Scientists Teaching Science

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Instructional Design

- The systematic design of materials, activities, and interactive environments for learning.
- Broadly informed by educational psychology theories and research.
- The major educational psychology theories are based on **behavioral, cognitive, and social cognitive perspectives.**

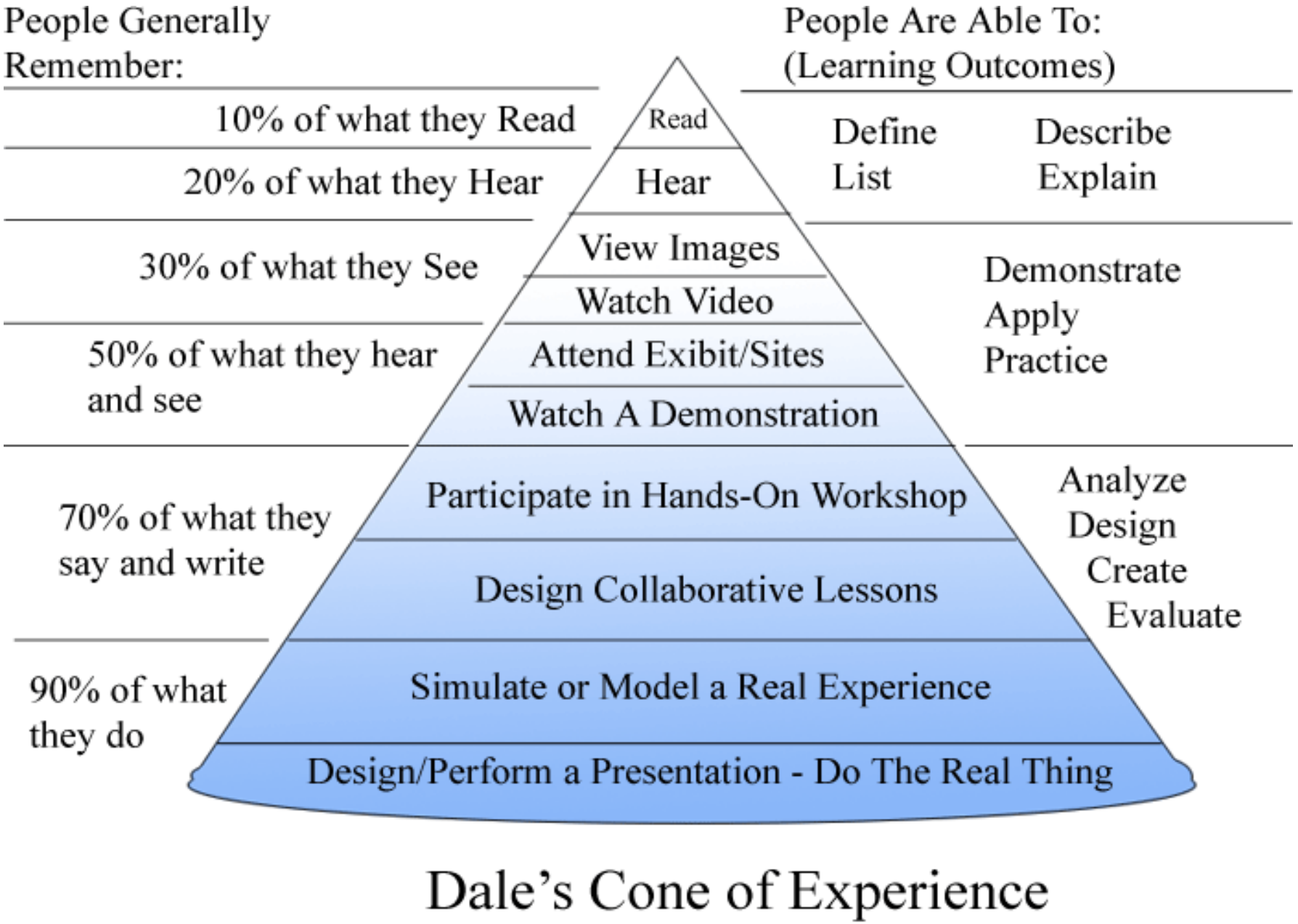
Behavioral Perspective

- Based on the principles of **operant conditioning:**
  - **Reinforcement:** a consequence that causes a behavior to occur with greater frequency.
  - **Punishment:** a consequence that causes a behavior to occur with less frequency.
  - **Extinction:** the lack of any consequence following a response; causes a behavior to occur with less and less frequency.

Cognitive Perspective

- Considers **traits, beliefs, memories, motivations, and emotions.**
- Describes memory structures that determine how information is **perceived, processed, stored, retrieved, and forgotten.**
- **Problem solving** is a fundamental characteristic of learning.

