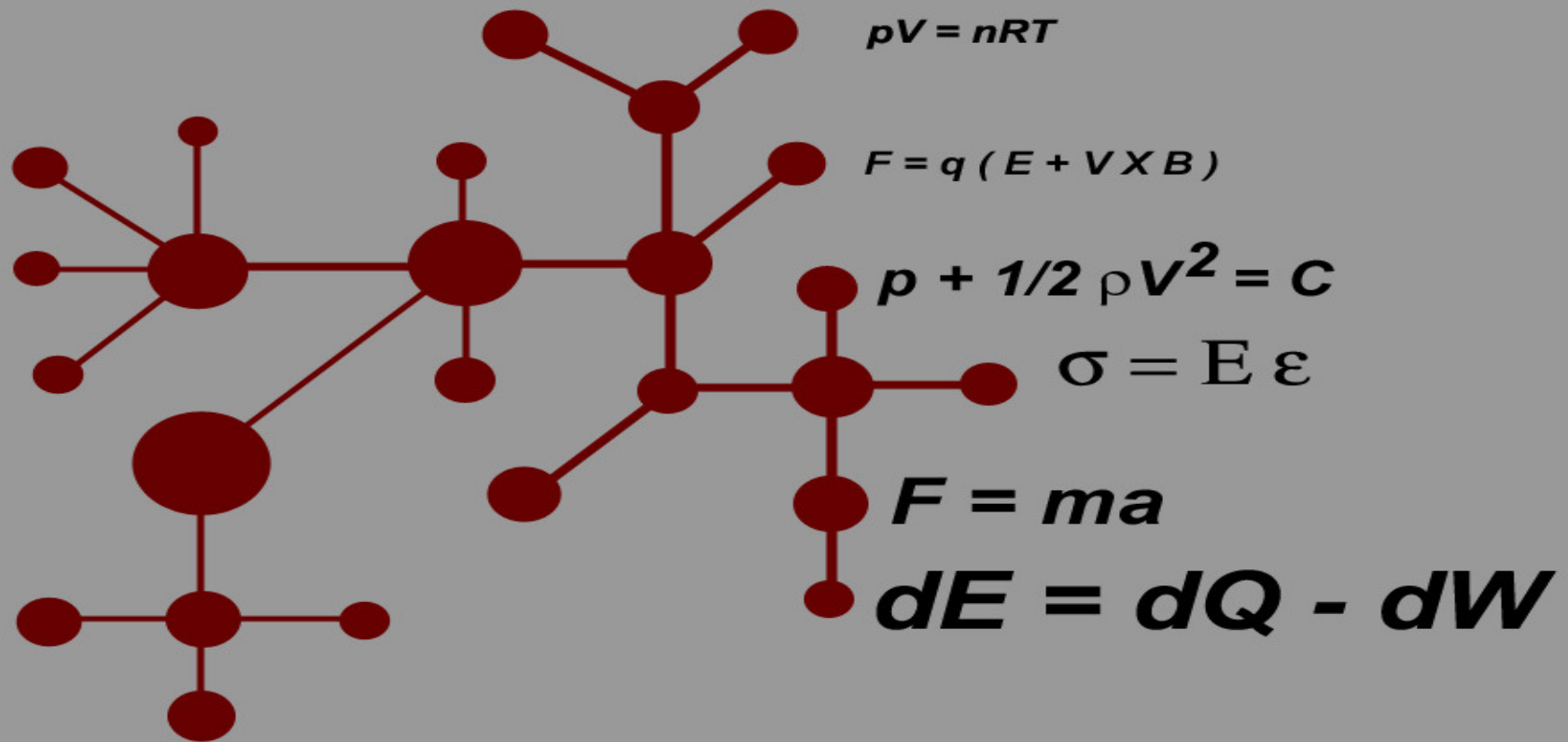


Concept Map

Organize, Apply, Explore, and Innovate



Actus Potentia, Inc.

