ASSESSMENT *AS, FOR, OF* LEARNING IN THE SCIENCE CLASSROOM

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- *“With school focusing most of their attention on the good test-taker, the expert fill-in-the-blanker, and the hand-raiser who always has the “right” answer, we’re left with a situation in which 99.9% of the country’s natural human resources could go undeveloped. A greater national tragedy could scarcely be envisioned.”*
- *Thomas Armstrong*

"We believe the primary purpose of classroom assessment is to inform teaching and improve learning, not to sort and select students or to justify a grade."

- *Jay McTighe and Steven Ferrara*

Effective learners operate best when they have insight into their own strengths and weaknesses and access to their own repertoires of strategies for learning."

(Brown, 1994)

"We need to assess reasoning, not recall. Assessment should include challenging tasks without obvious answers. They should be embedded in a real-life context, unlike tests of isolated skills. Of prime importance is the need to collect information on how students approach a problem (and how students transfer information to other situations and contexts)."

- Jay McTighe

Why elicit students' ideas?

"If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly"

(Ausubel, 1978, p.v)

Why elicit students' ideas?

- To make each student aware of his/her own ideas and thus able to make the necessary connection to new ideas in order to gain understanding and generate new knowledge
- To let the teacher know the status of students' prior knowledge and teach accordingly (design appropriate learning opportunities to meet intended or desired learning outcomes or goals

Ways to elicit students' ideas

- Whole-class question & answer session
- Group discussion
- Predict-Observe-Explain (POE)
- Discrepant events
- Concept cartoon
- Concept map
- Teacher demonstrations
- Interview about instances
- Interview about events
- Short quiz/pre-testing

Predict-Observe-Explain (POE)

The POE strategy was developed by White and Gunstone (1992)
The steps to carry out are:

- Set up a demonstration event.
- Tell students what you are going to be doing.
- Ask students, individually, to **P**redict the outcome of the event and why they think that way (ask students to write down or verbally tell the class)
- Carry out the demo. Let students **O**bserve and write down or verbally tell the class their observation.
- Ask students to amend or add to their **E**xplanation after the observation.
- Discuss ideas together.

http://www.ed-dev.uts.edu.au/teachered/poe/tasks/poehome.html

POE student worksheet

Discrepant Event

- A discrepant event is a puzzling or surprising event/situation usually with an outcome that is unexpected or contrary to what students may have predicted. Can be carried out nicely via POE.

  Example:
- Acceleration due to gravity – ping pong and golf ball

  Which of the balls will strike the floor first upon being dropped from the same height?
- Bernoulli's Principle – plastic bag

  Can a plastic bag be blown to three times the size of a human lung with one breadth?
- Newton's Second Law

