Teaching Science, Engineering, and Inquiry with Wood

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EZ BOARDWALK 40
01.30.2014

Dendrology

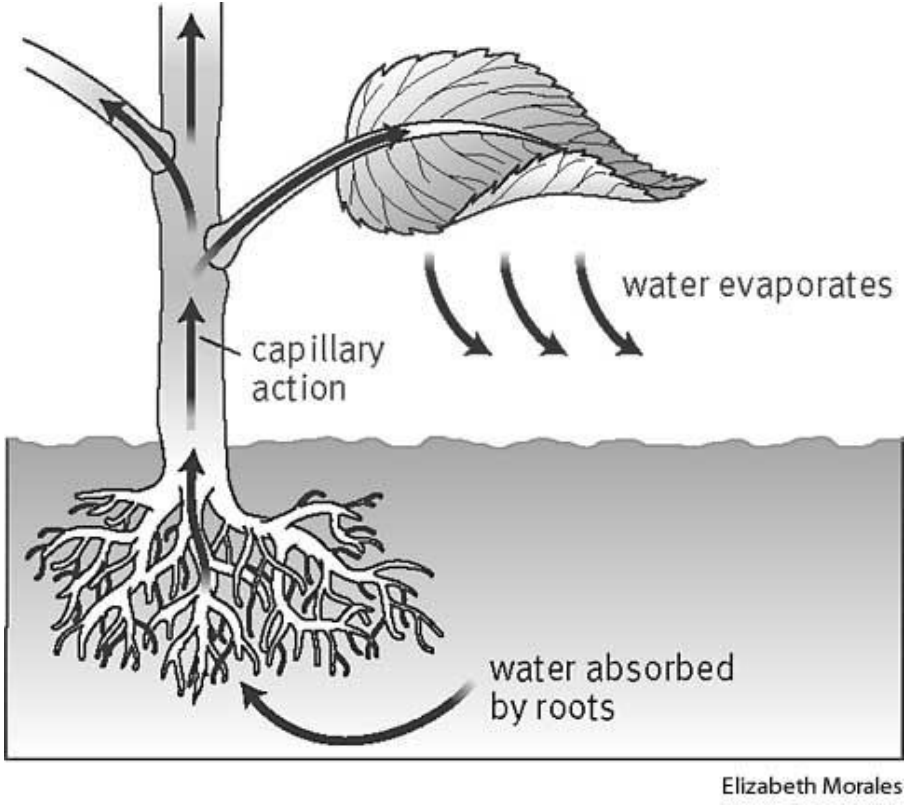
List 20 common trees (near your worksite, school, neighborhood)