- **A company based in Ames, Iowa**
- **Develop**
 - **Concept Map based Educational Software**
 - High school science courses
 - Beginning engineering courses
 - **Concept Map based Software for Business and Industry**
 - Design
 - Development
 - Planning

NEWS

THE NATIONAL ACADEMIES
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Date: Feb. 15, 2008

Contact: Randy Atkins, Media Relations Officer
National Academy of Engineering
202-334-1508; e-mail <atkins@nae.edu>



NATIONAL ACADEMY OF ENGINEERING
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CHALLENGE



GRAND CHALLENGES FOR ENGINEERING

Grand Challenges

Introduction

Make solar energy economical

Provide energy from fusion

Develop carbon sequestration methods

Manage the nitrogen cycle

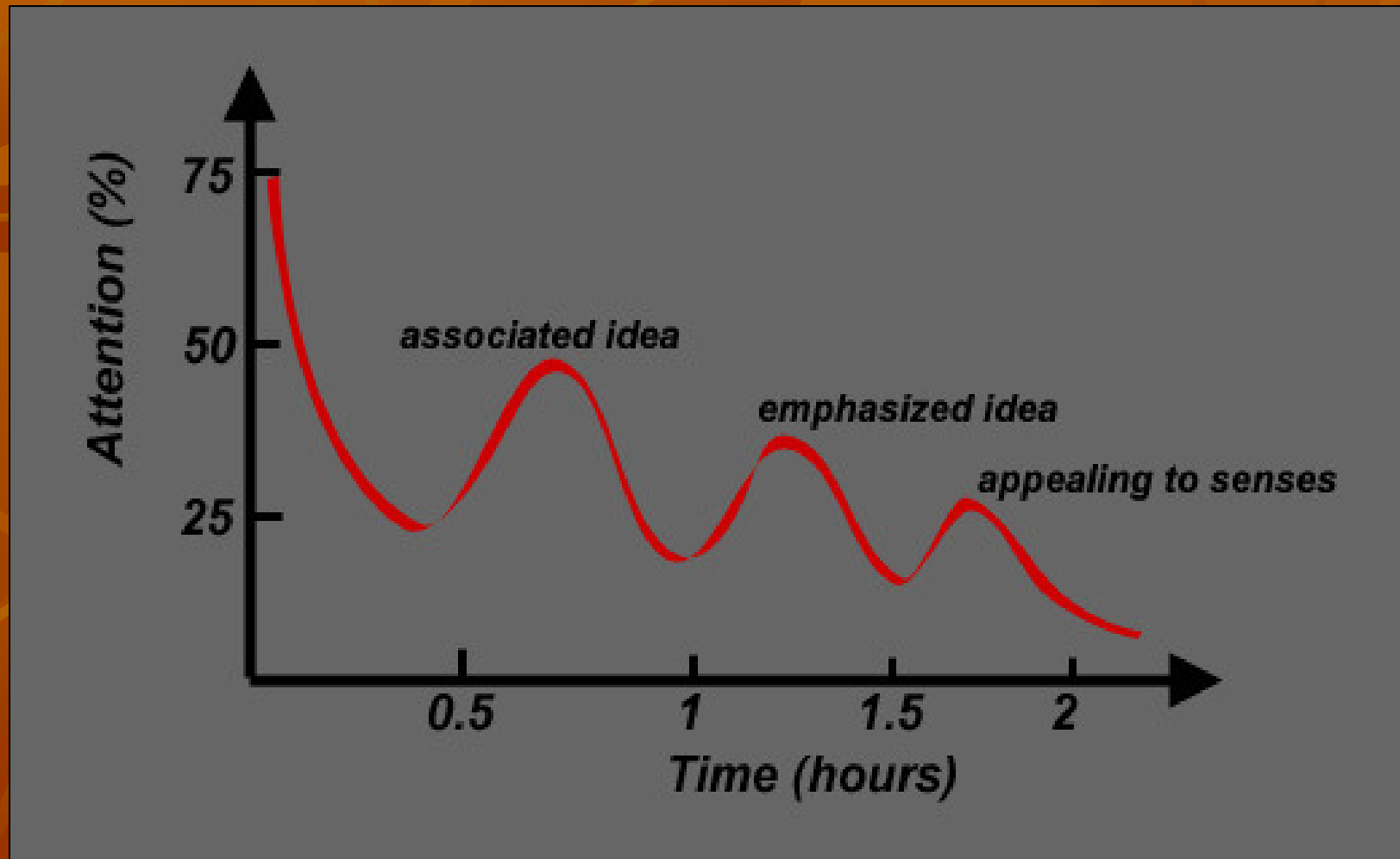
Provide access to clean water

> Home > Grand Challenges > Advance personalized learning

Advance personalized learning

Instruction can be individualized based on learning styles, speeds, and interests to make learning more reliable.

