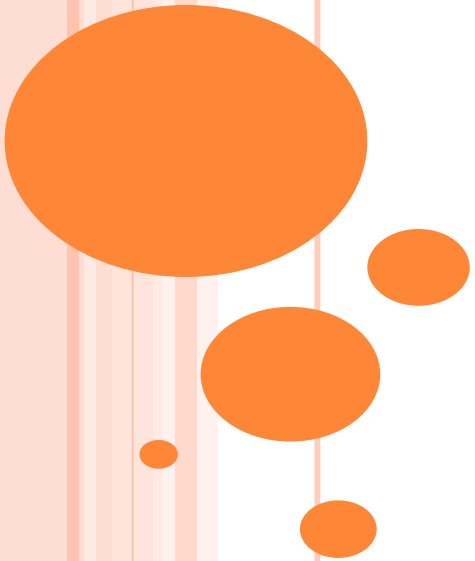
3. Thinking Scientifically (part 2)



What is a Science

- Is derived from the Latin word Scientia for knowledge
- The state of knowledge
- It is a method used by humans to try to make sense of the world in which they live.

What is a Science

- Oxford Advanced Learner's Dictionary
  - "Organized knowledge, especially when obtained by observation and testing of facts, about the physical world, natural laws and society; study leading to such knowledge."
  - " Branch of such knowledge: the natural science, e.g. Biology and geology; the physical science, e.g. Physics and Chemistry"

Goal of Science

- Acquire knowledge about the world.
- To explain the natural world as we observe it as much as possible and to search for ways of applying such knowledge for the benefit of humanity
  - Example: The popular phrase "Science tells us that smoking can kill you" really misleads.
  - "Science" doesn't tell us anything; people tell us things—in this case, people who have used scientific strategies to investigate the relationship of smoking to cancer.

SCIENCE VS TECHNOLOGY

➢**Technology**

- Originates from the Greek word "tekhnologia" and the Latin word "techologia";
  - which means an approach of doing something systematically
- Technology is the usage and knowledge of tools, techniques, crafts, systems or methods of organization

➢Technology is the application of Science to various tasks.

