OECD
PROGRAMME FOR INTERNATIONAL STUDENT ASSESSMENT (PISA)

SCIENTIFIC LITERACY _DECODING THE DEFINITION

DAY : 1

SESSION : 4

WHAT IS SCIENTIFIC LITERACY?

Scientific Literacy - "The capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity."

SCIENTIFIC LITERACY MEANS:

- ✓ that a person can ask, find or determine answers to questions derived from curiosity about everyday experiences.
- ✓ that a person can describe, explain and predict natural phenomena.
- ✓ being able to read with understanding, articles about science in the popular press and to engage in social conversation about the validity of the conclusions.

SCIENTIFIC LITERACY MEANS:

- ✓ that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.
- ✓ being able to evaluate the quality of scientific information based on its source and the methods used to generate it.
- ✓ the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately.

(National Science Education Standards, page 22)

SCIENTIFICALLY LITERATE STUDENTS HAVE A SET OF BASIC SKILLS THAT ALLOW THEM TO:

- Access the scientific information they need when confronting a real-world problem or question.
- Critique claims that they utilize scientific evidence to reconcile conflicting claims about scientific evidence.
- Understand human factors that influence the creation, interpretation, and communication of scientific evidence; and
- Integrate thinking scientifically about a question with knowledge from other fields.

http://scienceliteracy.bard.edu

WHY MUST SCIENTIFIC LITERACY BE CULTIVATED

One question that each Science teacher needs to ask within is -- What should my students know about science by the time they graduate from school?

They should certainly be **Scientifically literate**.

After PISA 2006, science was the focus domain (major domain) for the second time in PISA 2015.

Programme for International Student Assessment (PISA)

- Created in 1997 by OECD
- Aim: to monitor outcomes of educational systems in terms of student achievement
- Age: 15 years

Programme for International Student Assessment (PISA)

Surveys every 3 years since 2000 in reading, mathematical and scientific literacy

- 2000 **reading**, maths, science
- 2003 reading, **maths**, science
- 2006 reading, maths, **science**
- 2009 **reading**, maths, science
- 2012 reading, **maths**, science
- 2015 reading, maths, **science**
- 2018 **reading,** maths, science
- **2021** reading**,** **maths**, science

Why comparing countries in science and mathematics education?

- Economic importance of science and mathematics education
- Internationalization: mobility of students
- Tool for educational policy: monitoring, reform
- Learning from other systems: relative strengths and weaknesses

FOCUS OF PISA

- Collaborative effort: OECD + non-member partner economies
- To measure how well students at age 15 are prepared to meet challenges in future life
- Beyond school-based approach: use of knowledge in everyday tasks and challenges
- Based on model of lifelong learning
- Not only assessing knowledge: also how to apply knowledge in real-life issues

PISA's scientific exercises cover important concepts in physics, chemistry, biology and geosciences. In doing so, the PISA study examines the extent to which young people are scientifically literate when they complete their compulsory schooling.

Context

Life Situations that involve Science & Technology

*Personal

*Local/National

* Global

Competencies

*Explain Phenomena scientifically

*Interpret data and evidence scientifically

*Evaluate and design scientific enquiry

Knowledge

What they know about the natural world and technology (Knowledge of Science) ie Content

*Science itself (Knowledge about Science Procedural, Epistemic)

