

THE DEVELOPMENT OF CRITICAL THINKING SKILLS THROUGH SCIENCE EDUCATION

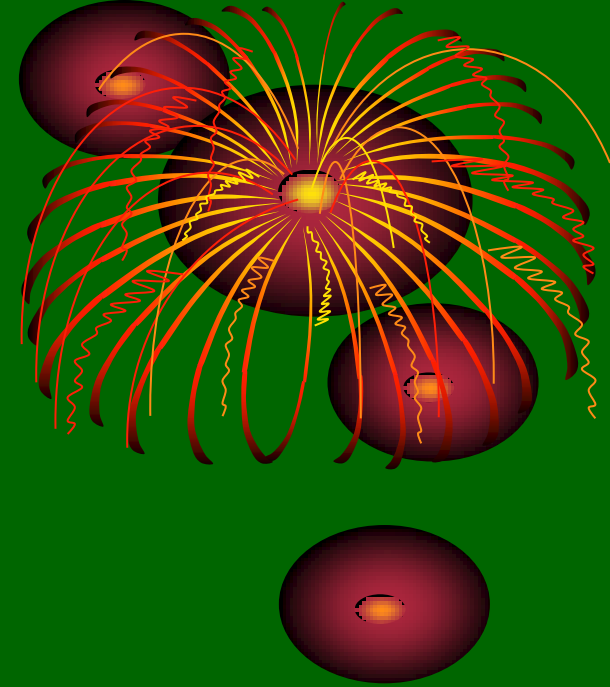


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SCIENCE EDUCATION PROGRAM

GRADUATE SCHOOL IUE

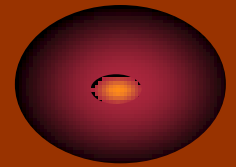
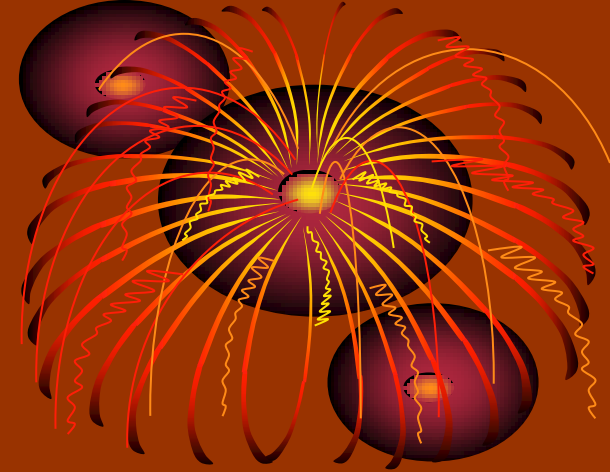
**WHAT KIND OF
THINKING NEEDED
TO LEARN SCIENCE?**



**LOWER ORDER
THINKING VS HIGHER
ORDER THINKING
SKILLS ?**

LOWER ORDER THINKING SKILLS: *WHAT TO THINK*

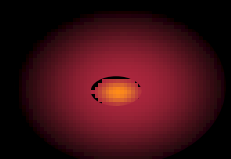
- **STUDENT PASSIVELY
ABSORB INFORMATION**
- **THEY REPEAT IT BACK**
- **MEMORIZE THE
INFORMATION**
- **WRITE IT BACK ON TEST**



HIGHER ORDER THINKING SKILLS: *HOW TO THINK*

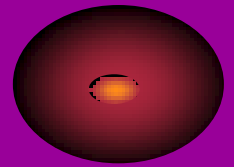
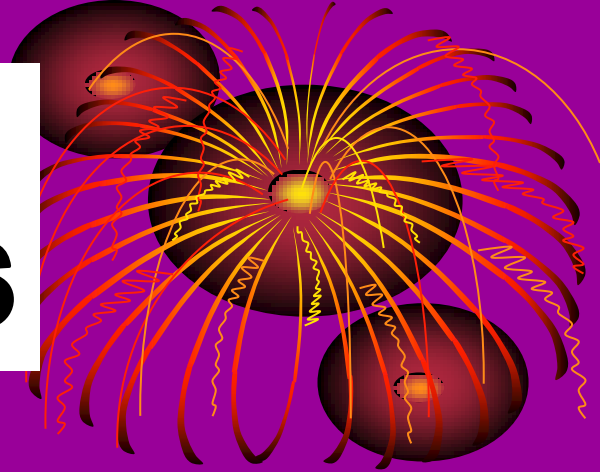