Differentiating Science and Technology

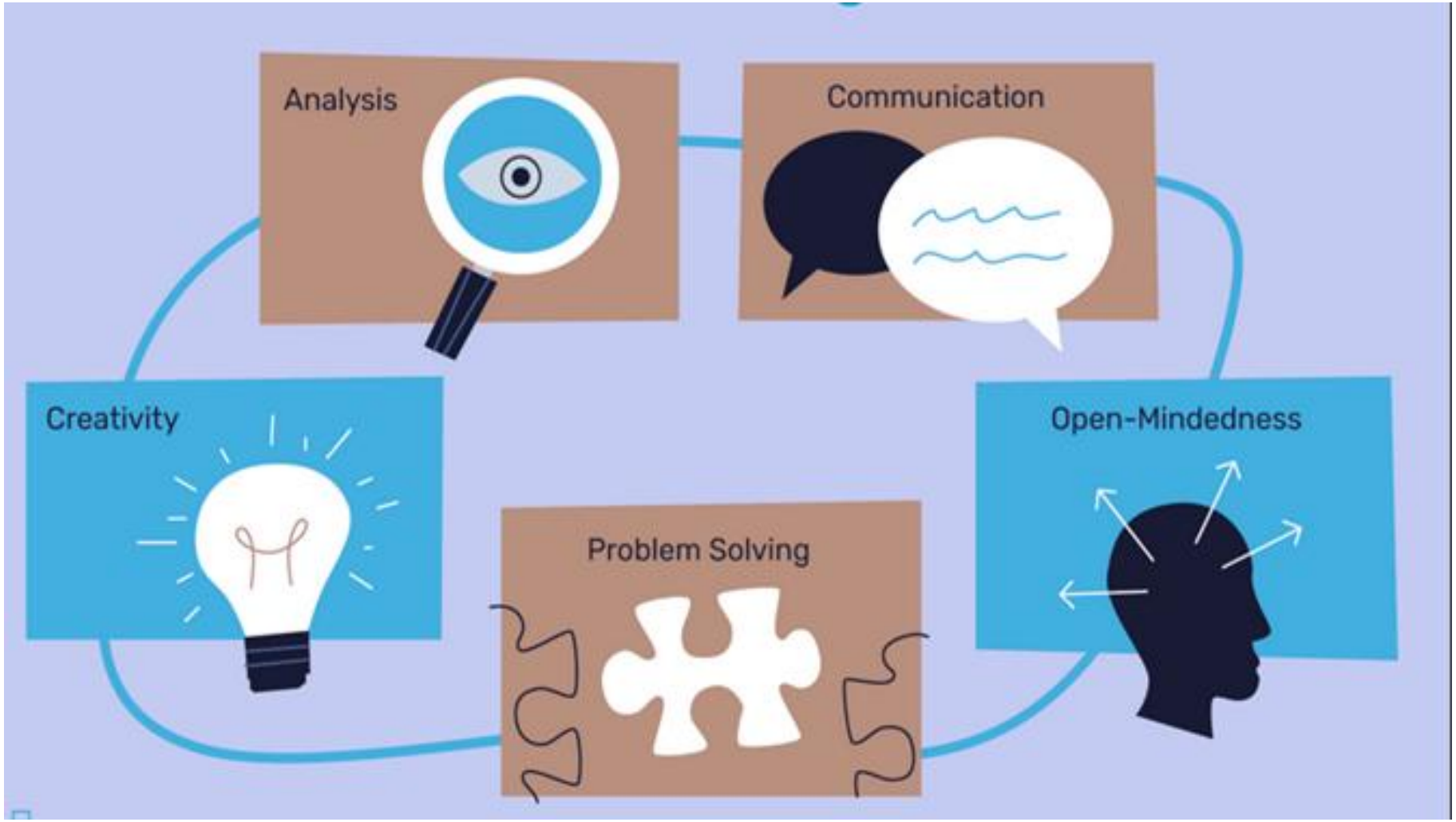
- Science and Technology are two different terms which have two different meanings
  - Science is a knowledge that explains natural phenomena
  - Technology is a field that is closely related to the world created by human to develop systematic ways in controlling either the natural world or the man-made world, as well as involving the process of doing something

Differentiating Science and Technology (Cont.)

- Example of Science
  - Chemistry: one molecule of water consists of two atoms of hydrogen and an atom of oxygen which is bonded by a covalent bond.
  - Biology: some diseases are caused by genes that can be passed from one generation to another
  - Physics: objects fall to the ground because of the presence of gravity

- Example of Technology
  - Chemistry: to find alternatives to fossil fuels, the technology to create energy from water by breaking water's covalent bond is being developed.
  - Biology: through genetic engineering, genes which carry diseases can be identified
  - Physics: Rocket and Jet technology have allowed mankind to defy gravitational pull to enable flight

Skills for scientific thinking



Steps of Scientific Method

- **The seven steps of the scientific method:**
  - Having a problem or question.
  - Gathering information to attempt to answer the question or solve the problem.
  - Propose a solution or answer to the problem or question. Performing a scientific **hypothesis**.

Steps of Scientific Method (Cont…)

- Testing the hypothesis by conducting an experiment . If the hypothesis fails the test, it must be rejected or modified.
- Collect and analyze the results.
- Construct, support or cast doubt on a scientific theory.
- Communicating the results