Attitude

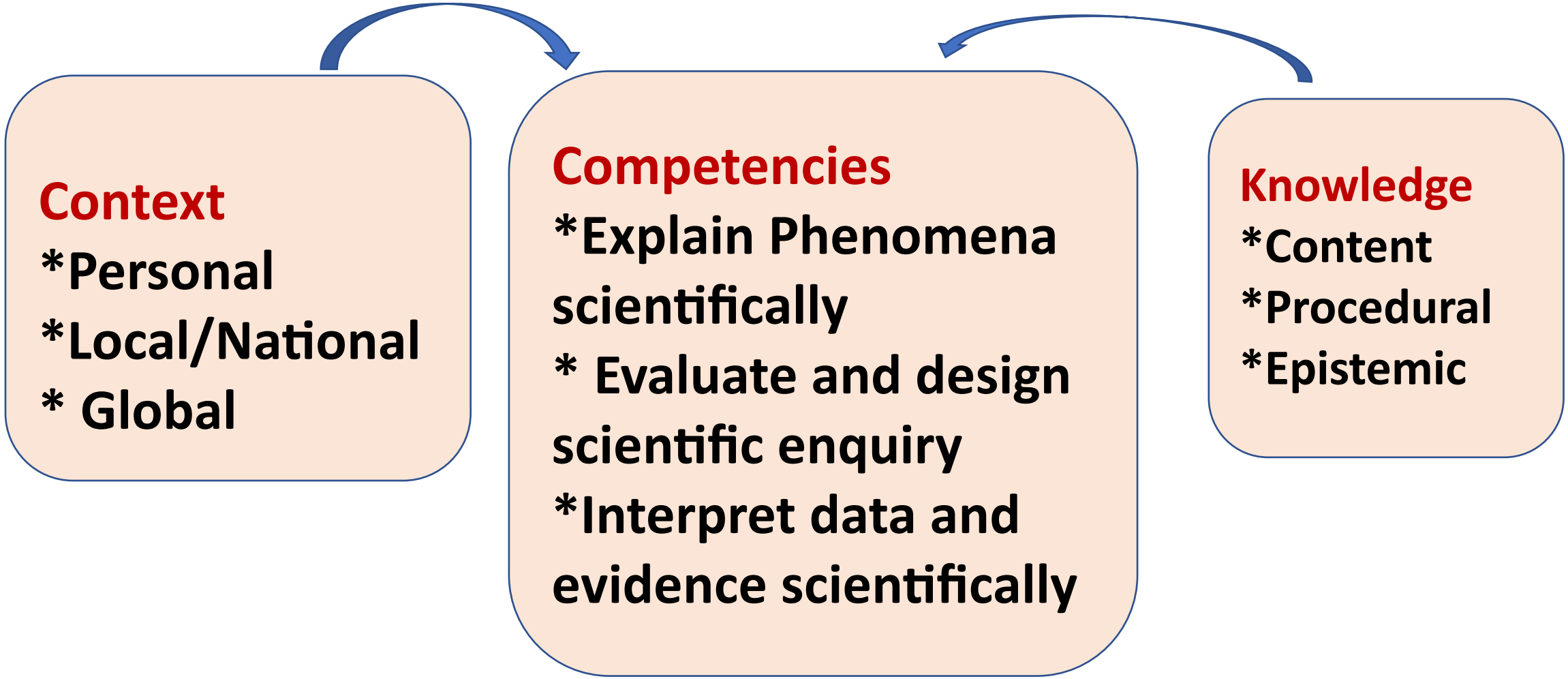
How they respond to Science issues:

*Interest in Science

*Valuing Scientific approaches to enquiry

*Responsibility and awareness towards resources & environments

The components of the PISA 2015 Scientific literacy framework (Science was a Major Domain in PISA 2015



The components of the PISA 2018 Scientific literacy framework
Science was a Minor Domain in PISA 2018

The conceptual framework defines five contexts, each of which may have a personal, social or global reference:

- health and disease
- natural resources
- environment quality
- hazards
- the frontiers of science and technology

SCIENTIFIC KNOWLEDGE:

Knowledge of science: i.e.Content Knowledge about

- Physical systems
- Living systems
- Earth and space systems

Knowledge about science:

- Procedural knowledge: variables, measurement, replicability, representing data, control of variables
- Epistemic knowledge: purposes, nature, values, justification, errors, collaboration and critique. (In other words Knowledge Construction)

THE 2015/ 2018 PISA DEFINITION OF SCIENTIFIC LITERACY?

A Scientifically literate person, therefore is willing to engage in reasoned discourse about Science and technology which requires the ***competencies*** *of:*

1. ***Explaining phenomena scientifically***
2. ***Evaluating and designing scientific enquiry***
3. ***Interpreting data and evidence scientifically***

HOW IS SCIENTIFIC LITERACY MEASURED IN PISA?

