

**Physics Education
Laboratory
Lecture 16
IBSE Laboratory**

Francesco Longo - 17/11/25

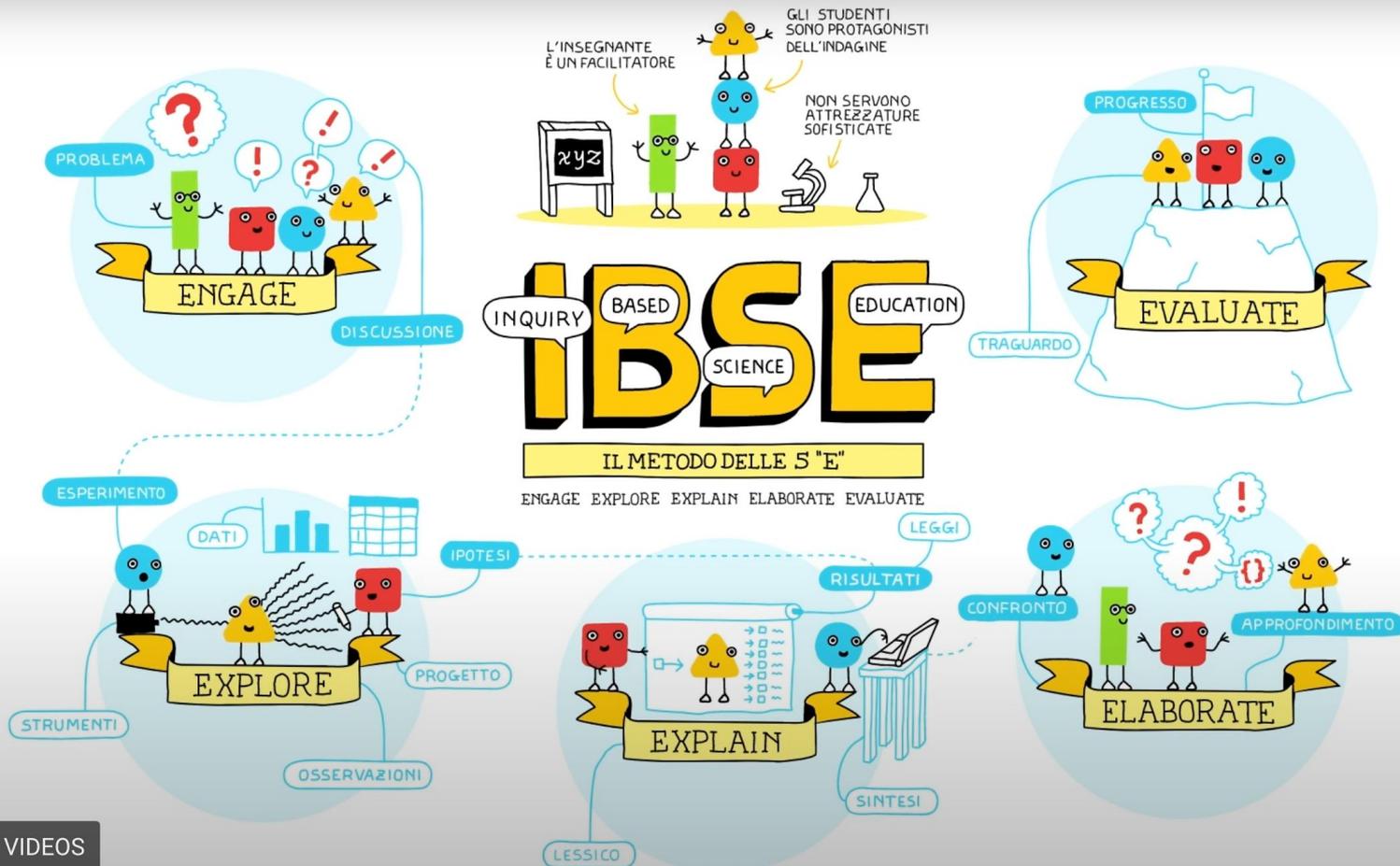


Inquiry Based
Science Education
(IBSE approach)