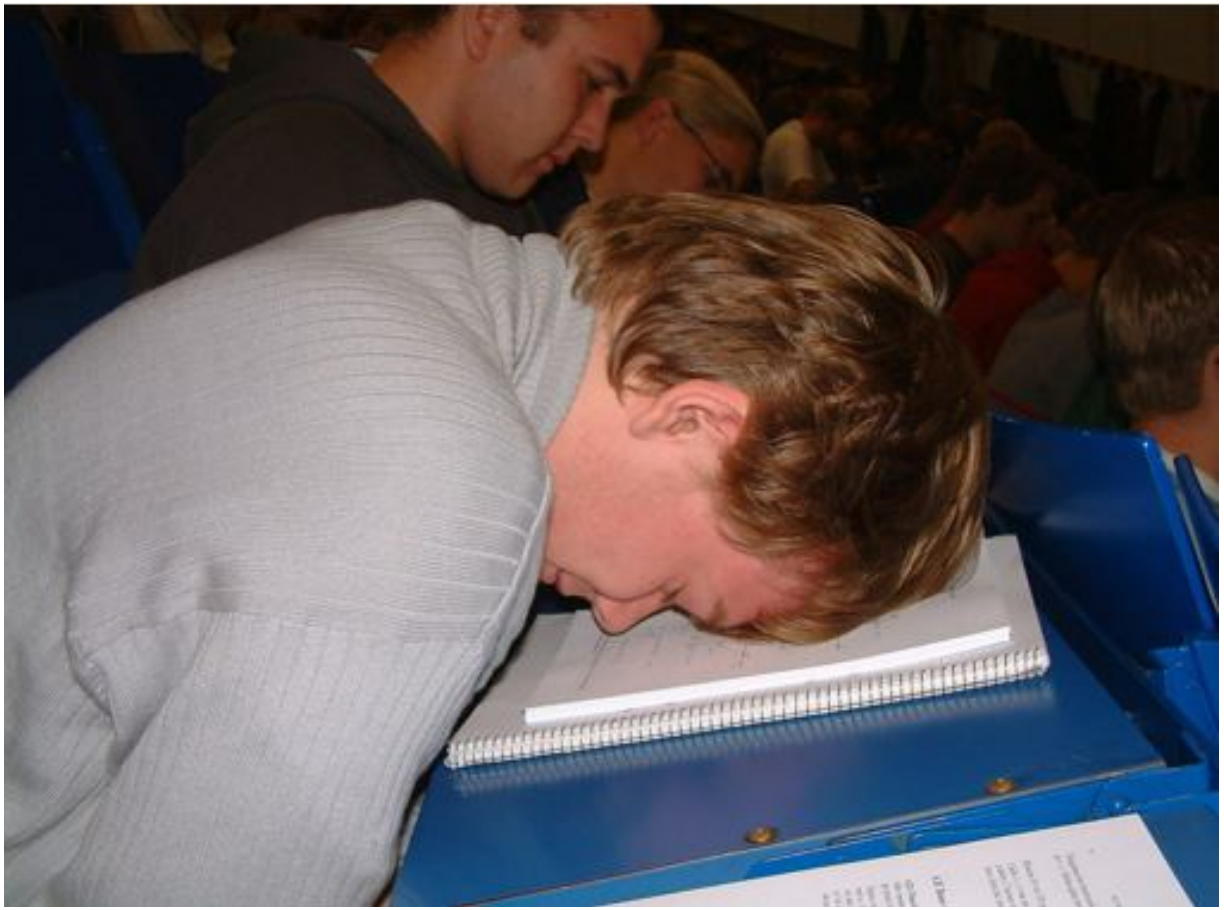
What are you thinking right now?



Dale's Cone of Experience

Dale, E. (1969) Audiovisual methods in teaching, third edition. New York: The Dryden Press; Holt, Rinehart and Winston.

Your Examples of Poor Instruction



Purpose of this Workshop

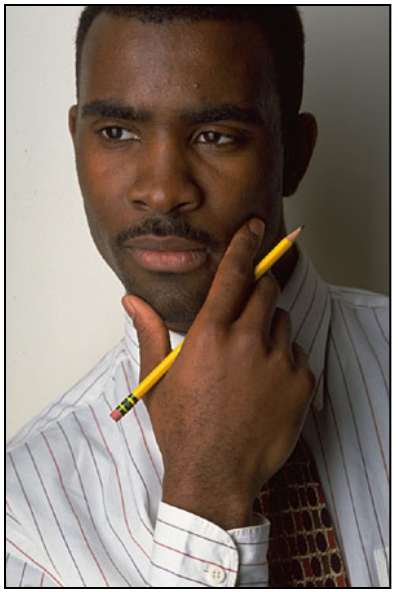
- Understand that even if you are an expert in your subject, you can still be a poor teacher.
- Learn some basic information about different methods to keep your students interested and learning.
- Learn a few basic facts about instruction and designing a course.