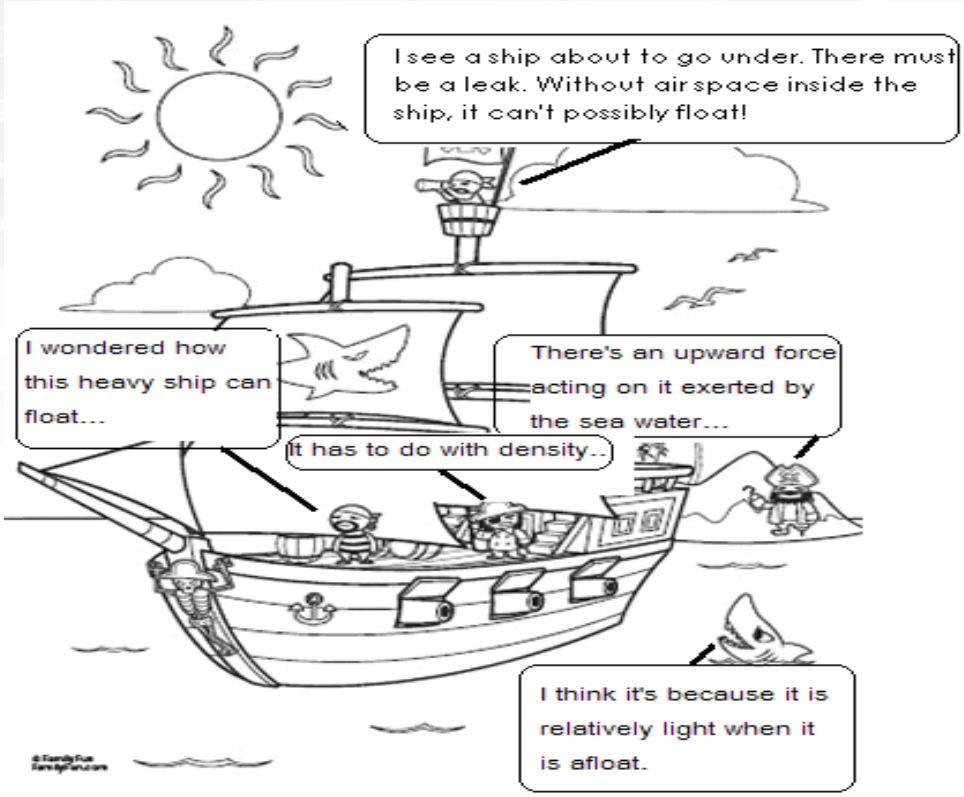
  http://www.plu.edu/~vedrosr/discrepant.html

Concept Cartoon

Concept Cartoon was created by Brenda Keogh and Stuart Naylor in 1991. It feature cartoon-style drawings showing different characters arguing about an everyday situation. It is designed to intrigue, to provoke discussion and to stimulate scientific thinking. Each character has its own viewpoint on the situation (which include scientifically acceptable and alternative ones) written in the form of a dialogue.

http://www.conceptcartoons.com/science/news.htm

Concept Cartoon on the concept of floating and sinking



How to use a Concept Cartoon

- Show a cartoon that is relevant to the concept that the teacher wishes to elicit
- Explain to students the situation or let students read for themselves
- Ask students which of the characters they agree with and why. Alternatively, leave a dialogue box blank and ask students for other ideas of their own (if any)