STUDENTS SHOULD BE:

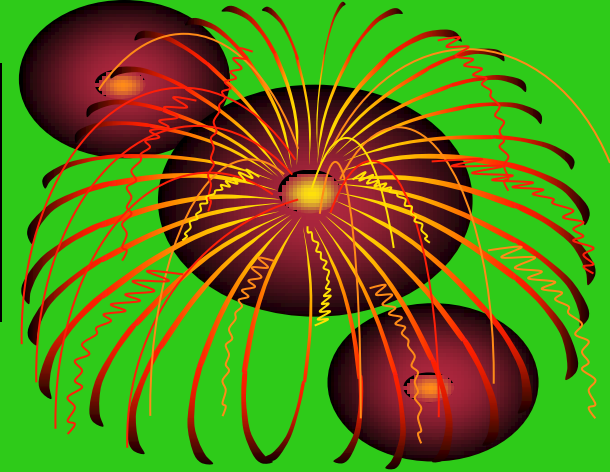
- **ACTIVE**
 - **MAKE INTELLIGENT OF IDEAS AND INFORMATION**
 - **INDEPENDENT**
 - **SELF-DIRECTED THINKERS**
 - **SELF-DIRECTED LEARNERS**
- 

HIGHER ORDER THINKING SKILLS

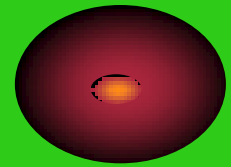
- **CRITICAL THINKING**
- **CREATIVE THINKING**
- **PROBLEM SOLVING**
- **DECISION MAKING**



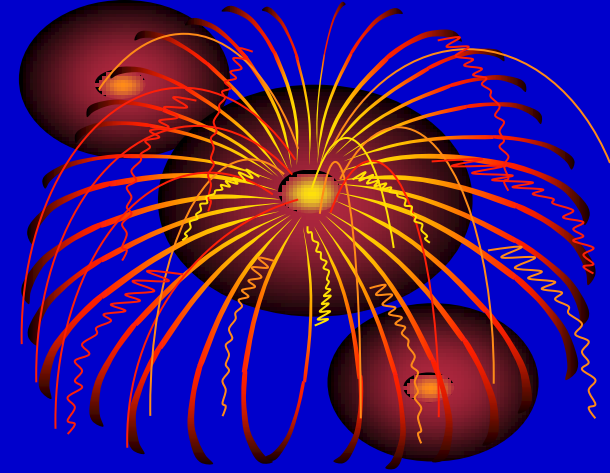
WHAT IS CRITICAL?



- **NEGATIVE & FAULT-FINDING**
- **INVOLVING/EXERCISING SKILLED JUDGMENT OR OBSERVATION**



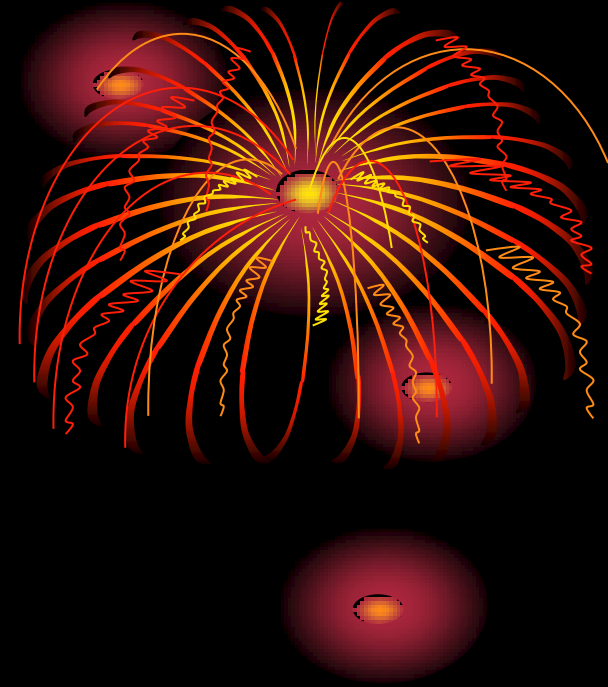
WHAT IS CRITICAL THINKING?