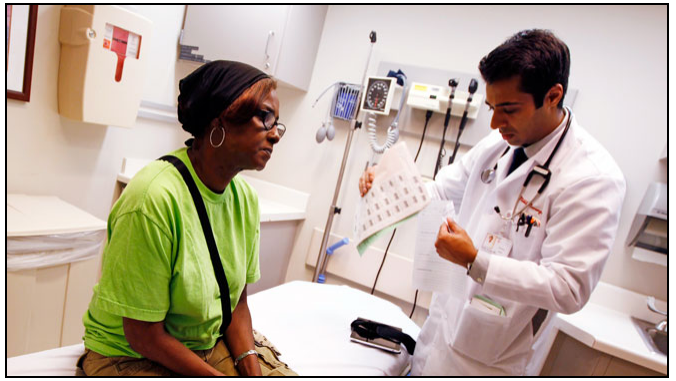
Objectives

1. Know about four major learning styles and their characteristics.
2. Compare methods of instruction that meet the needs of learners.
3. Identify some steps in preparing a course (curriculum design).

Learning Domains

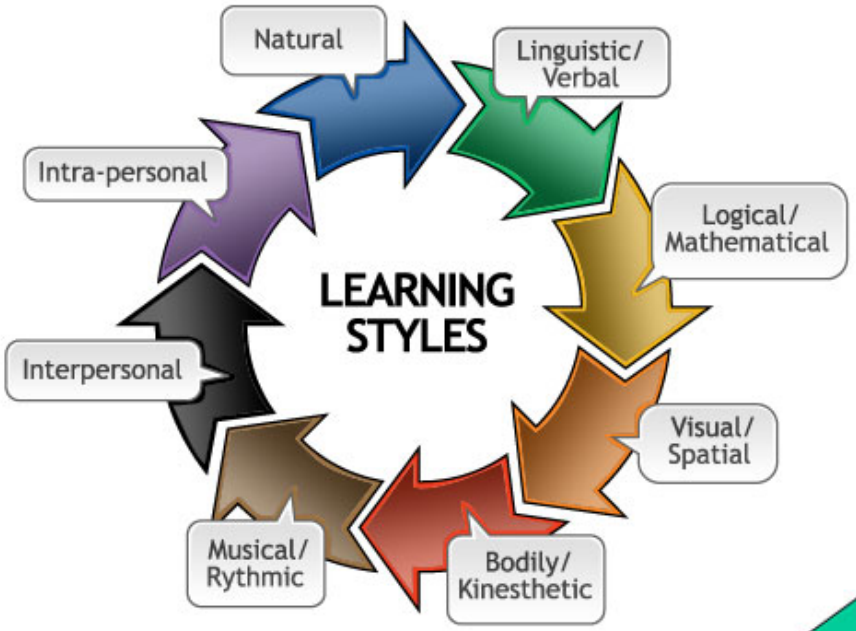
1. Cognitive: knowledge or mind based
2. Psychomotor: skill based
3. Affective: belief or behavior based