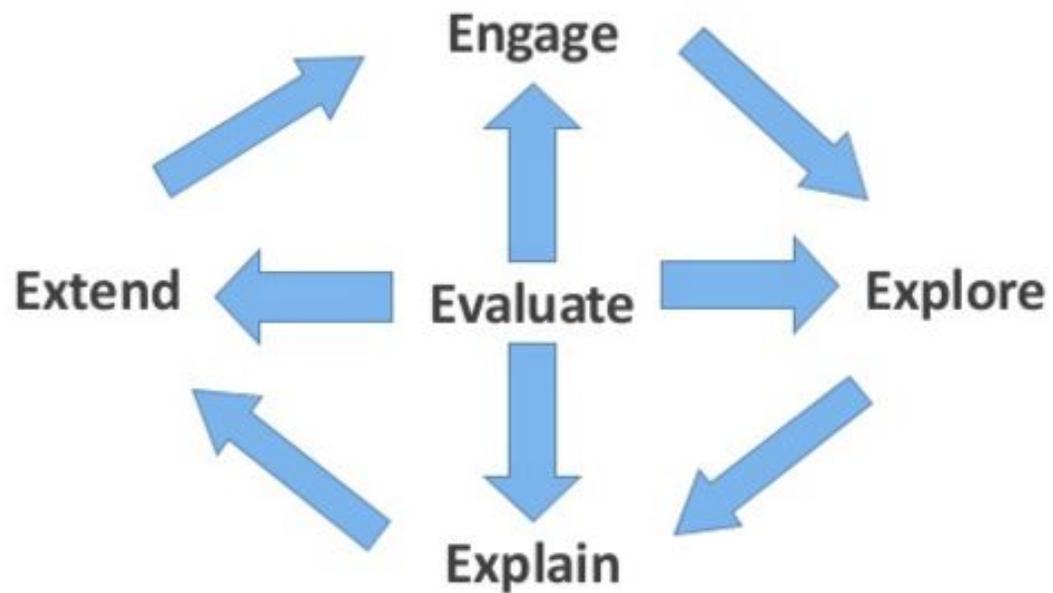


Inquiry is a multifaceted activity that involves: making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret 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.

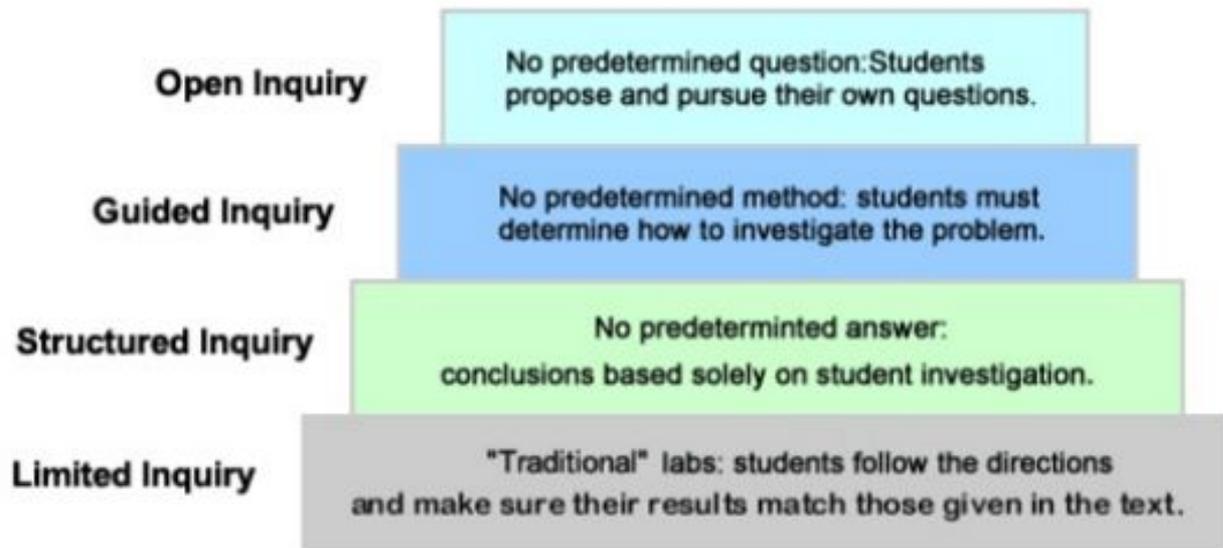
(National Research Council, 1996)