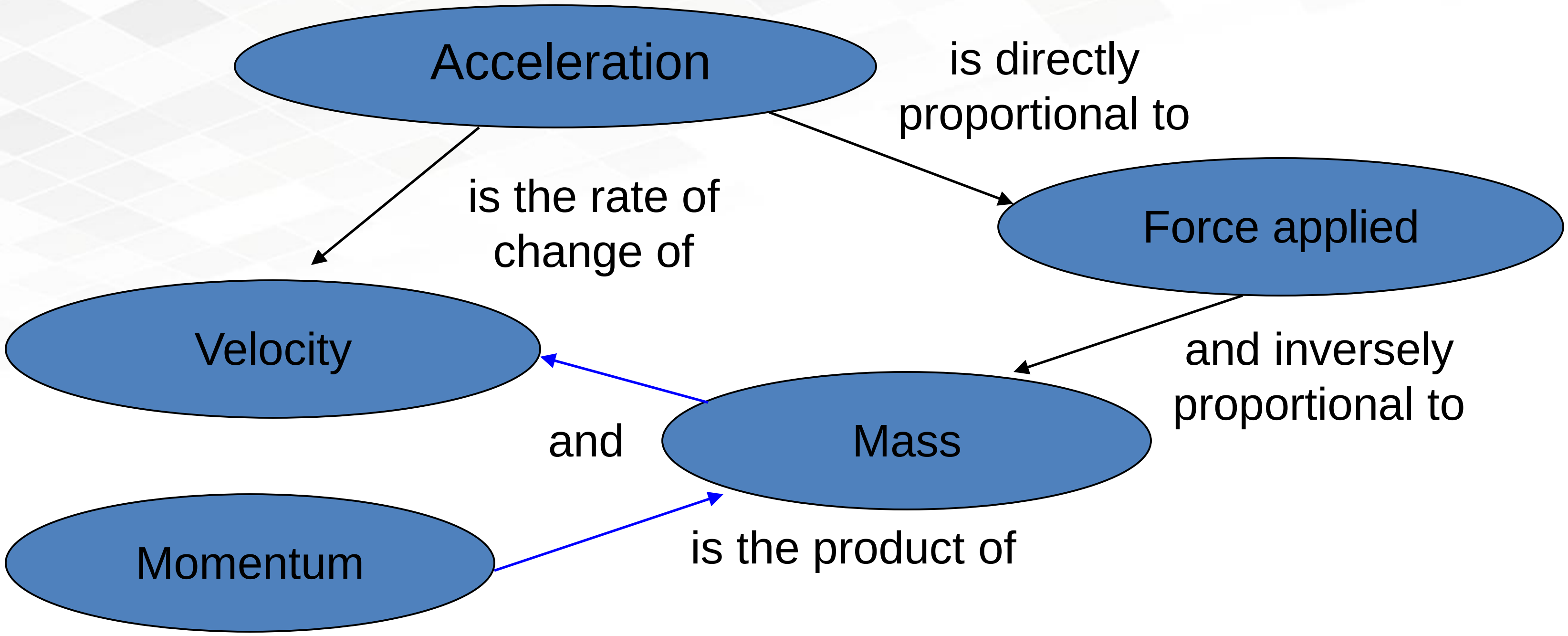
Concept Map

- A concept map is a *"kind of visual road map showing some of the pathways we may take to connect meanings of concepts."* In other words it represents knowledge graphically.
- The concept mapping technique was developed by Joseph D. Novak at Cornell University.
- Knowledge graphs are networks of concepts.
- Networks consist of nodes and links.
- Nodes represent concepts and links represent the relations between concepts.

