience and what will happen in each session. There are many possible questions to consider:

- What is the sequence or mini-storyline of the learning experience?
- How will students connect the work of the learning experience with what has come before? Where are they in the stages of inquiry?
- In each session, what types of activity will take place – hands-on work, discussion, writing, reading, etc.?
- What stage(s) of inquiry will they be doing in each session?
- How will the session and learning experience come to a close – with a discussion, a group presentation, the writing of a text?

The amount of detail for each session will vary a great deal. Brief descriptions of each step of an activity may be fine for the very skilled IBSE teacher but less useful for others.

Designing formative assessment (See Part One, Formative Assessment)

Each session of a learning experience offers opportunities to assess student skills, reasoning, and understanding. Identifying what might be important and possible to assess, strategies to use, and methods of documentation are all part of the design of the learning experience and of the individual sessions. These assessments are, of course, informed by the goals and objectives of the session. Some assessments may target the group as a whole, while others will be more focused on the individual. Some assessments may simply take the form of questions to ask students informally, behaviours to watch for, and comments to listen for. Others may be more structured, such as examining student notebooks or asking a particular question of the group. Finally, it is important to have a strategy for recording assessment data. Following are questions to consider:

- What are the goals and objectives of the session?
- Which ones are particularly important to focus on?
- In which part of each session will students be using a particular skill or developing a specific understanding?
What questions might give insight into the students' thinking and understanding?
- How will the data be analyzed and used by you? By the students?

Determining the grouping of students (See Part One, Science is a cooperative endeavour)

There are many ways to group students, and decisions around grouping are heavily influenced by the local context – the number of students in a class, their cooperative skills, the age level, etc.. However, there also are considerations directly related to the content of the learning experience and the stage of inquiry. These influence the decisions about when to have students work individually or in pairs, in small groups or as a whole class. Consider the following questions:

- What experience do students have working together? How well do they work on their own?
- What size group would work best with the specific materials?
- How much space will be required?

Planning the discussions and questions

(See Part One, Holding Group Discussions, and Crafting and Asking Questions)

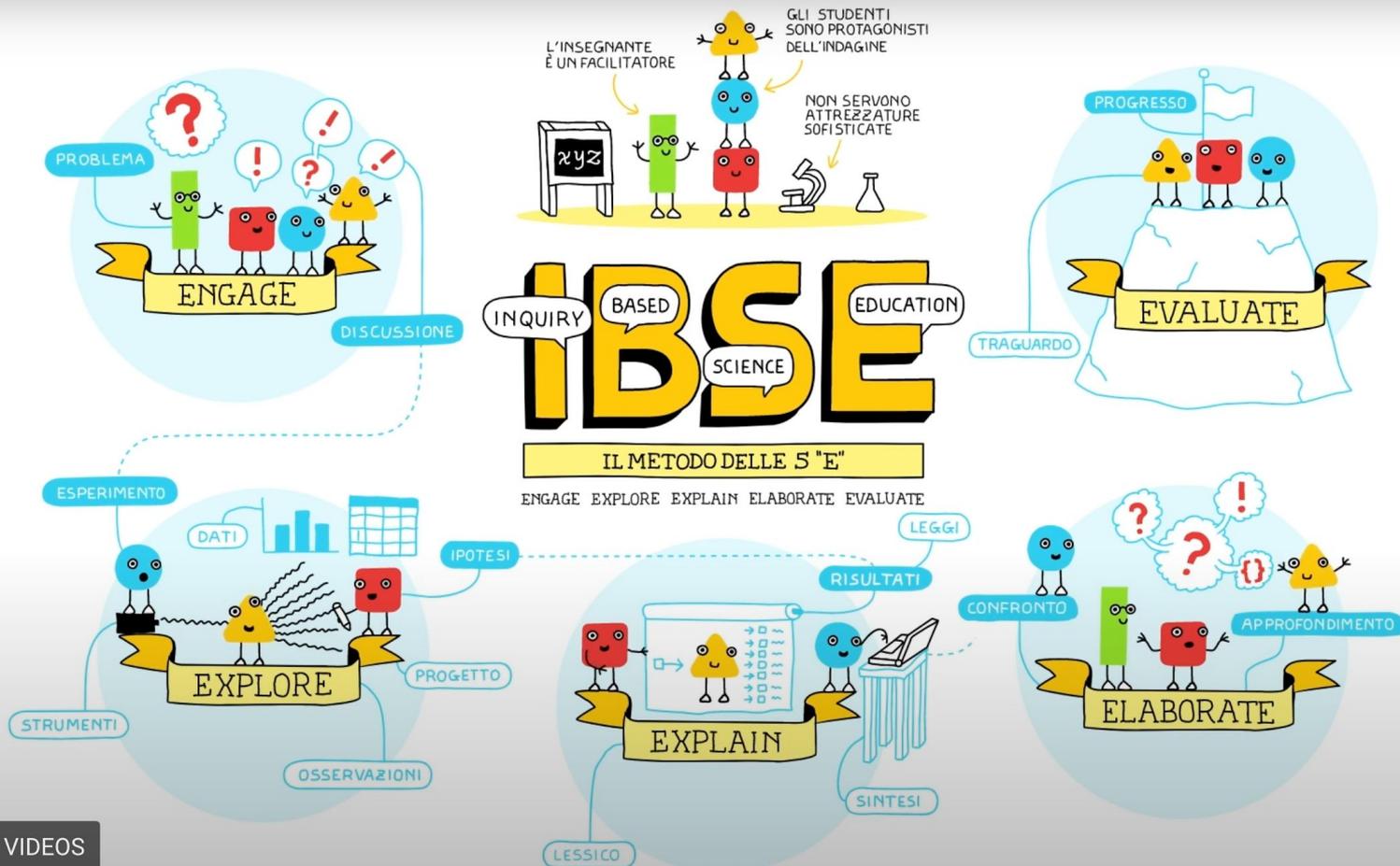
Time for students to discuss and debate their work must be built into each session of the learning experience. Depending on the session and stage of inquiry, the talk may take place between working pairs and teams, or as a full class. The time also will vary from a few minutes in a team to on-going discussion as teams engage in their investigations, to a lengthy debate as a class. Of particular importance for the class discussions are the questions and comments posed by the teacher during these times. Questions to think about include the following:

- When is a full group discussion important?
- What do the students need to do/have ready for the discussion?
- What question(s) will provoke a productive discussion?
- What type of closure will there be?

Planning the writing/recording (See Part One, Guiding Student Writing)

Just as with discussion, writing in the science notebook takes time. It is easy to say that students should write, but making clear when and how students record is important for them and for the teacher. This does not preclude additional writing; it simply makes sure that the necessary recording is done. It is also important to include in each session the nature of the writing the students will do. Questions to consider include the following:

- What stage of the inquiry process have the students reached? What are the implications for the writing?
- Do the students have the appropriate skills?
- Is the writing focused on the science and not only on writing skills?
- Is the writing individual or is it carried out as a group?



Let's try ... – GROUP 1

<p>ENGAGE: L'insegnante appoggia una piuma al pavimento e accende una ventola. Cosa ha fatto muovere la piuma?</p>	<p>EXPLORE: L'insegnante predispone vari materiali (piume, fogli, cannuce,...) e i bambini provano a soffiare, esplorare, osservare cosa si muove e cosa no</p>
<p>EXPLAIN: Seduti in cerchio i bambini dicono cosa hanno osservato e scoperto come ad esempio "Si muove quando soffio/La piuma si sposta perché l'aria la spinge,..."</p>	<p>ELABORATE: In circle time l'insegnante chiede "Com'è andata oggi? Cosa vuoi provare la prossima volta?"; autovalutazione: mi è piaciuto/ho capito; non tutto mi è chiaro; voglio provare ancora</p>

ENGAGE: perché si forma l'arcobaleno?

EXPLORE:

- perché ha piovuto
- perché è venuto il sole dopo la pioggia
- perché il cielo si colora

Per verificare le loro ipotesi, i bambini possono andare nel giardino della scuola accompagnati dal docente e fare degli esperimenti utilizzando uno spruzzino d'acqua e la luce del sole. In questo modo sarà possibile osservare che il fascio di luce subisce rifrazioni e riflessioni colpendo le goccioline d'acqua. Lo stesso esperimento può essere effettuato anche in aula, prima con la luce spenta e poi puntando una luce dietro lo spruzzo d'acqua.

EXPLAIN:

ELABORATE:

GRUPPO 2 - CONTINUAZIONE

EXPLAIN	ELABORATE
<p>i Bambini spiegano ai compagni ciò che hanno scoperto riguardo al fenomeno dell'arcobaleno</p>	<p>Approfondimento della conoscenza del fenomeno della rifrazione della luce coinvolto nella formazione dell'arcobaleno, applicandola ad altre situazioni-problema come quella della rifrazione della luce nel caso in cui essa venga puntata verso un prisma.</p>

Let's try ... – GROUP 3

<p>ENGAGE: domanda stimolo “Come fa l’acqua a salire sulle nuvole?”</p>	<p>EXPLORE: per rispondere a queste domande i bambini potrebbero ad esempio utilizzare due bicchieri d'acqua, dove uno viene posizionato al sole; mentre, l’altro all’ombra.</p>
<p>EXPLAIN: in questo modo i bambini notano che l’acqua contenuta nel bicchiere al sole si abbassa di livello.</p>	<p>ELABORATE: per collegare il fenomeno dell’evaporazione al ciclo dell’acqua i bambini realizzeranno un esperimento. Quest’ultimo viene chiamato “ciclo dell’acqua in un sacchetto”. I bambini disegneranno su un sacchetto il ciclo dell’acqua con il mare, il sole e le nuvole. Successivamente, il sacchetto verrà riempito con un po’ d’acqua e appeso su una finestra soleggiata. Dopo qualche ora i bambini noteranno che all’interno del sacchetto si forma la condensazione e vedranno in tempo reale le fasi del ciclo dell’acqua.</p>

<p>ENGAGE: la domanda stimolo è: “come mai quando cucini la pasta di formano le gocce sul coperchio?”</p>	<p>EXPLORE: Ai bambini viene chiesto di mettere su l'acqua, affiancati da un adulto, e di osservare i fenomeni e annotarli. Successivamente al rientro in classe i bambini si confrontano tra di loro su ciò che hanno osservato e le loro ipotesi.</p>
<p>EXPLAIN: uno ad uno i bambini espongono ciò che hanno scoperto, utilizzando un lessico adeguato.</p>	<p>ELABORATE:</p>