BASIC ENGINEERING DESIGN
Critical Thinking

GEN- N1003
Fall 2016
Lecture 3

Dr. Hassan Mostafa
د. حسن مصطفى
hmostafa@uwaterloo.ca

WHAT IS THINKING?

idea

idea

idea

problem

idea

idea

idea

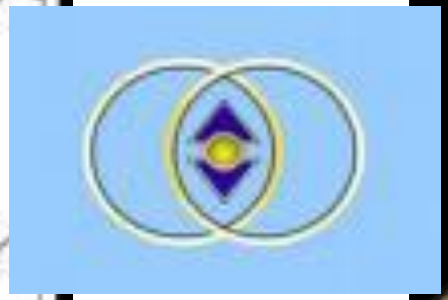
idea

idea

lots of alternative answers

WHAT IS THINKING?

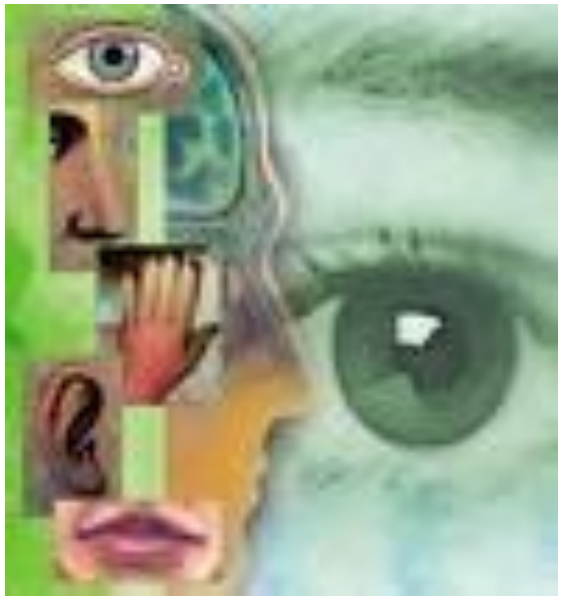
- Thinking is a process of **investigation** of **experience** in order to fulfill a certain purpose.



- Thinking is the **active process** by which we develop understanding

WHAT IS THINKING?

- **The two main thinking activities are:**
  - ✓Gathering information (perception)



  - ✓Processing information (Cognition)

THINKING versus LEARNING?

Thinking:

- ✓1-reasoning
- ✓2- understanding: idea, opinion, conceiving (creating something in mind)

Learning:

- ✓1- Education: known facts, ideas and skills
- ✓2- Discovery: catching, finding out
- ✓3-Memorizing: remembering

HOW DO WE THINK?

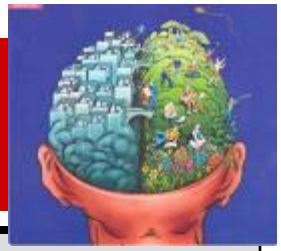
- Internalized mental image= **schema**
- The schema represents an **active organization of past experiences**
- The individual uses the same plan or work method **as a response to a wide variety of problem situations**

While our traditional **mode of thinking** is based on the use of schema:

design thinking is based on skills of new pattern creation

HOW DO WE THINK?

RIGHT & LEFT BRAIN THEORY



LEFT BRAIN	RIGHT BRAIN
Verbal	Visual
Organized /sequential	Non organized/ random
Logical	creative
Rational منطقي	Intuitive بديهي
Objective	Subjective
Orders the right brain	Obeys the left brain
Deals with parts/analyzing	Deals with wholes /synthesis
Scientific	Artistic

HOW DO WE THINK?