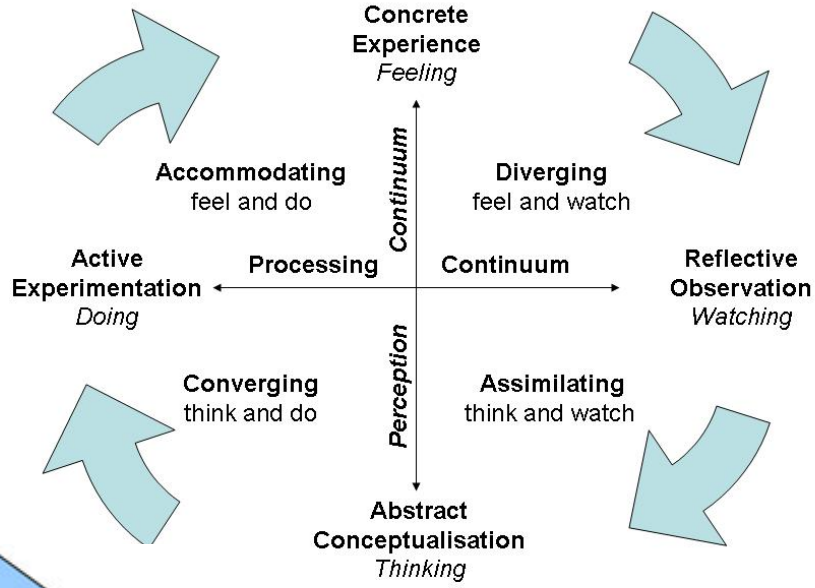


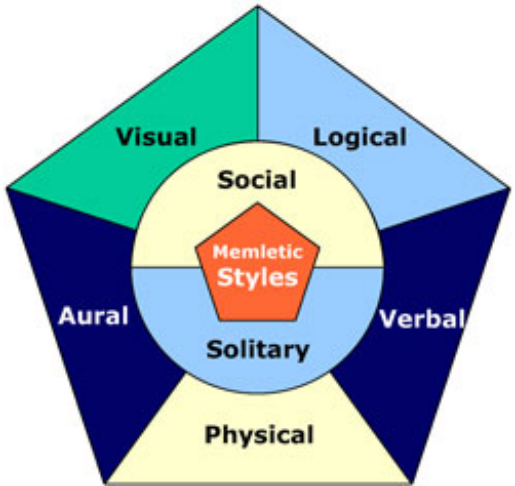


Learning Styles

There are several different theories about learning styles.







A benchmark definition of ‘‘learning styles’’ is ‘‘characteristic cognitive, effective, and psychosocial behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment.”

Learning styles are considered by many to be one factor of success in higher education. But there is no agreement on which single method is the best way to categorize them.

“When the majority of information is presented in formats that are misaligned with learning styles, students may spend more time manipulating material than they do in comprehending and applying the information.” (Romanelii, Bird, & Ryan, 2009)

VARK

Multiple Intelligence Quiz

Are you a:

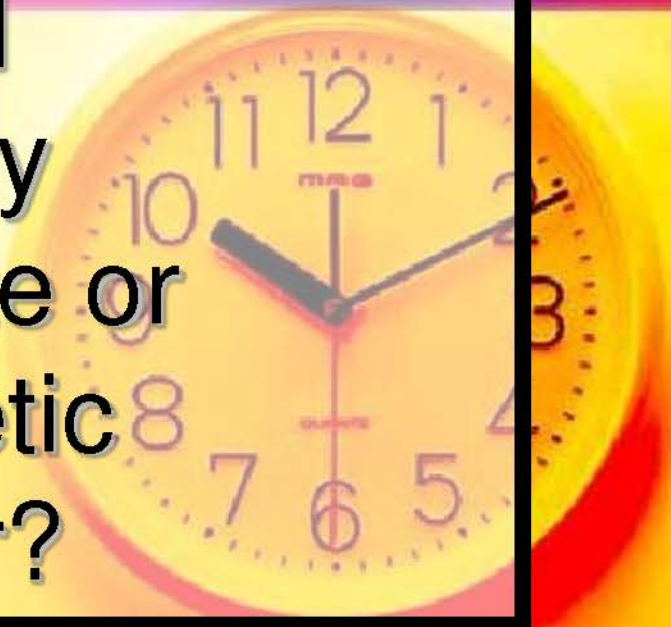
Visual

Auditory

Read/Write or

Kinesthetic

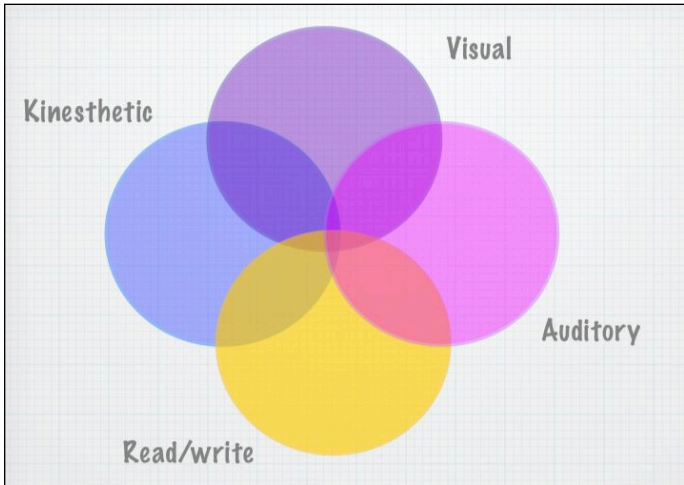
Learner?



What's Your Learning Style?

- THINK – PAIR - SHARE
- Use the VARK questionnaire to find your learning style(s).
- Or search VARK on your phone and choose "questionnaire" to take it online.
- Pair up with the person next to you.
- After finding your major learning style, discuss it with your partner.
- Share information about things you each do to learn new ideas or concepts.