Scientific Method

EXAMPLE

Steps of the Scientific Method

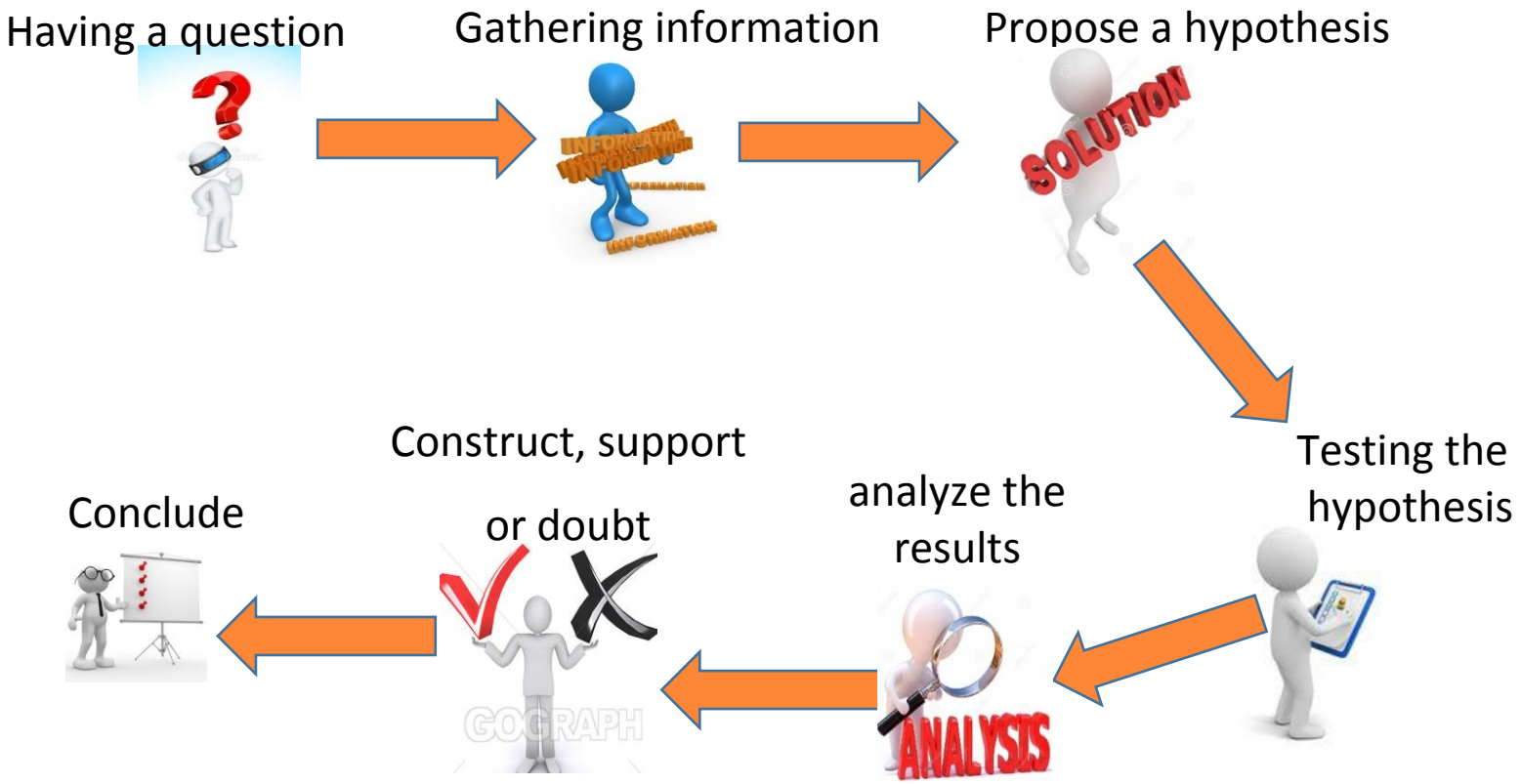
➢ **OBSERVE** a phenomenon or ASK a question	Does water freeze faster on its own or with sugar added?
➢ Construct a **HYPOTHESIS** (an educated guess)	I predict that water freezes slower with the addition of sugar.
➢ **TEST** it via experiment	Place two containers of water, one with sugar added, into the freezer...
➢ **ANALYZE** the data ➢ Draw **CONCLUSION** ➢ **COMMUNICATE** findings	


Experiment your way forward, instead of trying to decide your way forward
1
Challenge
3
Next Target Condition
(date)
Threshold of Knowledge
2
Current Condition
4
Experiments Toward the TC
At the current Knowledge Threshold