Thinking involves a series of **steps or stages:**

- **Understanding the problem**
- **Data Gathering the solution**
- **Generating the solution**
- **Evaluation the solution**

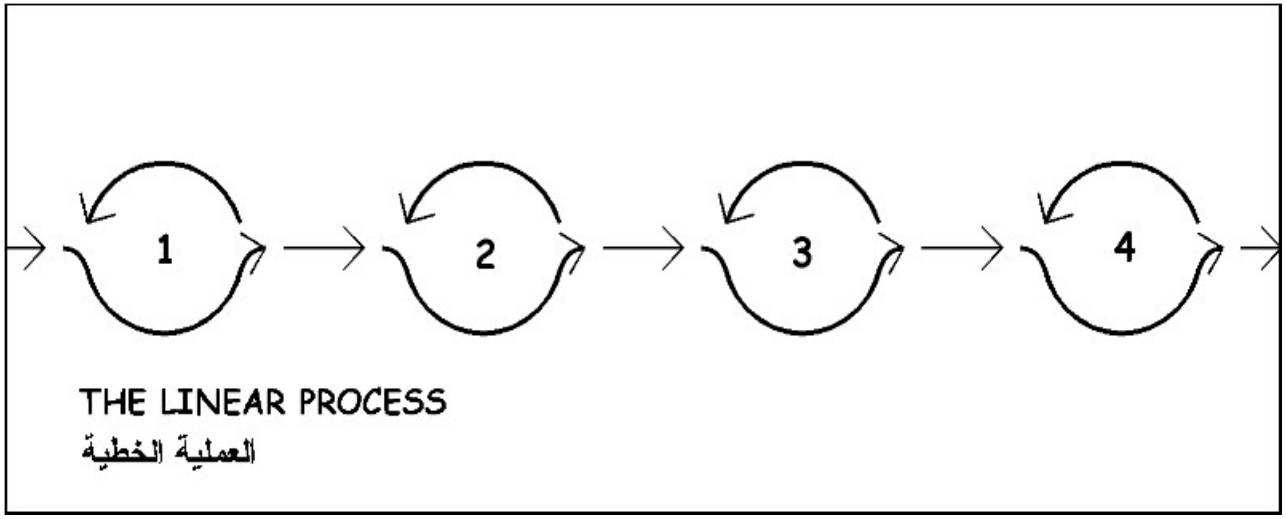
Beat Problem

- Four random students: First one should formulate a problem for the second team to think of solutions.
- My right side, third row, third student from the wall.
- My left side, fourth row, fourth student from the wall. Pick two helpers to form the team..

DYNAMICS OF THINKING

1. Linear Process العملية الخطية

- Every stage is finished before proceeding to the following
- Stage can be repeated when you are still in it
- No retreating to a former stage