Learning Cycle



Inquiry Levels



Confirmation inquiry

It is based on confirmation or verification of laws and theories. Confirmatory inquiry is appropriate at the beginning of IBSE implementation, when the teacher aims to develop observational, experimental and analytical skills of the students. When conducting experiments, students follow teacher's detailed instructions under his/her guidance.

Structured inquiry

The teacher significantly influences the inquiry at this level and helps students by asking questions and providing guidance. Students look for solutions (answers) through their inquiry and provide an explanation based on the evidence they have collected. A detailed procedure of experiments is defined by the teacher, but the results are not known in advance. Students show their creativity in discovering laws. However, they are conducted by teacher's instructions in the research. This level of inquiry is very important for developing students' abilities to perform high-level inquiry.

Guided inquiry

The third level of IBSE changes the role of the teacher dramatically. The teacher becomes a students' guide. He/she cooperates with students in defining research questions (problems) and gives advice on procedures and implementation. Students themselves suggest procedures to verify the inquiry questions and their subsequent solutions. Students are encouraged by the teacher much less than in the previous two levels, which radically increases their level of independence. Students should have previous experience of lower levels to be able to work independently.

Open inquiry

This highest level of IBSE builds on previous three inquiry levels and it resembles a real scientific research. Students should be able to set up their inquiry questions, methods and procedures of research, record and analyze data and draw conclusions from evidence. This requires a high level of scientific thinking and places high cognitive demands on students, so it is applicable for the oldest and/or gifted students.