Opposite Branching - MADCapHorse

Angiosperms

Gymnosperms

Transpiration from Photosynthesis



Photosynthesis and misconceptions

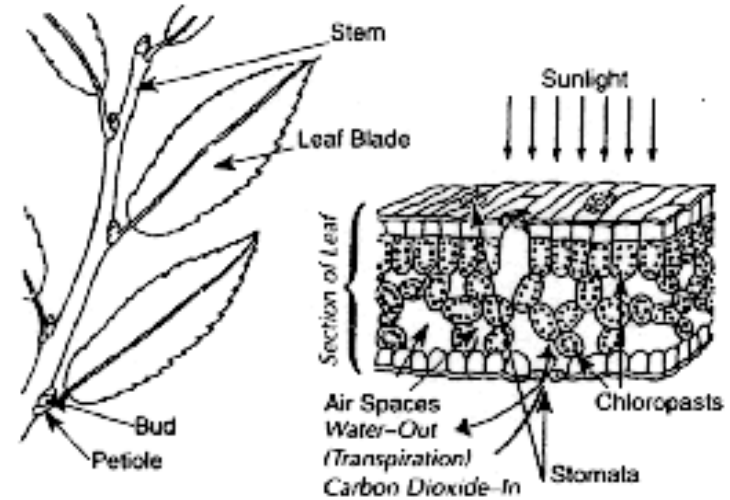


Figure 1. Stem and Leaves

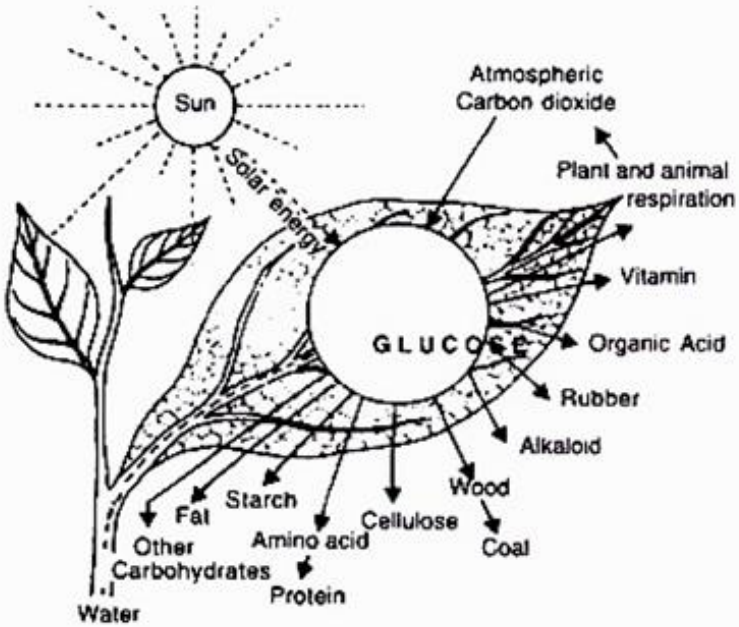


Fig. 6.1. Diagram showing the formation of different organic components from glucose which was also formed by the process of photosynthesis.