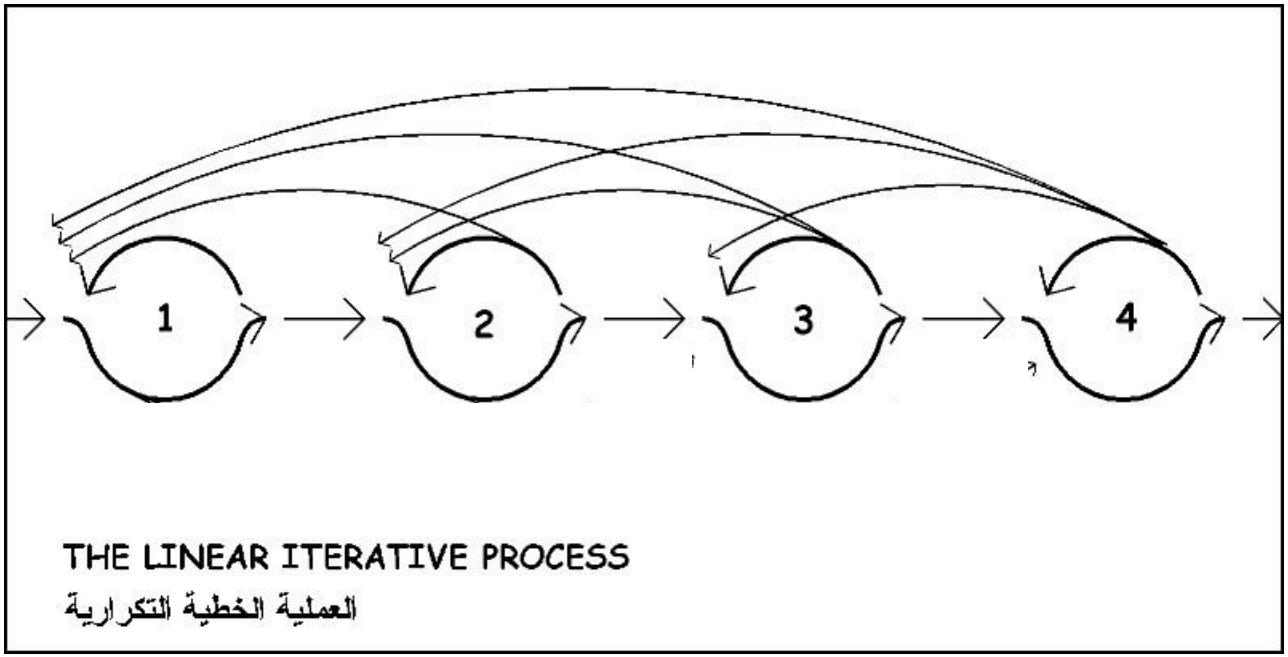


1.Brief 2.Analysis 3.Synthesis 4. Evaluation

DYNAMICS OF THINKING

2.Linear Iterative Process العملية الخطية التكرارية

- Process is **slightly flexible**
- Every stage is finished before proceeding to the following
- Stage can be repeated when you are still in it
- If needed you can retreat to a former stage but with **respect to linearity of process**

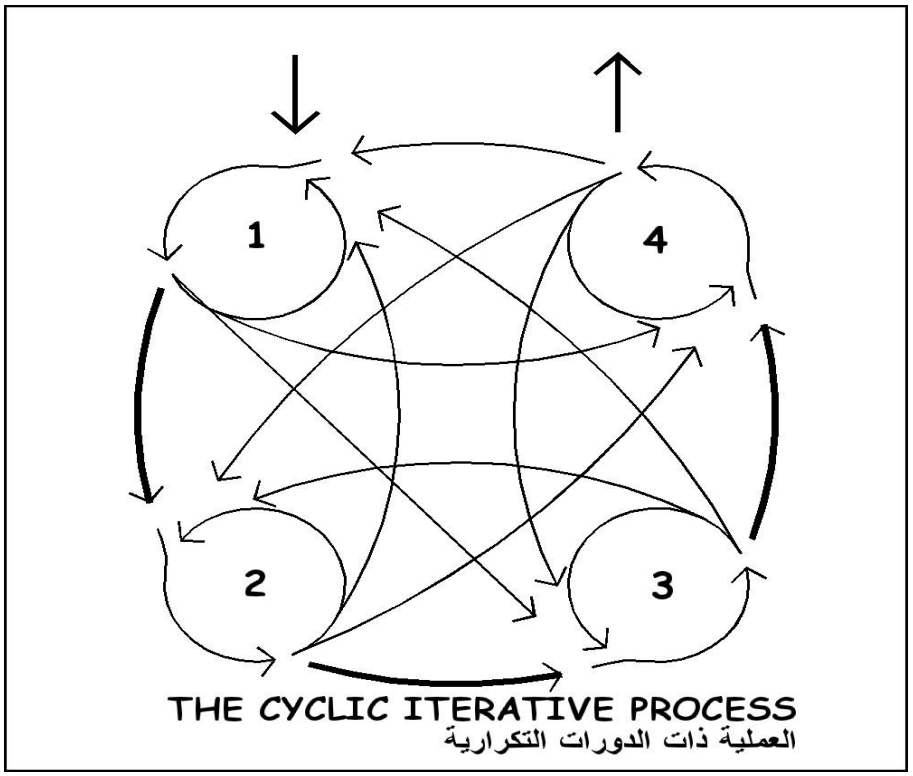


1.Brief 2.Analysis 3.Synthesis 4. Evaluation

DYNAMICS OF THINKING

3.Cyclic Iterative Process العملية ذات الدورات التكرارية

- **Flexible** process
- A stage may be repeated before proceeding to the following
- If needed you may retreat to a **previous stage or proceed to a following one without any restrictions**
- This process suits **educational processes & systematic architectural design**

