How to develop scientific temper among students

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Science

• Science is always interesting, informative and inspiring.

• However, for various reasons science continues to be alienated from the young minds in India.

• If this state of affairs continues to be so, the glory of the achievements we have created is not going to last.
Definition of Scientific Temper

• “The **attitudes** of mind which lie behind the **method** of acquiring **reliable and practical** knowledge may be called the scientific temper”, said Pandit Jawaharlal Nehru.

• Scientific temper describes an **attitude** which involves the **application of logic** and the **avoidance of bias** and **preconceived notions**.
Modern Trends in inculcating Scientific Temper

- Indian Science Congress
- Science & Technology Museums
- Science Communication Websites
- Science Film Shows: Nehru Science Centre, Mum
- Planetariums
- Observance and Celebrations of Important Days:
  - National Science Exhibition for Children by NCERT
  - National Technology Day by DST

But it takes less than 1% of students time
Role of Scientific Temper

- Scientific temper should create the attitude of mental activism, the spirit of urge, curiosity to find answer, striving to discover and do the work by taking interest and enthusiasm.

- It should also help in developing attitude of not accepting answers without scrutiny which requires observation, seeking solid information and incontrovertible data, suitable analysis before accepting any thing in the society and should finally culminate in innovations and inventions.

- Scientific attitude requires objectivity and not rushing into readymade opinions, but it requires observation and exploration before forming an opinion.

- It does not give room for blind beliefs and one sided set mind. But helps to look out for evidence, exploration and analysis in order to formulate dependable hypothesis.

- Analysis is a rational process and reasoning is applied to examine the data and draw conclusion from it.

How to develop scientific temper?
* Activity based Learning (ABL)
* Project Based Learning (PBL)

An Innovative Model for Learning
Many Names: One Concept

* Hands-On Activities
* Activity Learning Methodology
* Experiential Learning
* Learning by Doing
Activity Learning Methodology

Learning in fun ways

ACTIVE LEARNING METHODOLOGY

AN INITIATIVE OF SARVA SHIKSHA ABHIYAN, CHENNAI, TAMILNADU
KEY CONCEPTS RELATED TO CAREER EDUCATION

• Preparation for successful working careers shall be a key objective of all education
• Every teacher in every course will emphasize the contribution that subject matter can make to a successful career.
• “Hands-on" occupationally oriented experiences will be utilized as a method of teaching and motivating and learning of abstract academic content.
What is Activity Based Learning?

- Activity Based Learning - learning where student physically and mentally explore subject by simulation of the work environment, manipulation of tools and materials associated with the world of work, or performance of a real work task.
What is a hands-on activity?

• Where students participate individually or in groups, where learning by doing takes place.
Underlying Assumption

Doing an activity associated with a career area will be more meaningful and insightful than talking or reading about it in class.
Why is Hands-on So Important?

• Has a greater impact on learning and retention.
• Affects the emotions, feels and attitudes more than “Book Learning”.
• John Dewey said “All genuine learning comes through experience”
Two Basic Questions Every Teachers Faces?

• What to teach?
• How to teach?
Take about 2 minutes and list as many methods (or techniques) as you can?
Common Methods

- Presentation
- Teacher lead discussion
- Supervised study
- Job Instruction
- Cooperative learning
- Panel discussion
- Fieldtrip
- Guest Speaker
- Demonstration
Review of Learning Principles

• When the subject matter to be learned possesses *meaning, organization, and structure* that is clear to students, learning proceeds more rapidly and is retained longer.

• *Readiness* is a prerequisite for learning. Subject matter and learning experiences must be provided that begin where the learner is.

• Students must be *motivated* to learn. Learning activities should be provided that take into account the wants, needs interests, and aspirations of students.
Learning Principles, *Continued*...

- Behaviors that are reinforced (*rewarded*) are more likely to be learned.
- To be effective, reward (reinforcement) must follow as *immediate* as possible the desired behavior and be clearly connected with that behavior by the student.
- *Directed learning* is more effective than non-directed learning.
- To maximize learning, students should *inquire into* rather than be instructed in the subject matter. Problem oriented approaches to teaching improve learning.
- Students learn what they practice. *(repetition)*
How do we learn?
How much do we retain?

• Dale’s Cone of Experience
Edgar Dale's Cone of Experience

People generally remember... (learning activities)

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they see and hear
- 70% of what they say and write
- 90% of what they do.

People are able to... (learning outcomes)

- Define
- List
- Describe
- Explain
- Demonstrate
- Apply
- Practice
- Analyze
- Define
- Create
- Evaluate

- Read
- Hear
- View Images
- Watch Videos
- Attend Exhibits/Sites
- Watch a Demonstration
- Participate in Hands-On-Workshops
- Design Collaborative Lessons
- Simulate, Model, or Experience a Lesson
- Design/Perform a Presentation - "Do the Real Thing"
Project/Activity Based Learning

• **Emphasizes learning activities that are:**
  - **student-centered**
    – They become the problem solver, decisions maker, investigator, documentarian
    – They take on the role of those working in a particular discipline
  
  - **long-term**
    – Projects can be a variety of lengths
    – What they are *not* is one-day teacher centered lessons

• **integrated with real world issues and practices and have compelling questions**
  – Significance beyond the classroom walls
Project/Activity Based Learning

• **Develops real world skills**
  – many of the skills are those desired by today's employer such as:
    • the ability to work well with others
    • make thoughtful decisions
    • take initiative
    • solve complex problems.