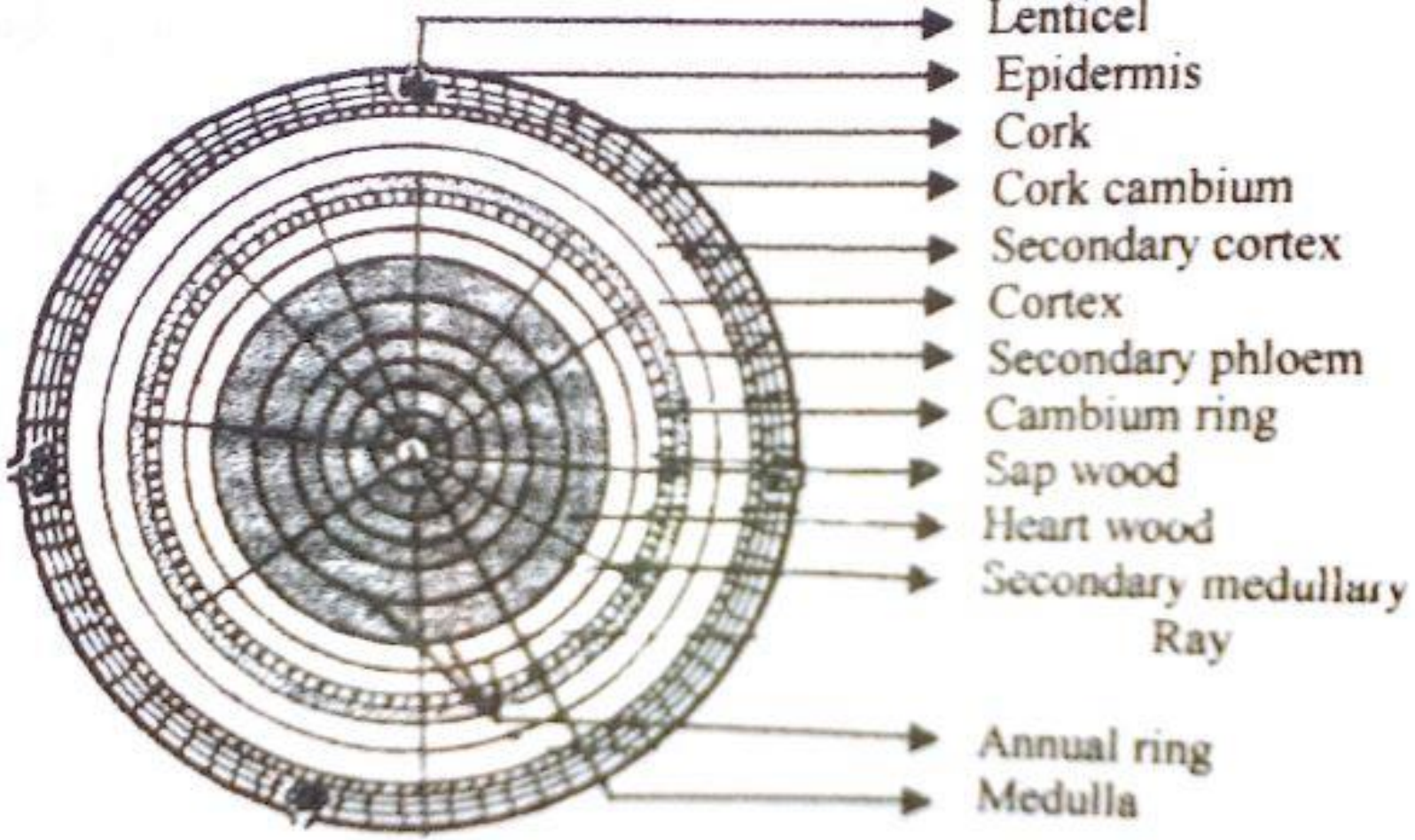
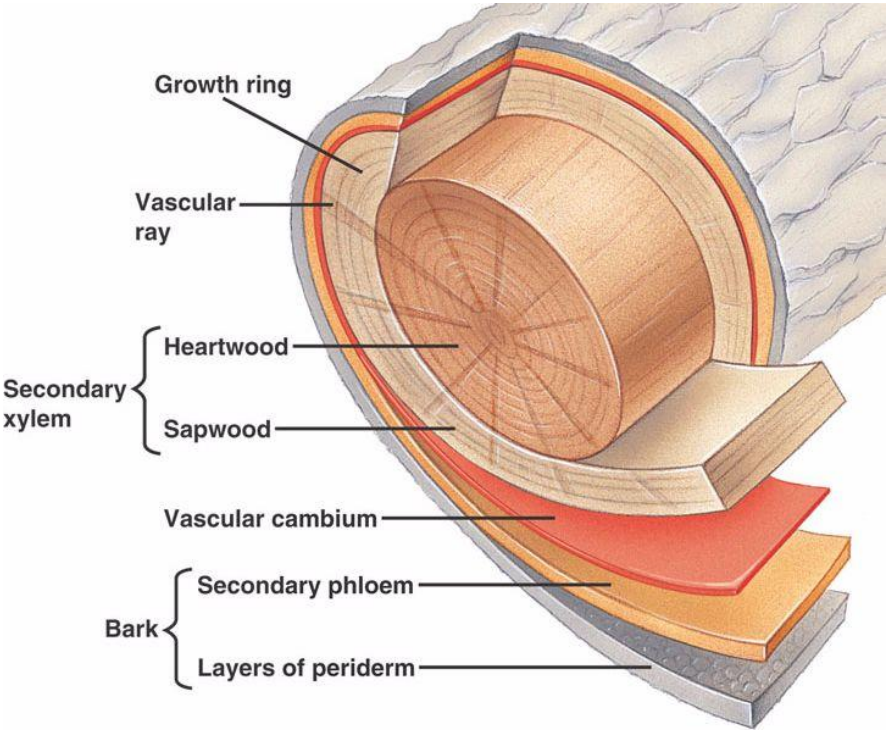