After Fleming, 1995

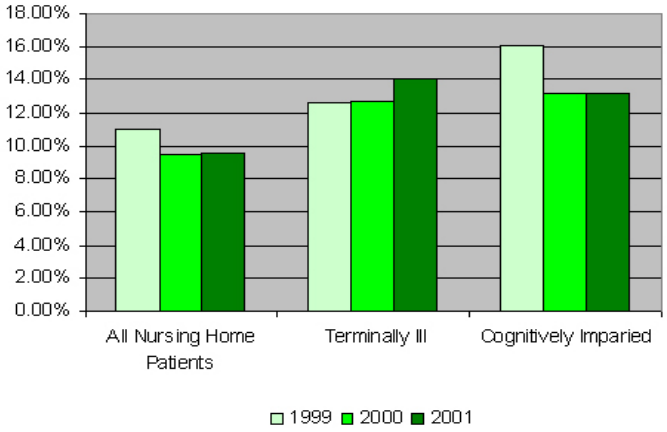


METACOGNITION

- Is thinking about **your own thinking**.
- You have determined what **you need to do** to learn and remember information.

Once you realize how you learn, you can come to understand that others may learn in different ways. This helps you vary your instruction to meet the needs of your audience.

For Visual Learners



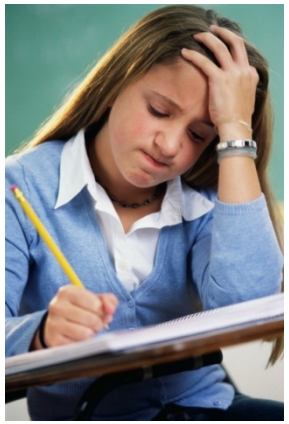
- Use books with graphs, illustrations, tables, flowcharts, diagrams, or photographs.
- Don’t just talk: SHOW the important points.
- The use of uncrowded slides and images is important.

For Auditory Learners

- Speak clearly and slowly.
- Encourage your students to ask and answer questions.
- Hold large and small group discussions; hearing others talk helps them remember.
- Make sure you repeat the key points. Your students may ask questions that repeat your statements because it helps them to remember better.

For Read/Write Learners

- Provide extensive written material for information.
- On slides or a board, write the key information in words.
- Ask for written summaries or explanations if possible.
- Post written summaries of key ideas at the end of a lesson or activity.



For Kinesthetic Learners

- Break up a lecture with small group discussions where people have to move about.
- Provide opportunities for people to handle equipment when learning important skills.
- Use concrete personal examples, simulations, or role-playing activities whenever possible.

You Can't Do It All

- Do you think you need to try to meet the needs of all four types at the same time?
- You will still mostly talk/lecture.
- Problems arise when an instructor uses one predominant style, and a student has a conflicting style of learning.
- This is the student who just doesn't seem to *get it*, no matter how many times you try to teach them.

Review

- What's one way to help:
  - read/write learners?
  - visual learners?
  - auditory learners?
  - kinesthetic learners?

- Keep in mind you can extend or enhance your lecture with different activities.