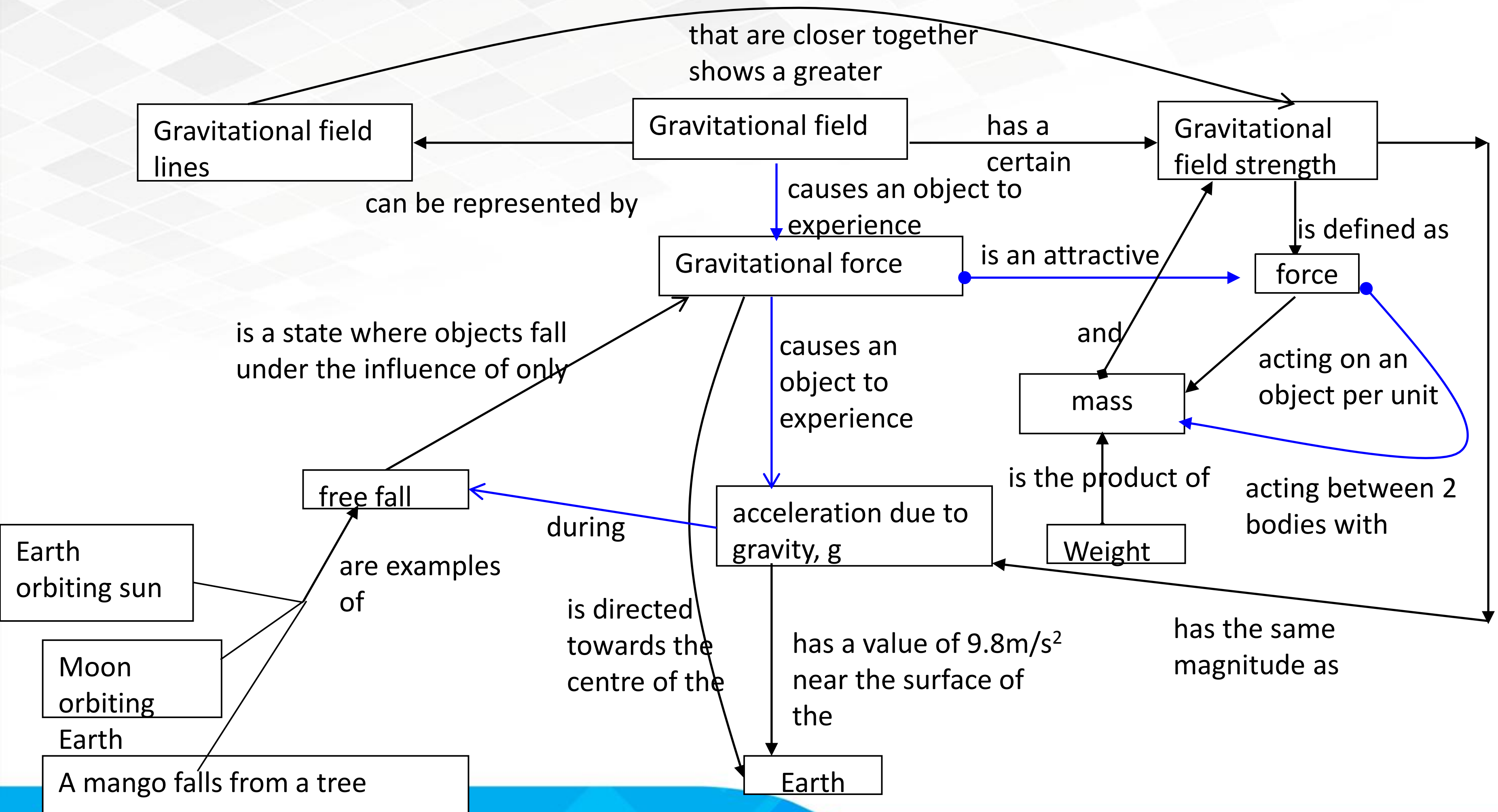
Concept Map

- Concepts and links are labeled.
- Links can be non-, uni- or bi-directional.
- Concepts and links may be categorized. They can be
  - simply associative,
  - Specified, or
  - divided in categories such as causal or temporal relations.

A concept map of concepts related to force and motion



A concept map of gravity related concepts



Assessing Active Science Learning

New forms of assessment and evaluation have emerged from the emphasis on theory and research in cognitive and motivational psychology and cooperative learning.

This recent trend is characterized by the following elements:

1. Some of the new assessment strategies involve performance assessment. Students are required to actually perform the skills and strategies in the form of hands-on assessment questions.

2. Assessment strategies provide teachers with better knowledge of their students' strengths and weaknesses by giving teachers insights into students' process skill abilities.

This recent trend is characterized by the following elements:

3. Assessment strategies rely on cooperative learning. Students actually work together on assessment problems.

4. Many assessment tasks are conceptual and therefore involve students in problem-solving, higher-level reasoning, critical thinking, and creativity.

Principles for Assessing Higher-Order Thinking

Asking “How would I (the student) have to think to answer this question or do this task? Should help you figure out ***what*** *thinking skills* are required for an assessment task.

Asking "What would I (the student) have to think *about* to answer the question or do the task?" should help you figure out *what content knowledge* is required for an assessment task.

As for any assessment, both should match the knowledge and skills the assessment is intended to tap.

5. Evaluation should be authentic.

- Assessment is authentic if it is “congruent with the results needed from science education;
- that is, if it asks students to demonstrate knowledge and skills characteristic of a practicing scientists or of the scientifically literate citizen.
- Authentic assessments involve the students in real experiences (e.g., doing science activities, solving problems, thinking critically and creatively, and being involved in projects in their community).

- Assessment might be considered the centerpiece for instruction because it is the process by which teachers make judgments about what their students have learned.