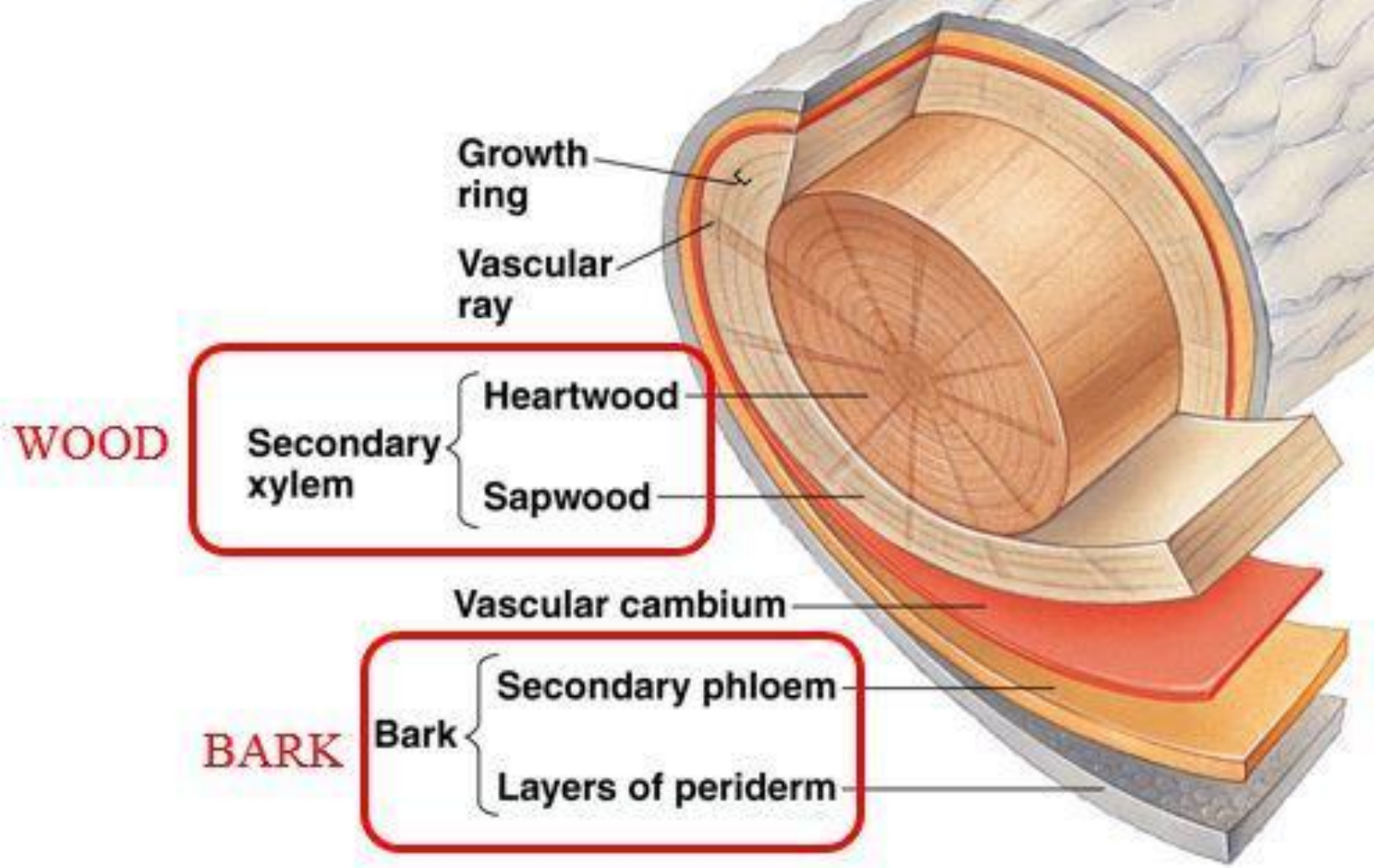