Teachers' Challenge



Teachers' Strategy

- **Associate and Emphasize ideas**
 - Better reception and retention
 - Pattern recognition and information processing
- **Appeal to senses**
 - Visual tool
 - Structure/Pattern enhances information processing
 - Engaging in the discovery of new aspects of acquired knowledge

Shared Responsibility

- **Step-1 (Teaching)**
 - Chronologically linear
 - Textbook, notes
- **Step-2 (Learning)**
 - Conceptually Linked
 - Problem Solving



One Concept – Multiple Uses

Speed = Distance / Time

$$V = \frac{d}{t}$$

- Problem - 1: d and t are given; find V
- Problem - 2: V and t are given; find d
- Problem - 3: V and d are given; find t

MECE

Mutually Exclusive Collectively Exhaustive

Build a structure of *linked and non-overlapping ideas* while making sure *no idea relevant to the problem is overlooked.*

What is a Concept-Map

- Network of concepts connected by paths.
- The paths show the relationships that exist between the variables through laws and principles, derived relationships, and definitions.

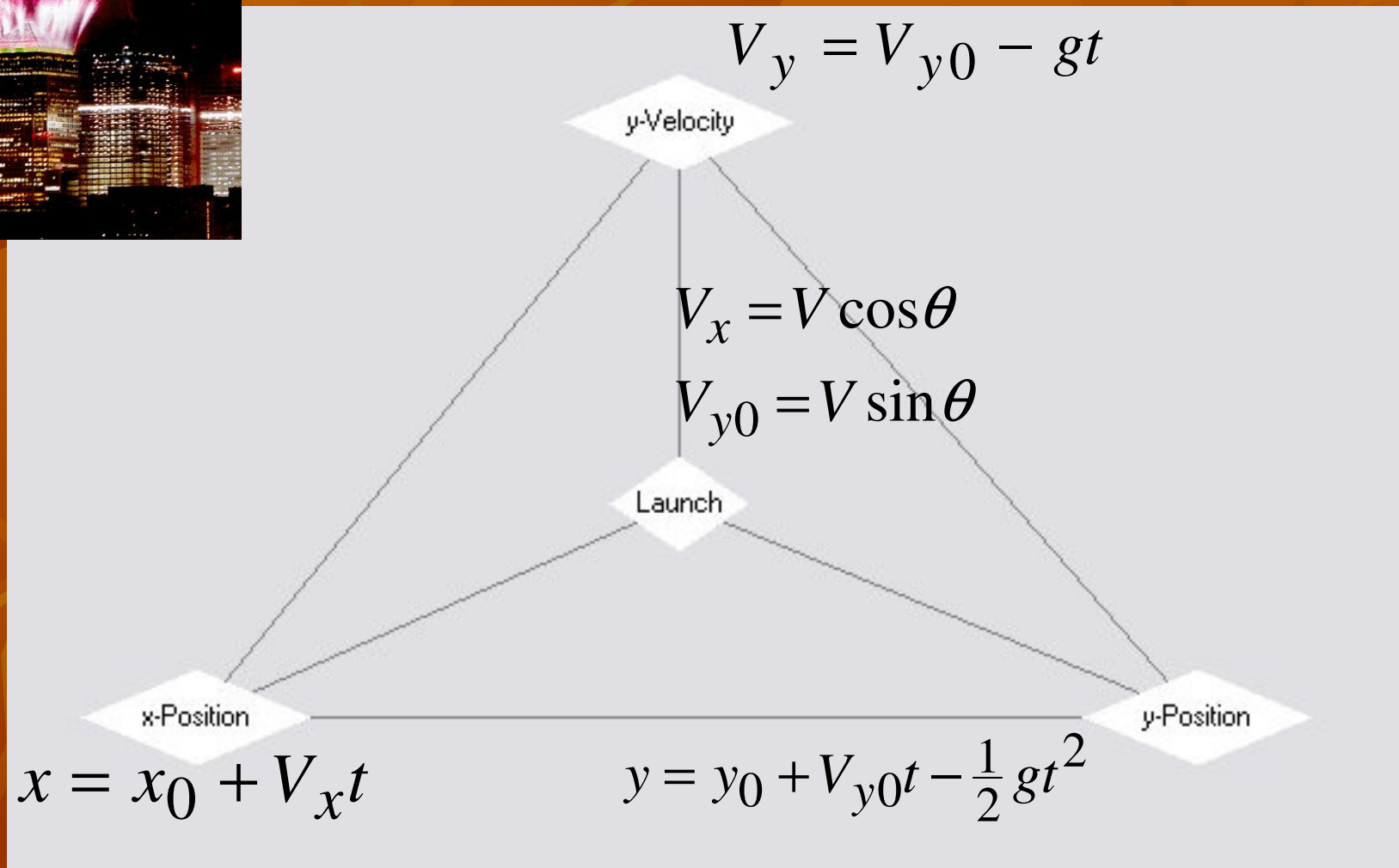
Variables

The causes and effects are the variables in a problem.

- Science/Engineering problems: load, stress, reaction-rate, temperature, electric potential, kinetic energy, etc.
- Economics/Business Problems: equilibrium price, surplus/shortage, revenue, profit, capital expenditure, etc.

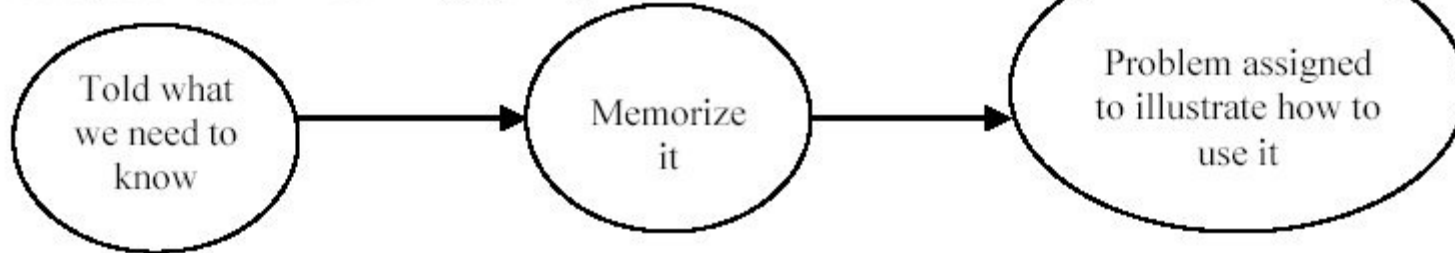


Projectile Concept Map

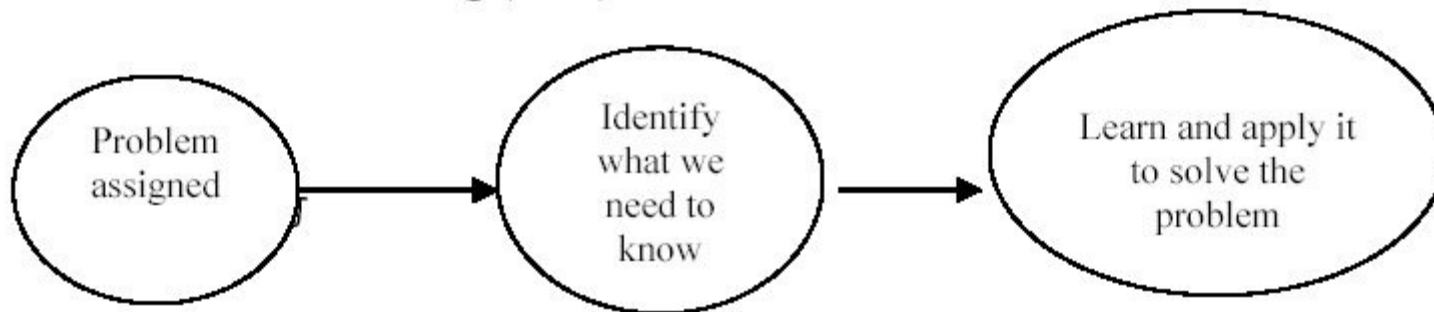


SBL versus PBL

Subject Based Learning (SBL)



Problem Based Learning (PBL)



Ref: Larry D. Spence, Director, Learning Initiatives, Pennsylvania State University.