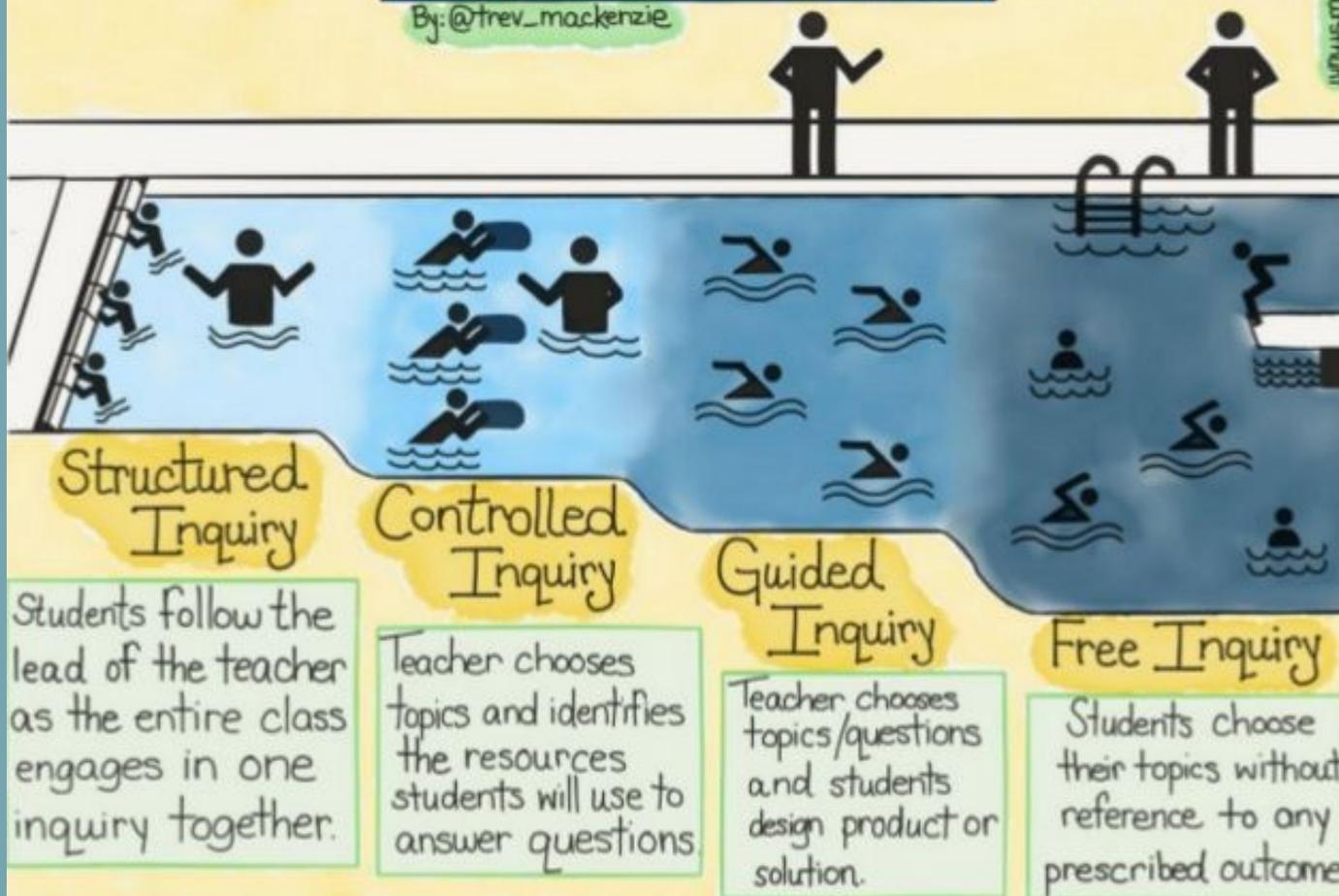
Inquiry Levels

	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

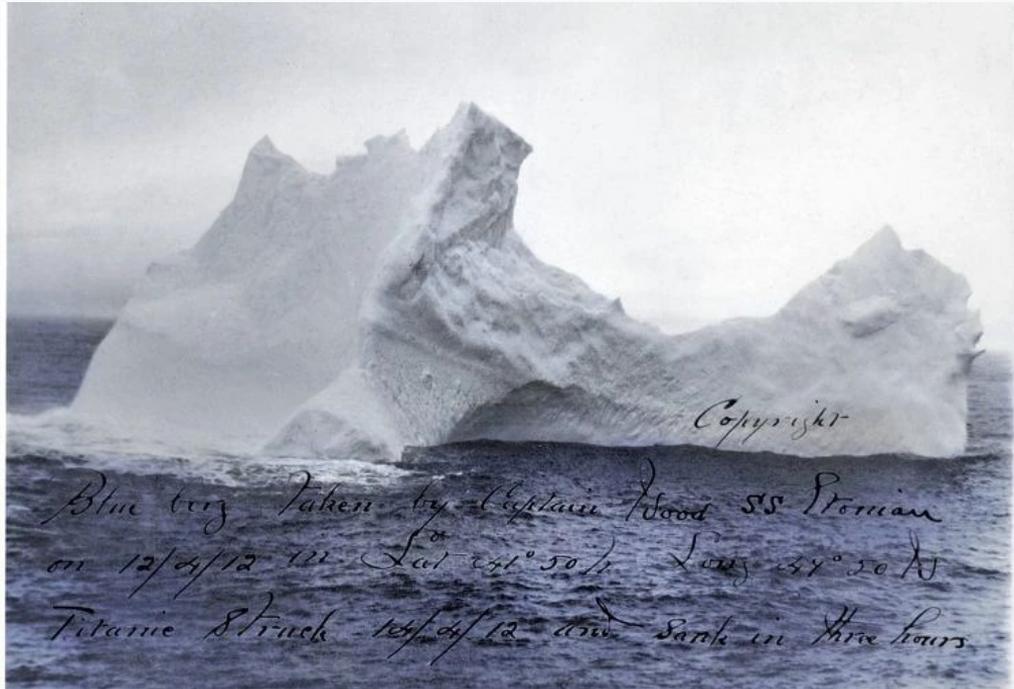
@trev_mackenzie



IBSE Engage Example for Fluidodynamics



IBSE Engage Example for FluidDynamics



IBSE Engage Example for Fluidodynamics



IBSE example for Fluidodynamics - 1

<p>ENGAGE: disastro del Vajont: discussione sulle conoscenze pregresse e lettura di alcune testimonianze. Visione di un filmato di una ricostruzione dell'evento.</p>	<p>EXPLORE: modello con bacinella d'acqua sopra una bilancia e un sasso (di massa nota) che ci cade dentro. Si vuole calcolare la quantità d'acqua che fuoriesce e la sua potenza. Si ripetono i calcoli con i reali valori della diga.</p>
<p>EXPLAIN: discussione qualitativa sulle diverse densità di acqua e roccia, considerazioni sulla legge di Archimede e i volumi in gioco.</p>	<p>ELABORATE: possibili domande sul ruolo dell'aria nel disastro (boato, vento, ...).</p>

IBSE example for Fluidodynamics - 2

<p>ENGAGE:galeone (narrazione della vicenda)</p>	<p>EXPLORE: esperimenti sul galleggiamento in bacinelle d'acqua con oggetti di pesi diversi che possono essere distribuiti in modo diverso</p>