Some indicators that students are really learning in class:

- When students can teach another student
- When students ask questions about the content they are studying
- If students can apply what they have learned to another situation
- When students' eyes light up – like a light went on
- When the students say that they really enjoy coming to the class

	Summative	Formative
What?	Examples include standardized tests, state/national tests, unit tests, final tests	Rubrics, teacher observation, student self-assessment, descriptive feedback to and from students
When?	Given at the end of instruction to determine if a student has mastered the topic	Given during instruction to guide the direction of instruction to meet student need
Why?	Commonly used for assigning grades, sorting students by achievement	Used to guide instruction to support student achievement of lesson objectives

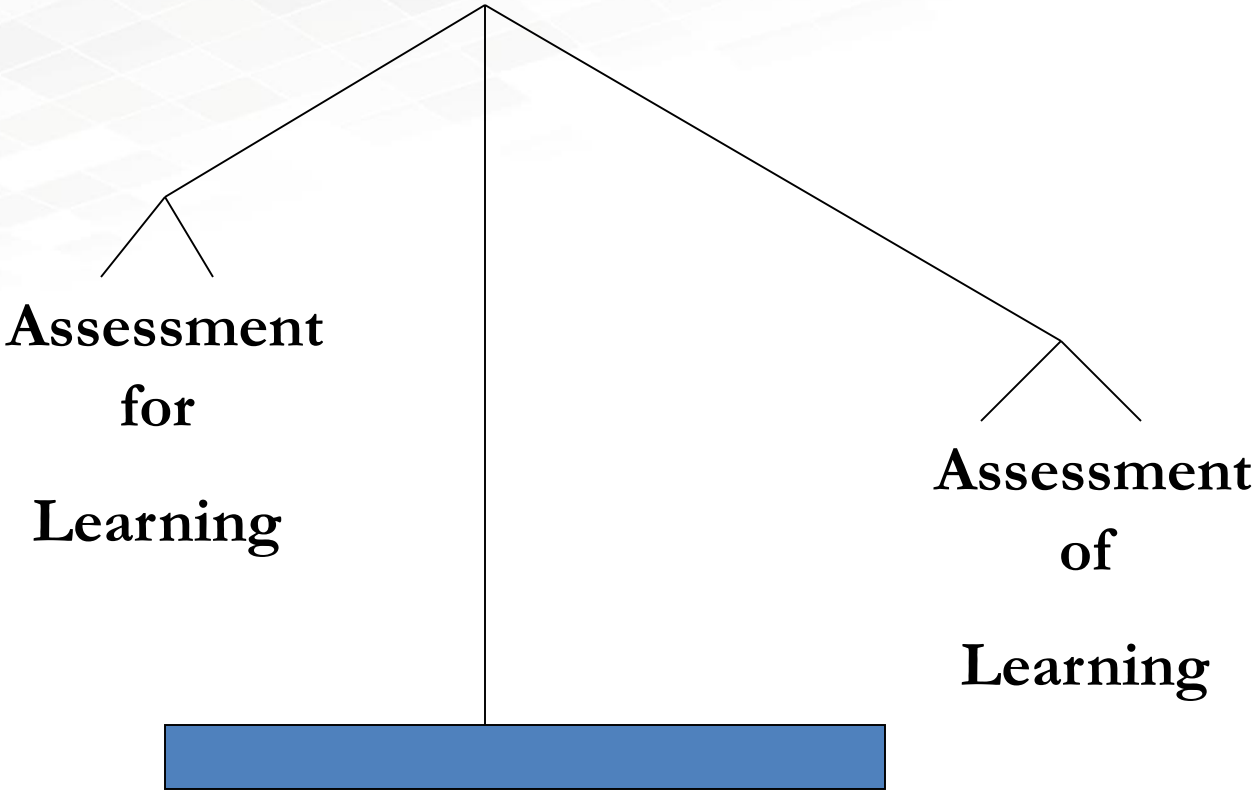
Who is it for?	The whole education community as well as parents, students, and teachers.	Students, teachers and parents.
What is it used for?	To tell others about students	To tell students about themselves
How given?	All students take the same test.	Students' progress toward a goal is showcased, and so the assessment is often more individualized.

AFL in Education

- Traditionally we have accepted that assessment in education should predominantly be summative, such as end of unit tests, marks out of ten or yes/no answers.
- These can be useful but because they tend to be at the end of the process they don't tell you what you don't know at a time when you need to know what you don't know.