Problem Solving in Instruction

We wish our students to develop expertise, but what exactly is “expertise”?

- Permits a person to reason and analyze physical situations in terms of concepts.
- Permits a person to supplement such reasoning with quantitative calculations
- Permits a person to adapt and attack unfamiliar problems

Ref: W.J. Gerace & I.D. Beatty, Scientific Reasoning Research Institute, University of Massachusetts

Experts and Novices

- Experts' knowledge is richly interconnected; novices' knowledge form disconnected groupings.
- Experts structure their knowledge hierarchically; novices store knowledge chronologically.

Ref: W.J. Gerace & I.D. Beatty, Scientific Reasoning Research Institute, University of Massachusetts

Efficient Teaching

- **Faculty time is valuable**
 - easy to learn software; short and steep learning curve
 - deliver knowledge as compact nuggets with purpose
- **Eliminates prolonged lecturing**
 - students have short attention span
 - combines abstract with applications.
- **Simultaneous teaching and learning**
 - engages students in lecture; enhances interaction
- **Transfer learning responsibility to student**
 - less hand-holding

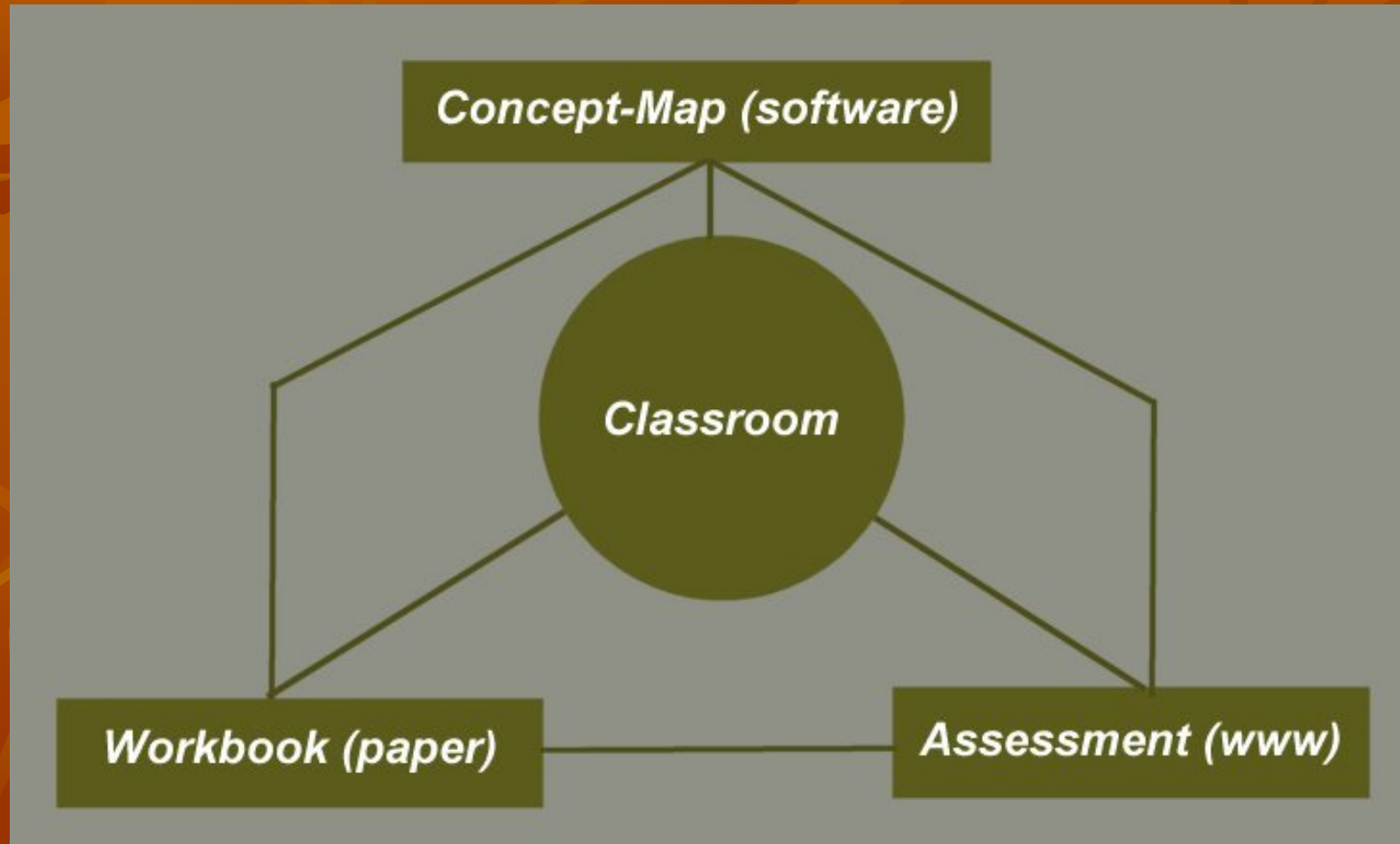
Efficient Learning

- Traditionally, teaching ends and learning begins
 - Blend teaching and learning
- Structured environment
- Interactive lessons
- Success keeps students motivated
- Increased drill and practice
- Reduce perceived volume of knowledge through MECE and association.

Why this software?

- Activity that supplements classroom instruction.
- Add variety in classroom
- Challenge, Engage and Motivate
- Give a taste of success
- Empower the students to learn
- 24-7 Personal guide and tutor
- Easily incorporated in existing curriculum and objective.

Software Packet



Sample Workbook Page

Exercise – 1

A tennis ball is dropped from a platform. The ball falls with acceleration of gravity, 9.8 m/sec^2 , until it hits the floor after 1.5 sec . The ball remains in contact with the floor for 0.1 sec . Then bounces off the floor where the rebound velocity is half of the impact velocity. What is the maximum height attained by the ball after it rebounds off the floor?

3. Why do the velocities at time $t=1.5 \text{ sec}$ and at time $t=1.6 \text{ sec}$ have opposite signs?