Designing Your Instruction

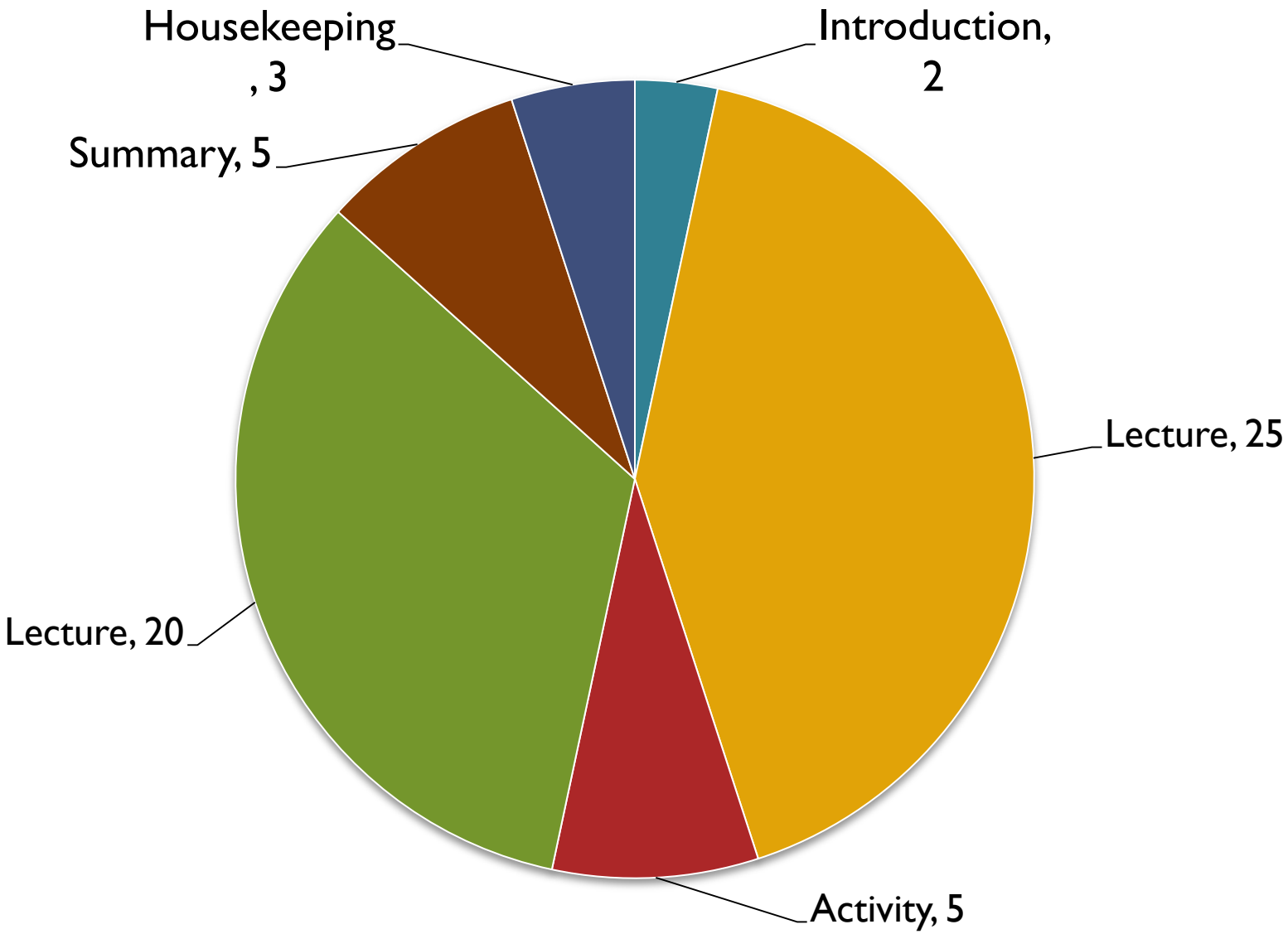
- What else can you do besides lecture?
- What other assessments can you assign other than reading and answering questions?

Alternatives to Lecturing

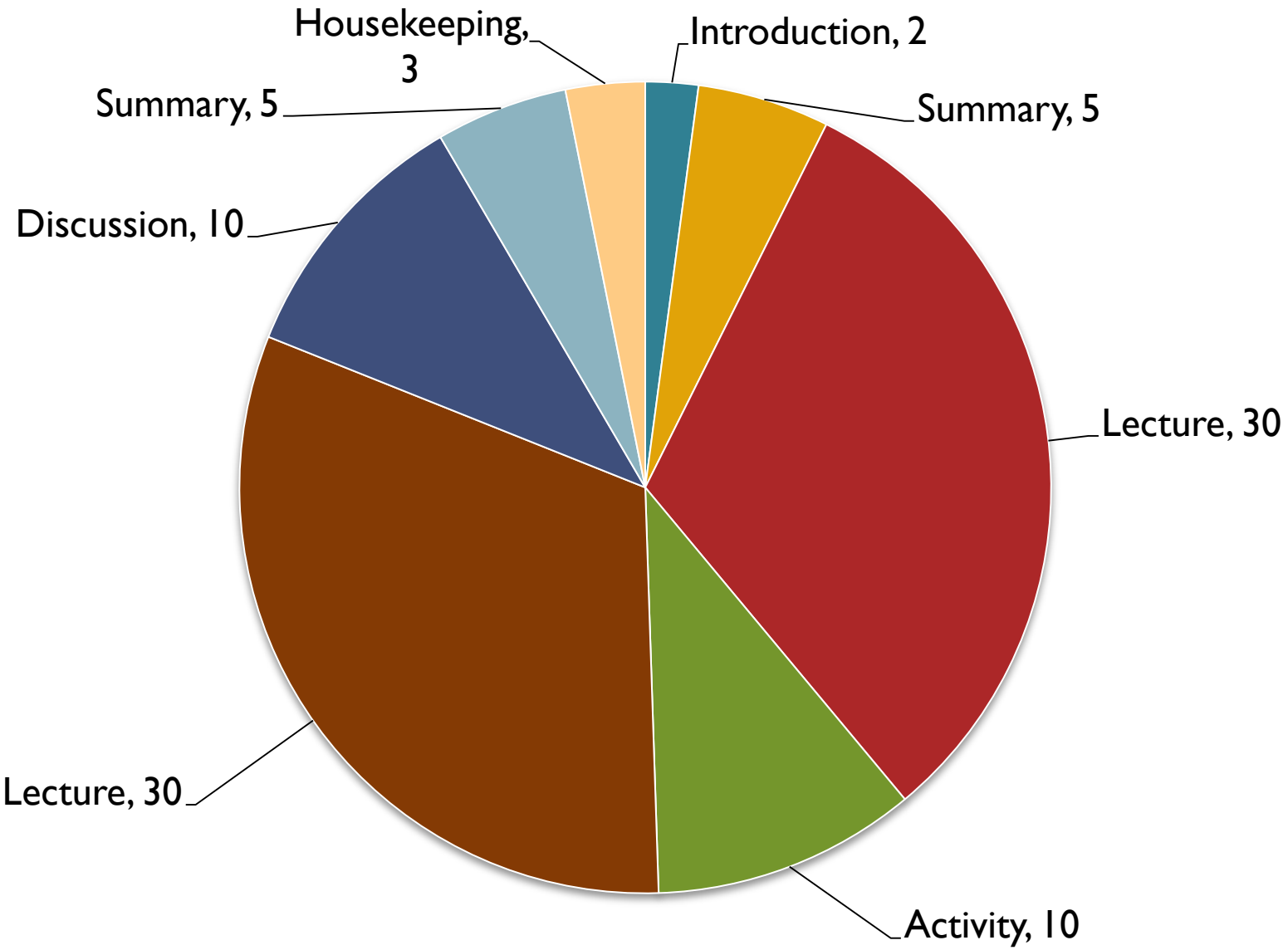
- Computer simulations.
- Small group discussions.
- Guest speakers.
- Panel discussion.
- Group discussion based on assigned reading or relevant questions.
- Case study.
- Videos or short demonstrations.