- They also most significantly don't' tell you how to get better and as a result tend to **encourage shallow, narrow teaching and learning leading to teaching to the test and superficial, constrained learning.**
- This type of teaching has generally been labeled as **transmissionist: I have the knowledge**; **I decide what's important**; **I pass it on to you**; **you recall it and I tell you how well you did but not how you can improve**.

Assessment Crisis



Crucial Distinction

Assessment OF Learning:

How much have students learned as of a particular point in time?

Assessment FOR Learning:

How can we use assessment to help students learn more?

Assessment ***of***

- Assessment ***of*** learning involves the monitoring of learning that has occurred.
- Assessment ***of*** learning – regard testing/ assessment chiefly as a way of figuring out how much students have learned; time-honored way of regarding testing was to conceive as assessment of learning
- Assessment ***for*** learning – regard testing to view it as a vehicle to enhance instructional effectiveness; is not supposed to replace all instances of assessment of learning; there should be more occasions when assessment for learning dominating an instructional scene.

Assessment ***for*** learning

- The term 'assessment *for* learning' has become a catch-cry over the last decade as a result of convincing research evidence by Black and William (1998) that formative assessment, properly implemented, is a powerful means to improve student learning.

Assessment ***for*** learning

- Assessment *for* learning is the process of seeking and interpreting evidence for use by learners and teachers , to identify where the learners are in their learning, where they need to go and how best to get there (Assessment reform Group, 2002).

Assessment ***for*** learning

- Earl (2005) considers that assessment *for* learning involves providing information to teachers to help them modify the teaching and learning activities and it is also a process of developing and supporting metacognition of students.
- “Students, as active, engaged and critical assessors make sense of information, relate it to prior knowledge and use it for new learning.

Assessment ***as*** learning

- **Assessment *as* learning** (Earl 2003), emphasizing assessment as a process of metacognition for students.
- Assessment ***as*** learning **seeks to help students take responsibility for their own learning and so build metacognition in the learner.**
- Assessment ***as*** learning focuses on the role that assessment can play in monitoring learning as it occurs, how this role can be used to enhance the quality of learning, and how this monitoring of learning as it occurs can then be used to plan further learning experiences and goals.

Assessment User	Assessment *for* Learning	Assessment *of* Learning
Students	Am I improving over time? Do I know what it means to succeed? What should I do next? What help do I need?	Am I succeeding at the level that I should be? Am I capable of success? How am I doing in relationship to my classmates? Is the learning worth the effort?
Teachers	What does this student need? What do these students need? What are student strengths to build on? How should I group my students? Am I going too fast? Too slow? Too far? Not far enough?	What grade do I put on the report card? What students need to be referred for special service? What will I tell parents?

Assessment User	Assessment *for* Learning	Assessment *of* Learning
Parents	What can we do at home to support learning? Is my child learning new things?	Is my child keeping up? Is this teacher doing a good job? Is this a good school? District?
Principal		Is instruction producing results? Are our students ready for the workplace or the next step in learning? How shall we allocate building resources to achieve success?
Superintendent		Are our programs of instruction producing desired results? Is each building producing results? Which schools need additional resources? How shall we allocate district resources to achieve success?

When Assessing for learning:

Teachers…

- understand and articulate achievement targets ***before*** teaching.
- inform students of targets in ***student friendly*** terms.
- create assessments that ***accurately*** reflect student achievement.
- use assessments ***positively*** to build student confidence in themselves as learners
- provide ***frequent, descriptive feedback*** to students to help them improve.
- continuously ***adjust instruction*** based on classroom assessment results.