Fig: T.S. of dicot stem with secondary growth (Diagrammatic)

Tree trunk anatomy

1. **Outer bark** - protection, continually renewed from within, regulates moisture, insulates against cold and heat, protection against insects, deer.
2. **Inner bark or "phloem"** - transfer of sugars, short-lived and turns to cork andpart of the protective outer bark.
3. **Cambium cell layer** - the growing part of the trunk, producing both new bark and new wood in response to hormones (auxins) through the phloem with food from the leaves (and leaf buds).
4. **Sapwood or " xylem"** - transfer of water to the leaves. Sapwood is new wood. As newer rings of sapwood are laid down, inner cells lose their vitality and turn to heartwood.
5. **Heartwood** - central, supporting pillar of the tree. Dead, but in most species does not decay or lose strength while outer layers are intact. A composite of hollow, needlelike cellulose fibers bound together by lignin.




Growth ring
Vascular ray
WOOD
Secondary xylem
Heartwood
Sapwood
Vascular cambium
BARK
Bark
Secondary phloem
Layers of periderm

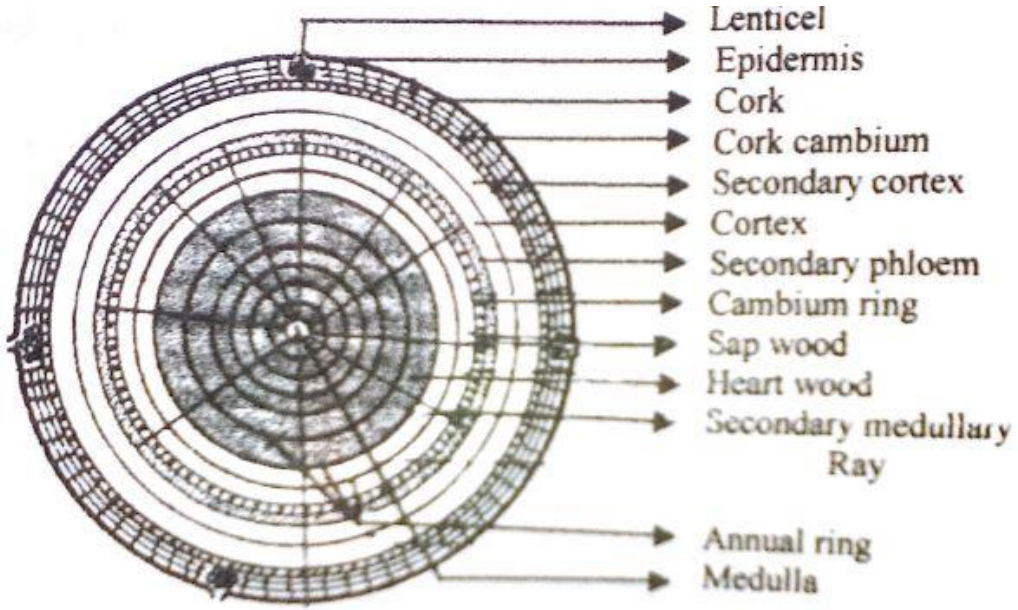


Fig: T.S. of dicot stem with secondary growth (diagrammatic)