Time – it's a matter of minutes

- Don't look at the time for instruction as one solid piece of time.
- Break up your instruction into smaller increments.



Time Management: 1 hour class



Time Management: 90 minute class

Alternative Assessments

- Group projects (provide plenty of time to complete and grade).
- Assign readings from popular news sources on new scientific findings (for younger students).
- You Tube video projects.
  - Large hadron rap: http://www.youtube.com/watch?v=j50ZssEojtM
- Allow students to create poems, songs, or animations about basic scientific processes.
- Have a grad student grade student projects.

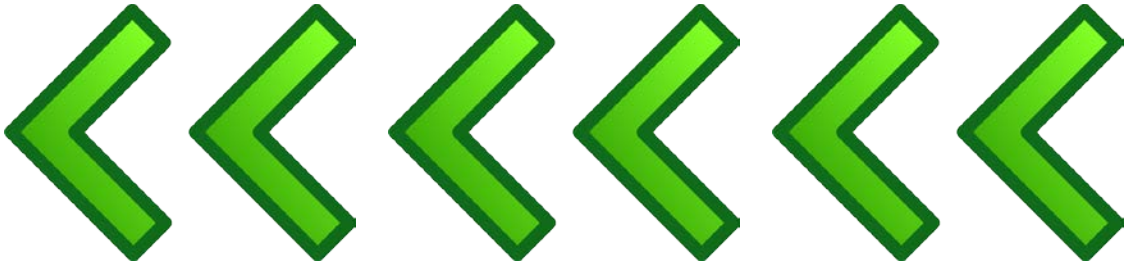
Curriculum Design

- There are many different models, all backed by research.
- Find what works best for you and the way you approach a problem.
  - Details come first
  - Big picture comes first, details come later
  - Everything organized before you start
  - Lots of room for spontaneity

Understanding by Design

Start at the end:

A backwards design model that centers on the idea of first identifying the desired results, and then 'working backwards' to develop instruction.