10 principles of assessment for learning

- Is part of effective planning
- Focuses in how students learn
- Is central to classroom practice
- Is a key professional skill
- Is sensitive and constructive
- Fosters motivation
- Promotes understanding of goals and criteria
- Helps learners know how to improve
- Develops the capacity for self-assessment
- Recognizes all educational achievement

Popham's Four Levels of Formative Assessment

Level	*Action*
Level I: Teachers' Instructional Adjustments	*Teachers collect evidence by which decide whether to adjust their current or immediately upcoming instruction in order to improve the effectiveness of that instruction.*
Level 2: Student's Learning Tactic Adjustments	*Students use evidence of their current skills-and-knowledge status to decide whether to adjust the procedures they're using in an effort to learn something.*
Level 3: Classroom Climate Shift	*Teachers consistently apply formative assessment to the degree that its use transforms a traditional, comparison-dominated classroom, where the main purpose of assessment is to assign grades, into an atypical learning-dominated classroom, where the main purpose of assessment is to improve the quality of teaching and learning*
Level 4: Schoolwide Implementation	*An entire school (or district) adopts one or more levels of formative assessment, chiefly through the use of professional development and teacher learning communities.*

Source: Popham,W.J. (2008). Transformative assessment (p.49). Alexandria, VA: Association for Supervision & Curriculum Development.

Feedback that helps learning – the point of contact

- *Are you the kind of teacher that lights up children's faces when you walk in the classroom? Or are you the kind of teacher that when you leave the classroom – children's faces lights up!*
- The point of contact between assessment and learning in the classroom is through formative feedback. This means feedback that helps the learner shape and direct the next phase of learning.

The key to effective feedback is through:

- Causing deep thinking in the learner
- Increasing reflection in the learner
- Negotiating the options for the next steps for the learner

Assessment for learning –

- Continuous feedback on students' learning and progress is the most significant factor in determining how much they learn

- Effective 'assessment for learning' consists of:
  – information on the strengths and weaknesses of students' work

  and

  –strategies so that students themselves can work out how well they are doing

What helps teacher feedback to be formatively useful to learners

- Non-judgmental feedback is helpful
- Grades are often not helpful
- Specific details are helpful
- Comments and questions on the text are often helpful
- Conversations or emails can be helpful

Benefits of formative assessment

Black and William's research (1998) indicated that improving learning through assessment depends on five deceptively simple factors:

1. Providing effective feedback to students.
2. Students' active involvement in their own learning.
3. Adjusting teaching to take account of the results of assessment.
4. Recognising the profound influence of assessment on students' motivation and self-esteem - both crucial influences on learning.
5. Ensuring pupils assess themselves and understand how to improve.

Benefits of assessment for learning

- It helps with planning because it involves giving clear learning intentions to students.
- It ensures that pupils are focused on the purpose of the task and that they can become involved in their learning and can comment on it – that is, there is a sharing of learning intentions.
- It empowers the student to realize his/her own learning needs and to have control over future targets. Students are trained to evaluate their own achievements against the learning intentions in oral or written form.
- It tracks progress diagnostically and informs a student of his/her successes and weaknesses.
- It ensures student motivation and involvement in progress – it raises achievement and keeps teachers informed of individual needs.

TECHNIQUES OF FORMATIVE ASSESSMENT

- classroom discussion
- teacher observation
- analysis of tests and homework
- questioning (thoughtful, reflective questions rather than simple, factual ones and then give students adequate time to respond)
- Effective feedback
- Self and peer assessment
- Student record keeping

Suggested strategies to involve everyone during discussion:

- **Invite students to discuss their thinking** about a question or topic in pairs or small groups, and then ask a representative to share the thinking with the larger group (sometimes called think-pair-share).
- **Present several possible answers to a question**, then ask **students to vote** on them.
- Ask all students to **write down an answer**, and then **read a selected few out loud.**

Teachers might also assess students' understanding in the following ways:

- Have students **write their understanding** of vocabulary or concepts **before and after instruction.**
- Ask students to **summarize the main ideas** they've taken away from a lecture, discussion, or assigned reading.
- Have students **complete a few problems or questions at the end of instruction** and check answers.
- **Interview students** individually or in groups about their thinking as they solve problems.
- **Assign brief, in-class writing assignments**

Tests and homework can be used formatively

- If teachers analyze where students are in their learning and provide specific, focused feedback regarding performance and ways to improve it.
- **Frequent short tests** are better than infrequent long ones.
- New learning should be tested within **about a week** of first exposure.
- Be mindful of the **quality of test items** and **work with other teachers** and outside sources to collect good ones.
- **Portfolios, or collections of student work,** may also be used formatively if students and teachers **annotate the entries and observe growth** over time and practice (Duschl & Gitomer, 1997).