The scientific literacy framework comprises four interrelated aspects:

- ✓ the **contexts** in which tasks are embedded
- ✓ the **competencies** that students need to apply
- ✓ the **knowledge domains** involved and
- ✓ **students´ attitudes** towards science

Table 4.2. Contexts for the PISA 2018 scientific literacy assessment

	Personal	Local/National	Global
Health and disease	Maintenance of health, accidents, nutrition	Control of disease, food choices, community health	Epidemics, spread of infectious diseases
Natural resources	Personal consumption of materials and energy	Maintenance of human populations, quality of life, security, production and distribution of food, energy supply	Renewable and non-renewable natural systems, population growth, sustainable use of species
Environmental quality	Environmentally friendly actions, use and disposal of materials and devices	Population distribution, disposal of waste, environmental impact	Biodiversity, ecological sustainability, control of pollution, production and loss of soil/biomass
Hazards	Risk assessments of lifestyle choices	Rapid changes (e.g., earthquakes, severe weather), slow and progressive changes (e.g., coastal erosion, sedimentation), risk assessment	Climate change, impact of modern communication
Frontiers of science and technology	Scientific aspects of hobbies, personal technology, music and sporting activities	New materials, devices and processes, genetic modifications, health technology, transport	Extinction of species, exploration of space, origin and structure of the Universe

- PISA 2018 assessed scientific knowledge using contexts that raised pertinent issues that were often relevant to the science education curricula of participating countries. However, assessment items were not limited to school science contexts.

- Items in the PISA 2018 science assessment related to the **self, family and peer groups (personal), to the community (local and national) or to life across the world (global).**
- The context may have involved technology or in some cases, a historical element that may have been used to assess students' understanding of the processes and practices involved in advancing scientific knowledge.

The PISA science assessment, assesses competencies and knowledge in specific contexts.

SCIENTIFIC LITERACY FRAMEWORK

A framework for mapping items against the two dimensions of **knowledge** and **competencies**. In addition, each item can also be mapped using a third dimension based on a **depth of knowledge (DoK) taxonomy.**

		Competencies			DOK		
		Explain Phenomena scientifically	Evaluate and design scientific enquiry	Interpret data and evidence scientifically	Low	Medium	High
Knowledge	Content Knowledge						
	Procedural Knowledge						
	Epistemic Knowledge						

SCIENTIFIC LITERACY—LEVELS

Levels – Depth of Knowledge Taxonomy

Low (L)

Medium (M)

High (H)

SUGGESTIONS FOR TEACHING

- Engage your students in each task in the document as a whole-class discussion or by asking students to attempt a task and then discussing it afterward with them.
- Scoring criteria used by the PISA markers to score the actual assessment are provided. Examine the criteria and review the acceptable answers with your students.
- Use the tasks when planning a unit of work on a specific topic in the curriculum. Try to incorporate the tasks into your instructional and assessment plans.
- Remind students that partial marks are given for partially correct answers and encourage them to take the assessment seriously and strive for excellence.
- Discussion on incorrect answers can open up new areas for conceptual understanding

Teachers' pedagogical strategies must center around hands-on, realistic, problem-solving situations.
We need to give students repeated opportunities to:

- Respond to real-world problems,
- Explore solutions to problems about which there is conflicting scientific evidence,
- Practice transferring their skills and knowledge from one context to another.
- If students can transfer skills and knowledge from one context to another in the classroom, they will certainly be able to replicate this challenge outside the boundaries of the classroom in the real-world situations.

PISA TESTS IN SCHOOLS

- Selection of schools
- School coordinator appointed
- Random selection of 35 ;15year olds per school
- Permission from parents
- Tests session organized by test administrator
- 13 different booklets with sets of questions
- 2 hours for knowledge testing of students
- 30 minutes for student questionnaire: personal background, learning habits, attitudes, motivation
- School questionnaire (headmaster): demographic characteristics, quality of the learning environment

PISA-SOURCES

- http://www.pisa.oecd.org/
- http://www.oecd.org/pisa/pisaproducts/

Thank you!