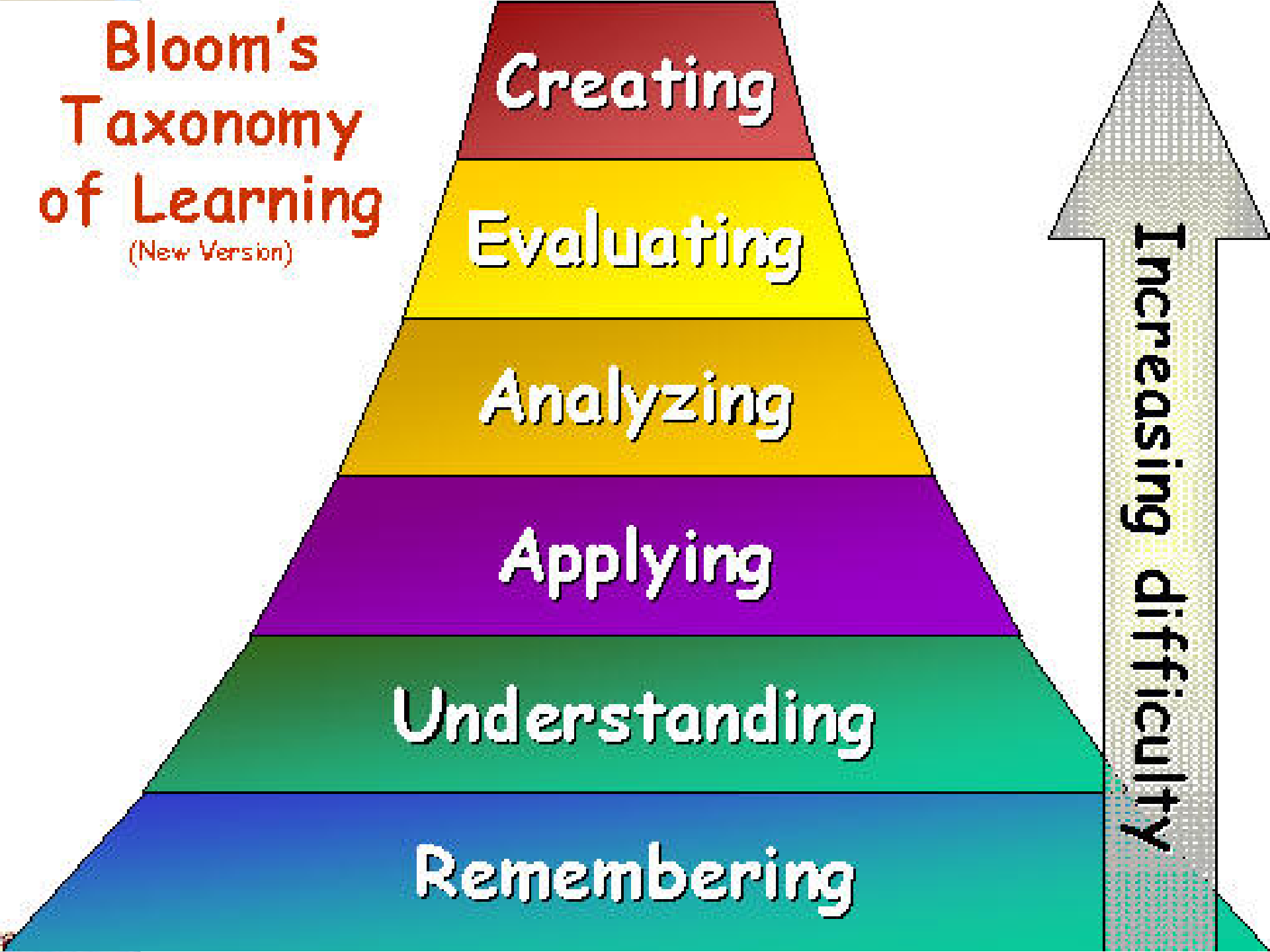


Decide What You Want to Accomplish

- Identify "the big ideas" you want students to remember after your class is over.
- Establish your goals.
  - big, fundamental concepts you want students to understand
- Write your learning objectives.
  - specific ways students will demonstrate they've learned the information

Bloom's Taxonomy of Learning

(New Version)



Writing Objectives

- Examples in your STS packet.
- Difficult to do at first – it needs practice before it becomes easier to do.
- Helps you organize to what degree or level of proficiency you want students to remember content.

Select Your Instructional Methods

- Ask yourself: "What are the ***students*** going to do?", not "What am ***I*** going to do?"
- Vary your methods to promote understanding by increasing attention and interest.

Develop Your Assessments

- Larger classes require more simple assessments (multiple choice tests, short essay questions).
- Smaller classes can have a variety of assessments.
- Write your final exam or create the final project before you begin teaching.
  - it will help keep you on track for where you want to end the course, instead of letting you get bogged down in content

Prepare Your Lecture Notes LAST!

- You have your course goals and objectives to guide you.
- You can pace the course better.
- You know what will be on your tests and assessments.
- You can use all the above to create your syllabus.

More Information

- Can be found in the STS packet:
  - determining the scope of a course
  - writing goals and objectives
  - writing a syllabus
  - pros and cons for alternatives to lecturing
  - how people learn

Summary of Workshop

- Different learning styles
- Alternatives to lecturing
- Alternative assessments
- Backwards design in course development

Examples of Teaching Methods

- Clear objectives stated at the beginning
- Varied instructional methods
  - large group discussion
  - think-pair-share
  - small group discussion
  - visual aids
  - notes matched lecture
  - movement throughout lecture
  - encouraged interaction between instructor and audience

Questions? Comments?