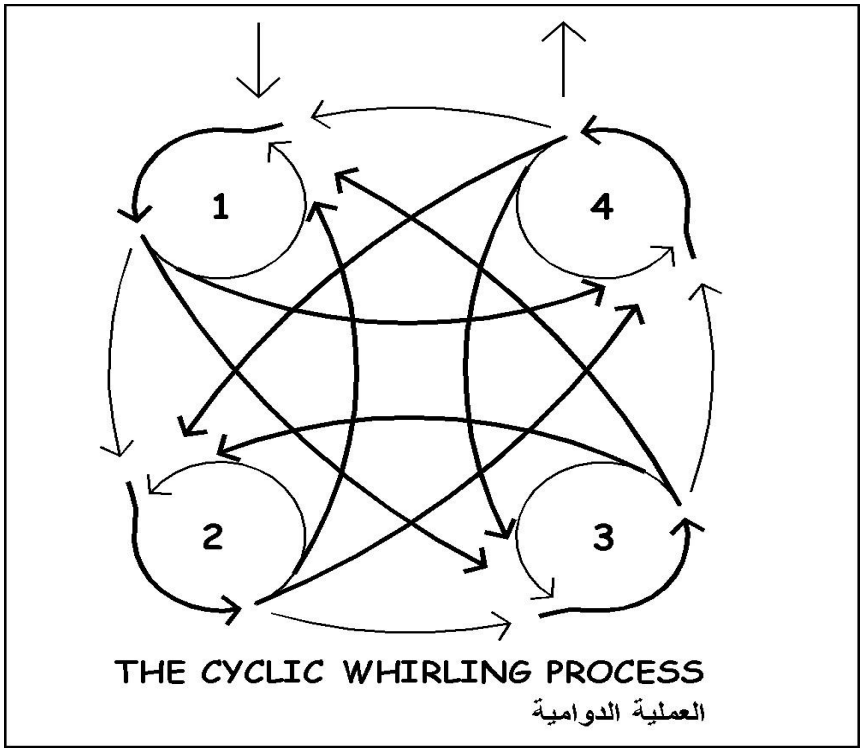


1.Brief **2.Analysis**
3.Synthesis **4. Evaluation**

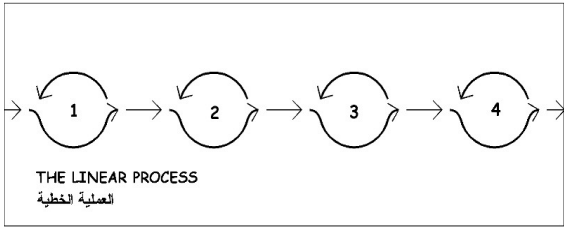
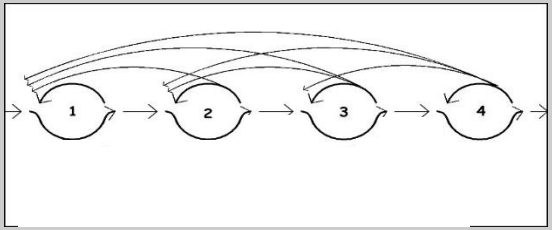
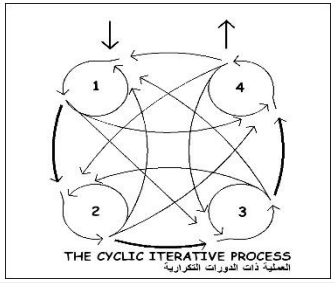
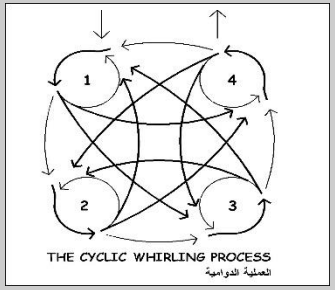
DYNAMICS OF THINKING