- **COGNITIVE SKILLS AND INTELLECTUAL DISPOSITION**
- **EFFECTIVELY IDENTIFY, ANALYZE, EVALUATE ARGUMENTS AND TRUTH CLAIMS**
- **DISCOVER AND OVERCOME PERSONAL PREJUDICES AND BIASES**
- **FORMULATE AND PRESENT CONVINCING REASON IN SUPPORT CONCLUSION**
- **MAKE REASONABLE AND INTELLIGENT DECISIONS ABOUT WHAT TO BELIEVE AND WHAT TO DO**

STANDARD OF CRITICAL THINKING

- **CLARITY**
- **PRECISION**
- **ACCURACY**
- **RELEVANCE**
- **CONSISTENCY**
- **LOGICAL CORRECTNESS**
- **COMPLETENESS**
- **FAIRNESS**



DISPOSITIONS OF CRITICAL THINKING



- **SEEK A CLEAR STATEMENT OF THESE/QUESTION**
- **SEEK REASON, TRY TO BE WELL INFORMED**
- **USE CREDIBLE SOURCES AND MENTION THEM**
- **TAKE INTO ACCOUNT THE TOTAL SITUATION**
- **SEEK A CLEAR STATEMENTS/THESES/QUESTIONS**
- **TRY TO REMAIN RELEVANT TO THE MAIN POINT**
- **KEEP IN MIND THE ORIGINAL/BASIC CONCERN**
- **LOOK FOR ALTERNATIVES**
- **BE OPEN-MINDED, TAKE A POSITION**

5 STAGE ABILITIES OF CRITICAL THINKING

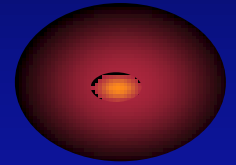
- 1. ELEMENTARY CLARIFICATION**
- 2. BASIC SUPPORT**
- 3. INFERENCE**
- 4. ADVANCED CLARIFICATION**
- 5. STRATEGY AND TACTICS**