4. What is the acceleration during the time interval $t=1.5 \text{ sec}$ and $t=1.6 \text{ sec}$?
5. The acceleration during the time interval $t=1.5 \text{ sec}$ and $t=1.6 \text{ sec}$:
 - a. Does not include effect of acceleration of gravity as gravity disappears during the collision between the ball and the floor. (True/False)
 - b. Is caused by a combined effect of wall and acceleration of gravity. (True/False)
6. What is the acceleration caused by the collision with the floor?
7. After the collision, when the ball is bouncing up:
 - a. The effect of the floor remains in the memory of the ball and its motion continues to get affected by the floor. (True/False)
 - b. When the ball loses contact with floor, it forgets about the floor, and has zero acceleration. (True/False)
 - c. When the ball rises after collision, it forgets the effect of the floor but continues to get affected by acceleration of gravity. (True/False)
8. When the ball is rising after the bounce, its maximum altitude corresponds to what value of velocity?
9. What is the maximum altitude attained by the ball after the first bounce? (You can only determine an approximate value from the Tabular data)

Assessment (web-based)

- **Workbook problems – Test**
 - Grading/Feedback
 - Redirection to relevant material
- **Database**
 - Teachers
 - Curriculum
 - Emphasis
 - Reduced workload
 - Students
 - Efficiency ratings
 - Trends
 - Style recognition and remedy

Differentiated Instruction

- **Content (Textbook and Concept Map)**
 - Access to the content and learning opportunity.
 - Focus on the concepts not on minute details or unlimited facts.
- **Process (Workbook)**
 - Learners interact and work together as they develop knowledge of new content.
 - Introductory discussions of content big ideas followed by small group or pair work.
- **Product (Assessment Database)**
 - Continuous Assessment
 - Identifying level of each student and assisting in learning.
 - Students are active and responsible explorers.

Collaboration

- Participant schools
 - Use our model
 - Participate in “Learning Technology System”
 - Team of science teachers
 - Exchange and enhance methodology
- Actus Potentia
 - Provide the software at no cost
 - Arrange workshop for Personnel Development