4. Cyclic Whirling Process العملية الدوامية

- It is **most flexible**
- A stage **may not be continued before proceeding to the following**
- **It is not necessary to start with the first stage**
- It is recommended to **move freely** through the stages without any restrictions
- Suitable for **creative thinking** in architectural design problems



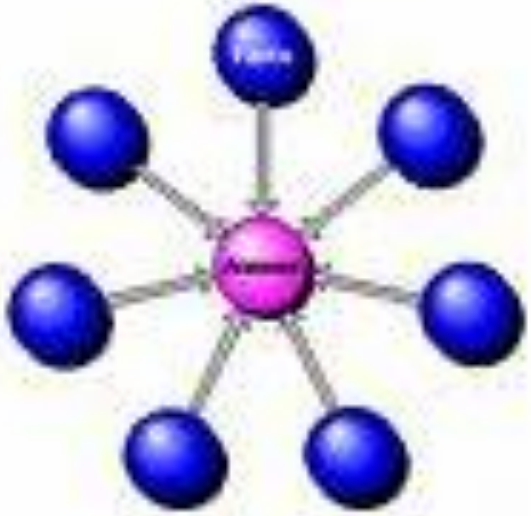
1.Brief **2.Analysis**
3.Synthesis **4. Evaluation**

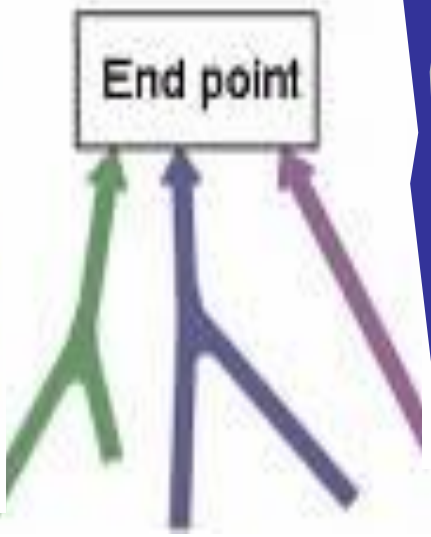
1. Linear Process		•Every stage is finished before proceeding to the following •Stage can be repeated •No retreating to a former stage
2.Linear Iterative Process		•Every stage is finished before proceeding to the following •Stage can be repeated •If needed you can retreat to a former stage
3.Cyclic Iterative Process		•A stage may be repeated before proceeding to the following •If needed you may retreat to a **previous stage or proceed to a following one without any restrictions**
4. Cyclic Whirling Process		•A stage **may not be continued before proceeding to the following** •**It is not necessary to start with the first stage** •It is recommended to **move freely** through the stages without any restrictions

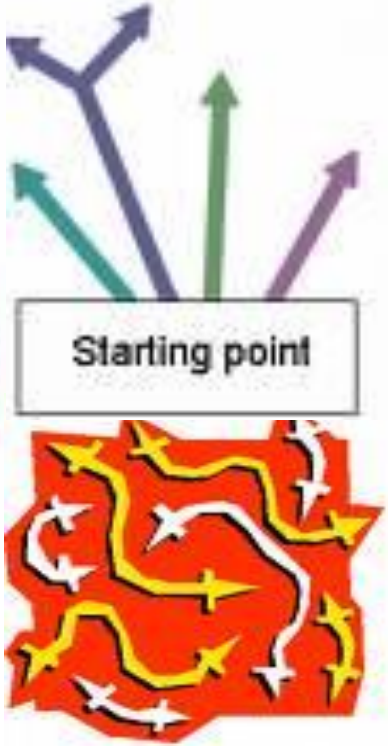
Beat Problem

- Four random students: First one should formulate a problem for the second team to think of solutions.
- My right side, second row, first student from the wall.
- My left side, fifth row, first student from the wall. Pick two helpers to form the team..