<p>EXPLAIN: gli studenti devono notare che la diversa disposizione degli oggetti varia il baricentro</p>	<p>ELABORATE:gli studenti concludono l'esistenza di una forza (forza di archimede) che si oppone alla forza peso e che la stabilità (momento delle forze) della nave dipende dal baricentro</p>

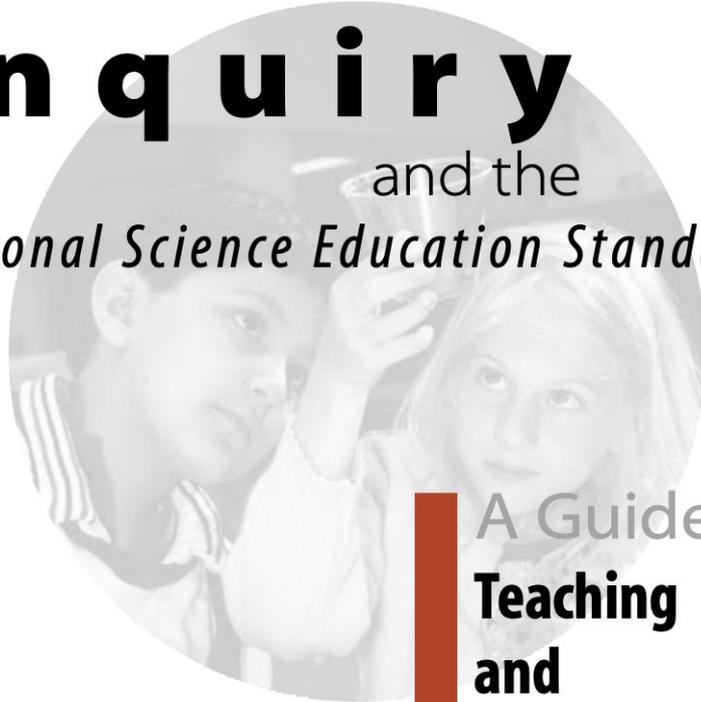
IBSE example for Fluidodynamics - 3

<p>ENGAGE: Titanic</p>	<p>EXPLORE: forniti i materiali per esplorare 3 diverse situazioni (variazione, densità corpo, variazione densità fluido e variazione volume</p>
<p>EXPLAIN: scheda con domande aperte sulle diverse situazioni, individuare relazioni tra i diversi casi, come queste diverse situazioni spiegano l'evento del Titanic.</p>	<p>ELABORATE: confronto tra le considerazioni dei vari gruppi in crisi discute sui risultati altrui. come gruppo classe si arriva a delle conclusioni comuni</p>

I n q u i r y

and the

National Science Education Standards



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A European Schoolnet overview

pollen.



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