Constructing Informal or Formative Assessment Tools

- Creating informal assessments is a complex process that does not follow any strict decision rules.
- Some assessment scholars refer to the assessment construction process as WYGWYA("what you get is what you assess").
- In short your informal assessment can serve several purposes simultaneously (Herman, 1997).
- What and how you informally assess will depend on your teaching context.

Butler and Stevens (1997) suggest three basic questions before constructing an informal assessment:

- What information do you want to collect from your assessment?
- How will that information be collected?
- How will that information ultimately be used and who will use it?

Journaling and Collecting Informal Writing Samples

Journals: Three interrelated purposes:

- Offering students an outlet for expression and fluency in language usage
- Offering students an outlet to apply what they have learned
- Providing students a tool of communication to express their own personal narratives and ideas

Writing can give students the freedom and power to express experiences that they may not be comfortable speaking about in the presence of other students.

One of the challenges that this science teacher faced in using journals was constructing questions and/or issues that motivated students to write.

Another challenge is finding the time to respond to all of his students individually.

Although collecting writing samples from student journals may be a time-consuming activity, the benefits outweigh the challenges.

Two other examples of journaling include:

- **Dialogic Journaling.** Students and teachers converse with one another in either a paper journal or in an electronic format.
- **Double-Entry Journals**. Students divide their journal pages in two sides. They write quotes from their texts on one side and their personal reactions to those quotes on the other side.

The Reflection Log

For example, after you have held a discussion in class, you can ask students to respond to the following prompts:

- What were the main points in our discussion?
- What connections can you make to other classes that you have?
- What connections can you make in your life with the issues raised in our discussions?
- What questions do you still have after today's discussion?
- What are several additional points you would add if we were to continue our discussion at a later date?

The Wrap-Around

- is another **writing activity** that will allow you to check in informally with your students to see **how they are feeling about specific issues** related either to the classroom or to their own lives.

Example:

- The most important thing about myself that I learned today is _____.
- I was really surprised by today's discussion when _____.
- When I am a parent I'm sure I will tell my children about _____.
- Given today's debate, I would have changed _____.

The KWL Response Chart

- (Know, Want, Learn) is the most usable format here and can be kept in students' journals so that they can respond to it as time passes in your lesson.
- can be used prior to a lesson to engage students about pertinent background information as well as helping students predict what they might learn.
- What do you **know** about _____?

- What do you **want** to know about_____?

- What have you **learned** about_____?

Observations

As an effective teacher, it is important to constantly observe your students and listen intently to what is occurring in class.

These observations are utilized to ascertain such factors as:

- the nature of student participation in class discussion
- the kinds of questions asked
- the interpersonal skills used in cooperative groups
- the correctness of student responses to questions
- the nature of student responses to examples
- how students react to an assignment

Observation and interviews:

- are the best of all assessment methods for examining learners' reasoning/thinking and procedural/process knowledge.
- ability to assess student affect and attitudes
- have the potential to greatly improve the student/teacher relationship and build an environment that centers on trust and promotes learning.

How then can we obtain accurate and useful information from day-to-day observations of our students?

- Clearly specify what you are looking for.
- Concentrate on one or two particular behaviors.
- Observe specific behaviors.
- Defer inferences and conclusions.
- Make observations as unobtrusive as possible.
- Obtain as many observations as possible.
- Use several observers.

THANK YOU VERY MUCH FOR YOUR ACTIVE PARTICIPATION !