CONVERGENT THINKING	DIVERGENT THINKING
Attempts to bring thoughts **from different directions into a union** or common conclusion.	Starts from a **common point & moves outward into variety of perspectives**







SCIENTIFIC THINKING

❑Scientific thinking is:

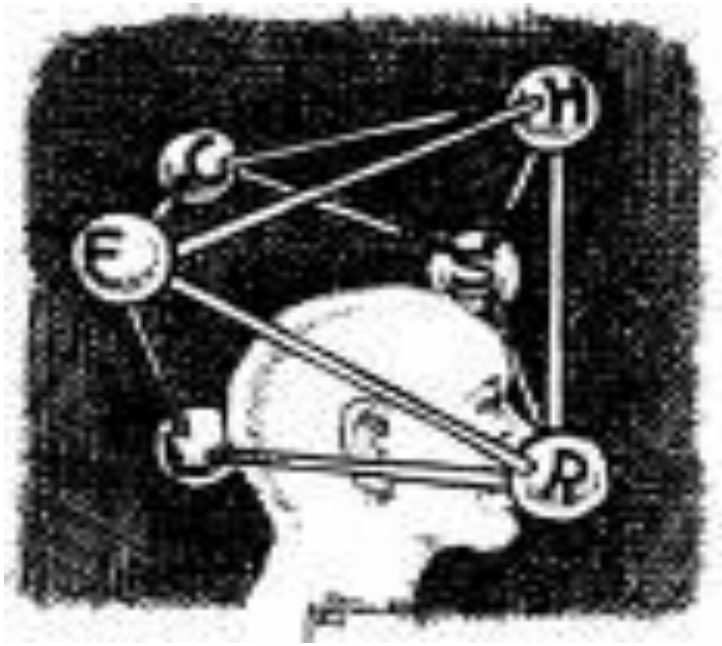
- Accumulative
- Organized
- Reasonable
- Universal
- Accurate & Abstract
- Experimental

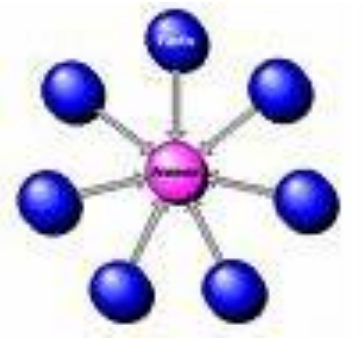
CREATIVE THINKING

- **Creative thinking**: this is divergent thinking. It generates **something new** or different involves having a different idea that works as well or better than previous ideas.

"Creativity involves breaking out of established patterns in order to **look at things in a different way**"