ELEMENTARY CLARIFICATION



- **FOCUSING ON A QUESTION**
- **ANALYSING ARGUMENTS**
- **ASKING & ANSWERING QUESTIONS**



BASIC SUPPORT

- **JUDGING THE CREDIBILITY A SOURCE, CRITERIA**
- **OBSERVING AND JUDGING OBSERVATION REPORTS, CRITERIA**



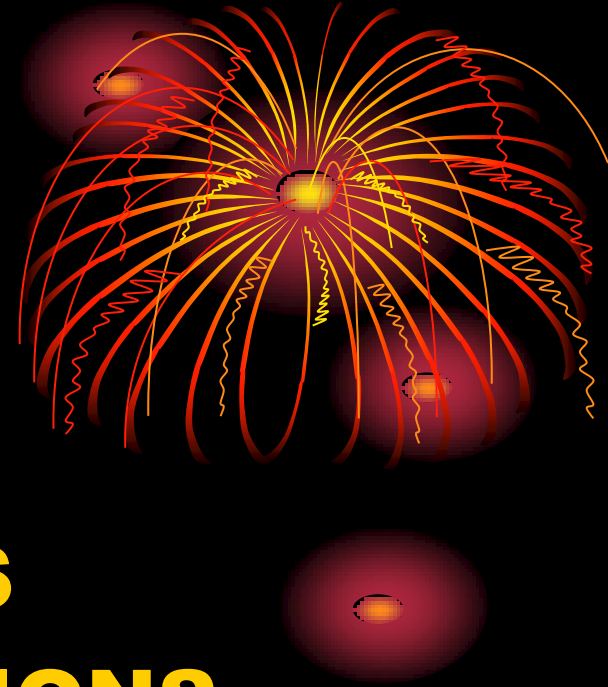
INFERENCE

- **DEDUCING AND JUDGING DEDUCTIONS**
- **INDUCING AND JUDGING INDUCTIONS**
- **MAKING AND JUDGING VALUE JUDGEMENTS**



ADVANCED CLARIFICATION

- **DEFINING TERMS AND
JUDGING DEFINITIONS**
- **IDENTIFYING ASUMPTIONS**

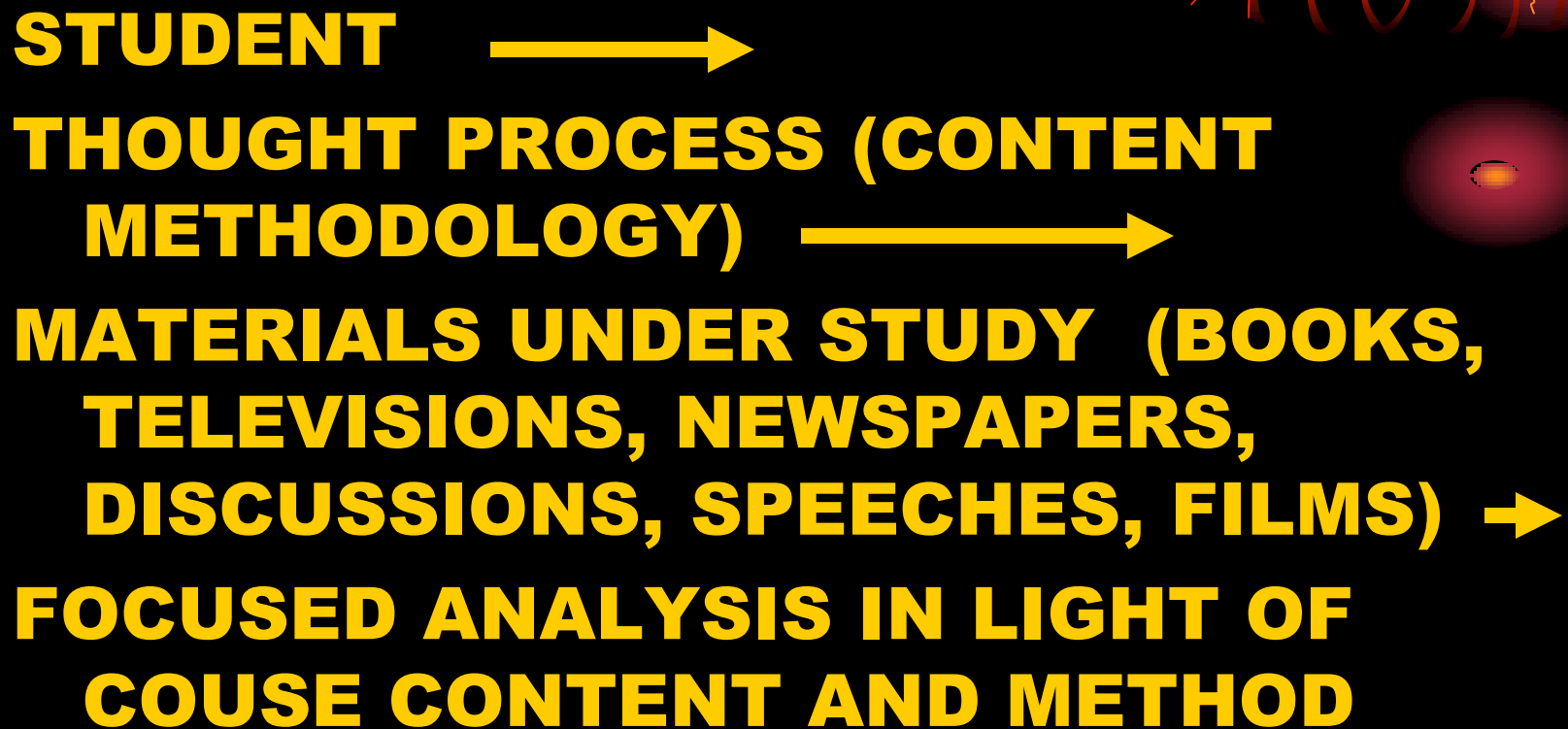


STRATEGY AND TACTICS

- **DECIDING ON AN ACTION**
- **INTERACTING WITH OTHERS**



VISUAL MODEL OF CRITICAL THINKING



CRITICAL THINKING IN THE CLASSROOM

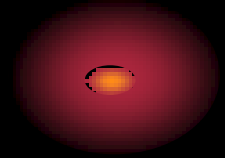


- **UNDERSTANDING THE ARGUMENTS AND BELIEFS OF OTHERS**
- **CRITICALLY EVALUATING THOSE ARGUMENTS AND BELIEFS**
- **DEVELOPING AND DEFENDING ONE'S OWN WELL-SUPPORTED ARGUMENTS AND BELIEFS**

STRUCTURING CLASSES TO PROMOTE CRITICAL THOUGHT



- **BALANCING CONTENT & PROCESS**