How to experiment your way forward rather than deciding your way forward

Examples

Scientific Method (Just to remember)



1= do mice grow larger if given vitamin C

2=Learn about mice , vit C ,and mice's diet

3= hypothesis (if mice is given Vit C then they will grow larger)

4= experiment on 2 groups (group 1 gets Vit C and group 2 doesn't get)

5=collect results. weigh all mice after 2 weeks

6=hypothesis is not correct

7=mice don't grow larger if given vitamin C

 1= do planting carrots deep in soil, causes them to take longer time to grow than in shallow soil.	 2=Learn about carrots , carrots' planting , deep soil planting and shallow soil planting	 7= planting carrots deep in soil, causes them to take longer time to grow than in shallow soil
 3= hypothesis (If we plant carrots deep in soil, it will take them longer to grow than in shallow soil)	 4= experiment on 2 groups (group 1 plant carrots deep in soil and group 2 carrots planted in shallow soil)	
 5=collect results measure carrots' roots in both groups	 6=hypothesis is correct	

 1= How does the size of a dog affect how much food it eats?	 2=Learn about dogs and dogs diet	 7= the size of a dog affect how much food it eats
 3= hypothesis (If the dog size is big then it will consume more food)	 4= experiment on 2 groups (group 1 small dogs and group 2 large dogs)	
 5=collect results. measure amount of food consumed by both groups	 6=hypothesis is correct	

Thinking traps

"I can handle it"
"There is always a way".

- **Definition:**
  - Thinking traps are **c**ertain types or patterns of thoughts that tend to **trap** us in **anxiety**.
  - The first important step to **overcome** Thinking traps is to **recognize** your personal **traps…..then *start dealing with it*** .

Examples of thinking traps

- First thinking trap: Being a perfectionist
- Second thinking trap: Self-delusion

- **First thinking trap: Being a perfectionist:**

- If you don't allow yourself to make mistakes,,, you aren't just putting yourself under a lot of pressure BUT you won't develop any further either.
- It's unrealistic and unattainable to be perfect
- If you don't allow yourself to make mistakes; you can never develop any further either because, without mistakes, you can't learn.

How to get out of this thinking trap

- The goal should be to see the positive in mistakes and to accept them as well as those of others.
- Mistakes are a learning experience and help you to progress.
- Instead of looking into the past with an
  - "*Oh God, how could I have done that*"
- think of the future and say to yourself :

"*Okay, that went badly but I got an excellent experience and next time I'll do it better*."

- Remember nobody wants to be around someone *perfect* all the time

Second thinking trap: Self-delusion

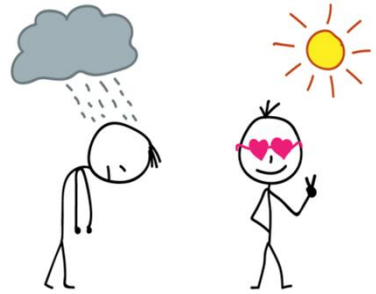
- Sometimes it's okay to indulge a little, but it can become problematic when this prevents you from achieving your goals on the longterm.
- Indulging and telling yourself things that distract you from what matters is obviously an ineffective approach.

How to get out of the thinking trap

- In general, it's good to **question** yourself, to be **critical**, and to ask again and again a bout what is drawing you back.
- In that way, you can **consider what to do about** it.
- It's better to **intervene** with yourself as soon as possible.
- Use Useful affirmations such as
  - ***"I can stand up for my own goals"***

Practical tips to avoid thinking traps

- You can challenge your own thinking traps by finding a "sparring partner" to support you in changing your behavior and to benefit from his experience and knowledge.



- Thinking traps wouldn't be so awful if we were able to recognize them and nip them immediately.

- Think about a certain situation when you were facing a lot of challenges but you were able to overcome this situation and you were able to turn your failure into success– this is called an *anchor*.

- *Anchor* is a great technique for those thoughts that resurface when you least expect.

- Remember You don't adopt a new way of thinking overnight simply by flipping a switch. It takes a lot of repetition to get rid of your old thinking patterns.