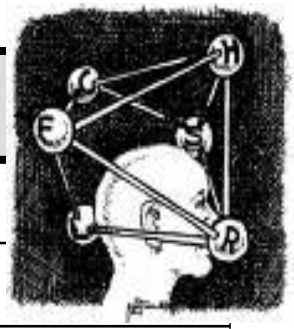
CRITICAL THINKING



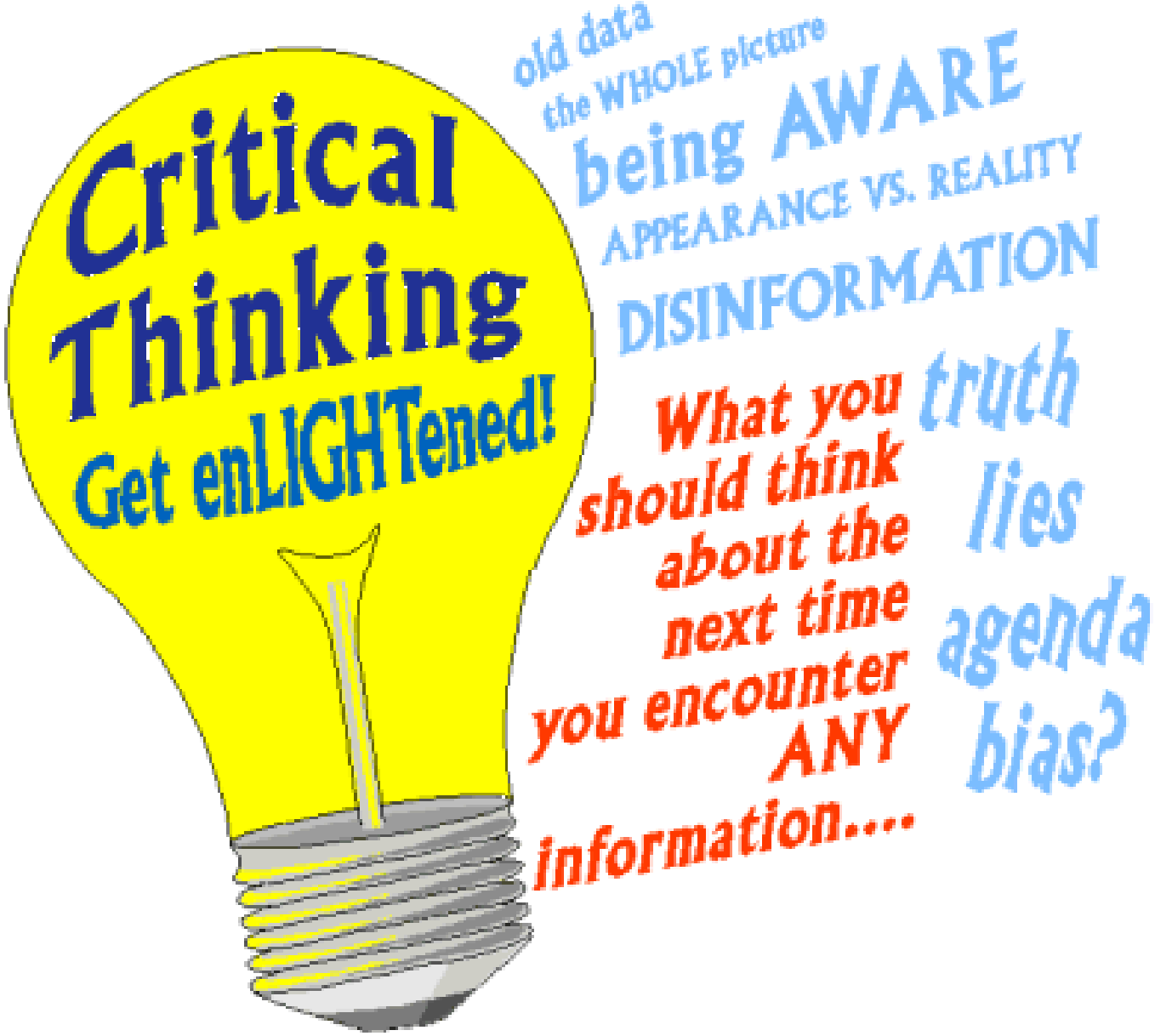


- **Critical thinking** is convergent. Assesses **the worth** & validity of **something existent**. It involves accurate objective analysis

CREATIVE vs. CRITICAL THINKING



CREATIVE		CRITICAL
Divergent	**Thinking style**	Convergent
Intuition	**Mental abilities**	Intelligence
Without a certain goal	**Goal**	Directed towards a goal
Without a known result	**Result**	The result is previously known
Introduces various situations	**Nature of Solution**	It has only one solution
Doesn't require special experience	**Experience**	Requires experience
Right brain	**Brain**	Left brain
Used in design processes	**usage**	Used in evaluation processes


Critical Thinking
Get enLIGHTened!
old data
the WHOLE picture
being AWARE
APPEARANCE VS. REALITY
DISINFORMATION
What you should think about the next time you encounter ANY information....
truth
lies
agenda
bias?