- **BALANCING LECTURE & INTERACTION**
- **GENERATING CLASSROOM DISCUSSION**



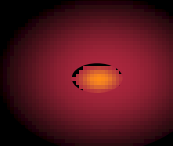
KEYS TO CREATE INTERACTIVE CLASSROOM

- ❑ **BEGIN EACH CLASS WITH A PROBLEM OR CONTROVERSY**
- ❑ **USE SILENCE TO ENCOURAGE REFLECTION**
- ❑ **ARRANGE CLASSROOM SPACE TO ENCOURAGE INTERACTION**
- ❑ **WHEREVER POSSIBLE, EXTEND CLASS TIME**
- ❑ **CREATE A HOSPITABLE ENVIRONMENT**



THE BASIC PATTERN OF SCIENTIFIC REASONING

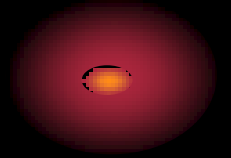
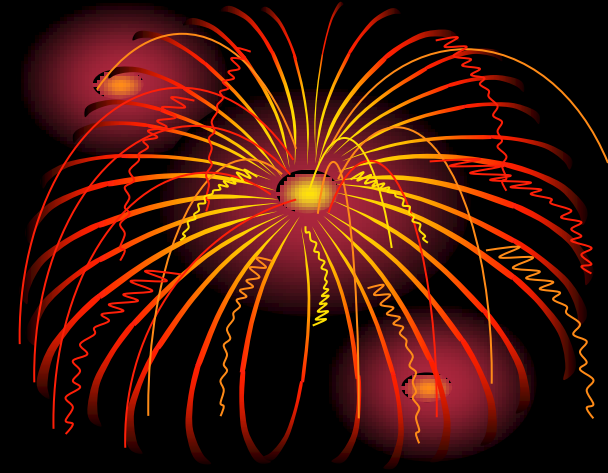


- **IDENTIFY THE PROBLEM**
 - **GATHER RELEVANT DATA**
 - **FORMULATE HYPOTHESES TO EXPLAIN THE DATA**
 - **TEST THE HYPOTHESES BY OBSERVATION OR EXPERIMENT**
- 

THE LIMITATIONS OF SCIENCE



- **SCIENCE DEALS WITH EMPIRICALLY OBSERVABLE FACTS, CANNOT ANSWER QUESTIONS OF MEANINGS AND QUESTION OF VALUE:**
- **DOES THE UNIVERSE HAVE A PURPOSE?**
- **DOES LIFE HAVE A PURPOSE?**
- **IS IT EVER RIGHT TO LIE?**
- **IS ABORTION ALWAYS WRONG?**



**THANK YOU
FOR YOUR ATTENTION**