• **Allows for a variety of learning styles**
  – accessible for all learners
  – invite parents
The Students Move

✓ From following orders
  . . to carrying out self-directed learning activities

✓ From memorizing and repeating
  . . To discovering, integrating and presenting

✓ From listening and reacting
  . . To communicating and taking responsibility
The Students Move

- From knowledge of facts, terms and content
  - to understanding processes
- From theory
  - to application of theory
- From teacher dependent
  - to empowered
Examples
Fifth Grade Science

- Goal: How sprinklers work?

**Essential Question:**

- How do I show its principles?
- How to make students make themselves?
Fifth Grade Science

How to demonstrate Action-reaction principle
Fifth Grade Science

How sprinklers work? Learn with fun!

MATERIALS

- Cycle Spoke with Nut
- PVC Pipe
- Straw
- Plastic Bottle
- Scissors
- Bead
- Cello Tape

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What you will do:

1. Take a plastic bottle.
2. Cut a small hole on the bottle.
3. Insert the PVC pipe into the hole.
4. Wrap the straw around the pipe.
5. Secure the straw with tape.
6. Pipe the water from the bottle.

What you can observe:

- The water will come out in a pattern.
- You can adjust the pattern by changing the position of the pipe.

Enjoy your science experiment!
Rocket Projectile

How to teach this principle to students?
Rocket Projectile

Lean with fun

MATERIALS

Plastic Pipe (2-cm X 60-cm)

Pointed Cone

Cello Tape

Scissors
Activity based learning: Physics

- Principle of floatation
- How the ball can be made to float?
Activity based learning: Physics

Principle of floatation: Egg in bottle

MATERIALS

PLASTIC BOTTLE

FRESH EGG

TAPE

SALT
Activity based learning: Physics

- Vacuum creates low pressure
- Low pressure suck fluid
- Example: pump
- How to demonstrate to students?
Activity based learning: Physics

Learn with fun: candle can create vacuum
Activity based learning: Physics

Surface tension

Mosquito on water

Water on penny
Activity based learning: Physics

TOYS FROM TRASH

SURFACE TENSION
How much a weight a balloon can support?
How much a weight a balloon can support?
Aerodynamics

• How aeroplane flies?

• What is scientific principles?

• How lift and drag can be controlled?

• Surveillance/unmanned aeroplanes
Aerodynamics

TOYS FROM TRASH

Aero Modeling

Design: Samarth Kirloskar
Aerodynamics

Bernoulli's principle
Aerodynamics

Bernoulli's principle
Aerodynamics

Bernoulli's principle: the mystery
Aerodynamics

Bernoulli's principle

How a *pichkaari* works?
How a engine carburetor works?
Aerodynamics

Bernoulli's principle

![Image of a person blowing through a straw into a cup with the text "Toys from Trash" and "Straw Spray".]
Activity based learning: Chemistry

- Water absorbent polymer
- How nappy works?
- How to teach students in the class?
- Agriculture application
Activity based learning: Chemistry
Magnetic levitation

- High speed train run on magnetic levitation principle
- How to demonstrate the principle to students
Magnetic levitation

- High speed train run on magnetic levitation principle
- How to demonstrate the principle to students
Upper Elementary/Middle School Science

• Goal: How electricity is produced?

Essential Question:
– How to show the working principle?
– How to students can produce electricity?

• Benefit: Students will become electrical engineer, innovate new methods of producing electricity.
Methods in schools

Boiler-steam-turbine-generator-electricity

Wind-turbine-generator-electricity

Parts of a Wind Turbine
1. Rotor
2. Generator
3. Directional System
4. Protection System
   - Housing
   - Hut can be rotated
   - Lightning Conductor
5. Tower
Electricity from Salt water
Project/Activity Based Learning

How to generate electricity
How a electric motor works?

• At home the electric motor is used in a dozen appliances – the fan, cooler, mixer, washing machine etc.
• But still very few children ever make a motor.
How to make a simple DC motor
The Design Process

• **Start with the desired results**
  – What is important for students to do, know, perform
  – What are the enduring understandings that are needed?
  – What are the essential questions?

• **Think about the evidence of learning**
  – How will you measure their understanding?
  – What collective evidence using a variety of formal and informal assessments will you use?

• **Plan the learning experiences**
  – Take a real-world topic and begin an in-depth investigation
  – What activities will help the students gain the knowledge and skills you have identified?
  – What strategies will you use?
One cannot become an actor by just watching movies
   - But by practice/acting

One cannot teach students scientific principles just by theory
   - But by activity/hands-on

Thank you