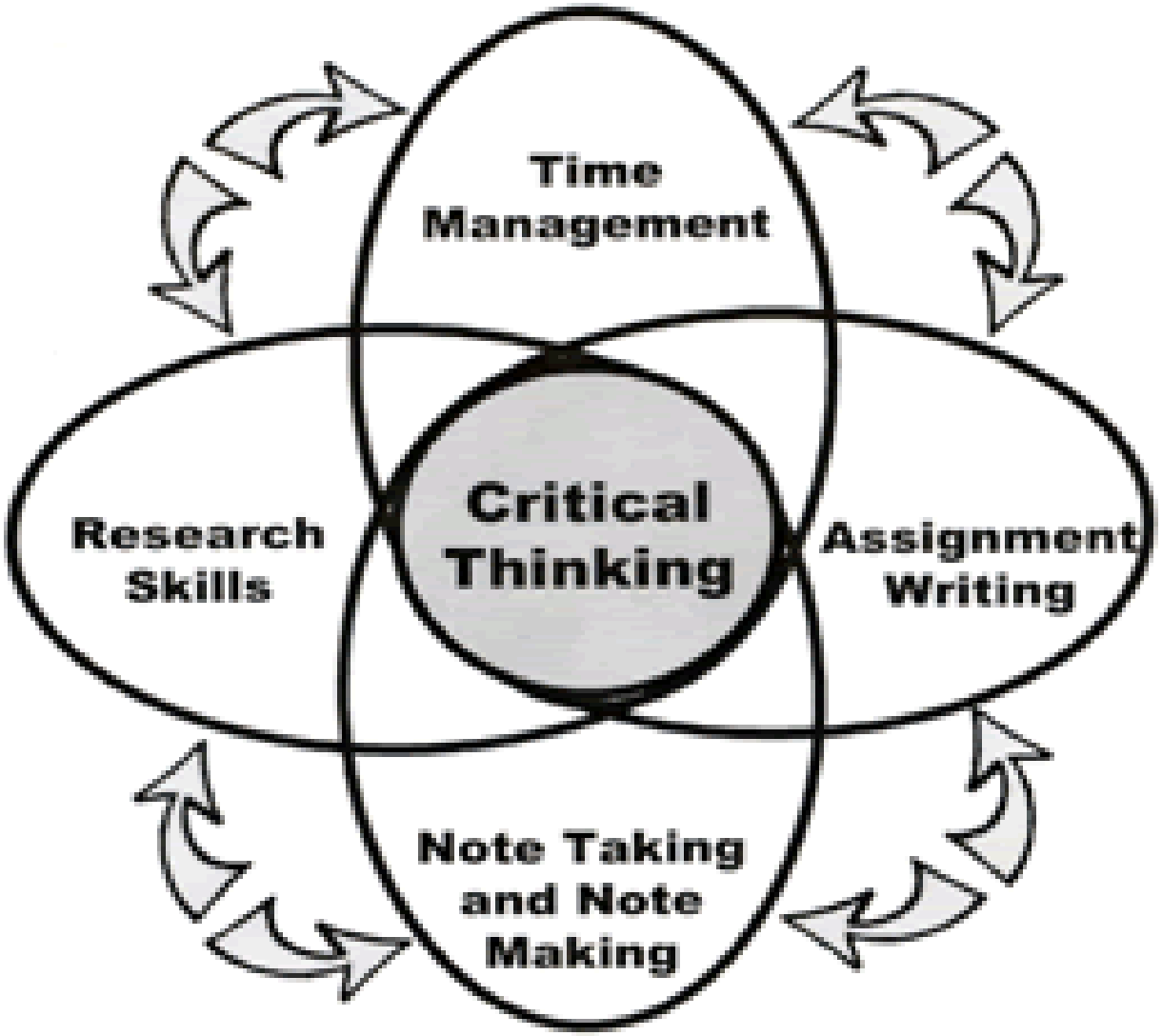
- **Critical thinking:**

is the process of **applying reasoned** and **organized thinking** to a **subject**.

To do well in **your studies** you need to think 'critically' about the things you have **read, seen or heard**.

Errors in Thinking

- Jumping to Conclusions
- Attacking the Person
- A hasty generalization
- Appeal to Common Belief and traditions
- Common Practice
- Follow Wrongs


Time Management
Research Skills
Critical Thinking
Assignment Writing
Note Taking and Note Making

The Critical Thinking Process

- State the problem in a clear way
- Identify the alternative views
- Watch for mistakes in reasoning
- Find at least 3 different answers
- Construct your own reasonable view