Wood used for boatbuilding

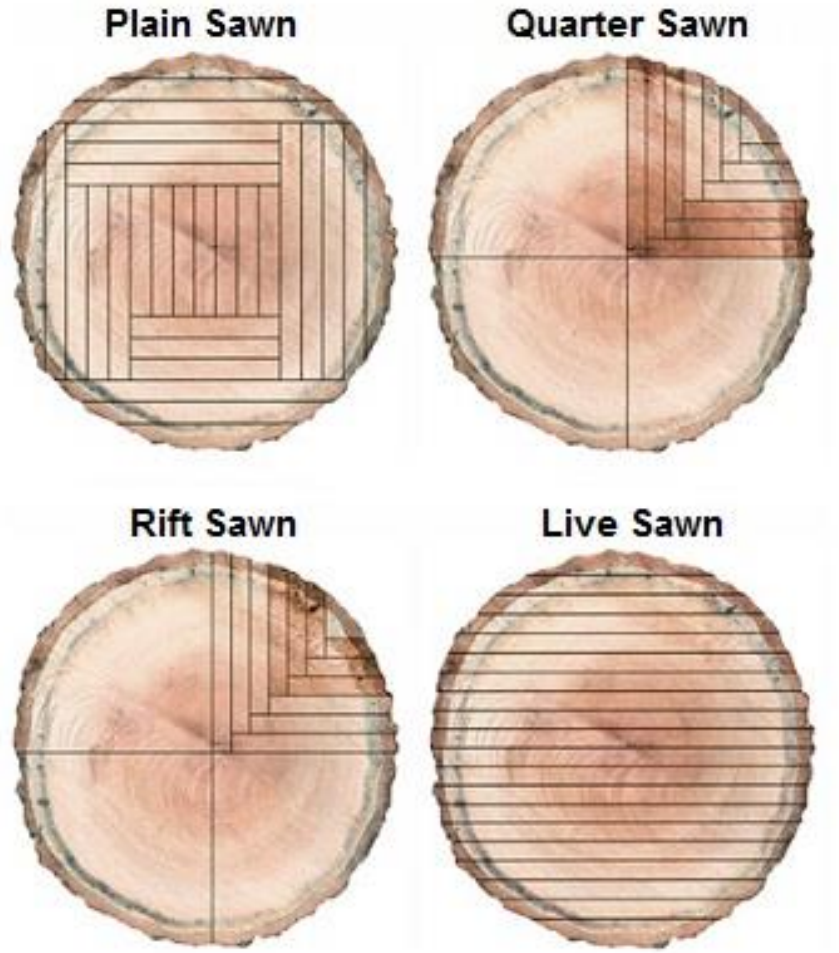
Characteristics:
Strength, water resistance (swelling), rot resistance, shrinkage, accessibility

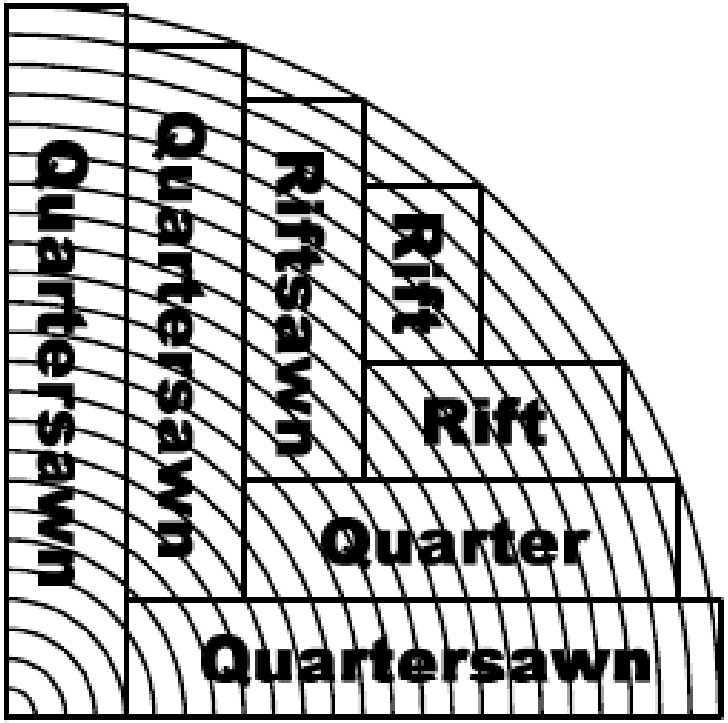
Interior

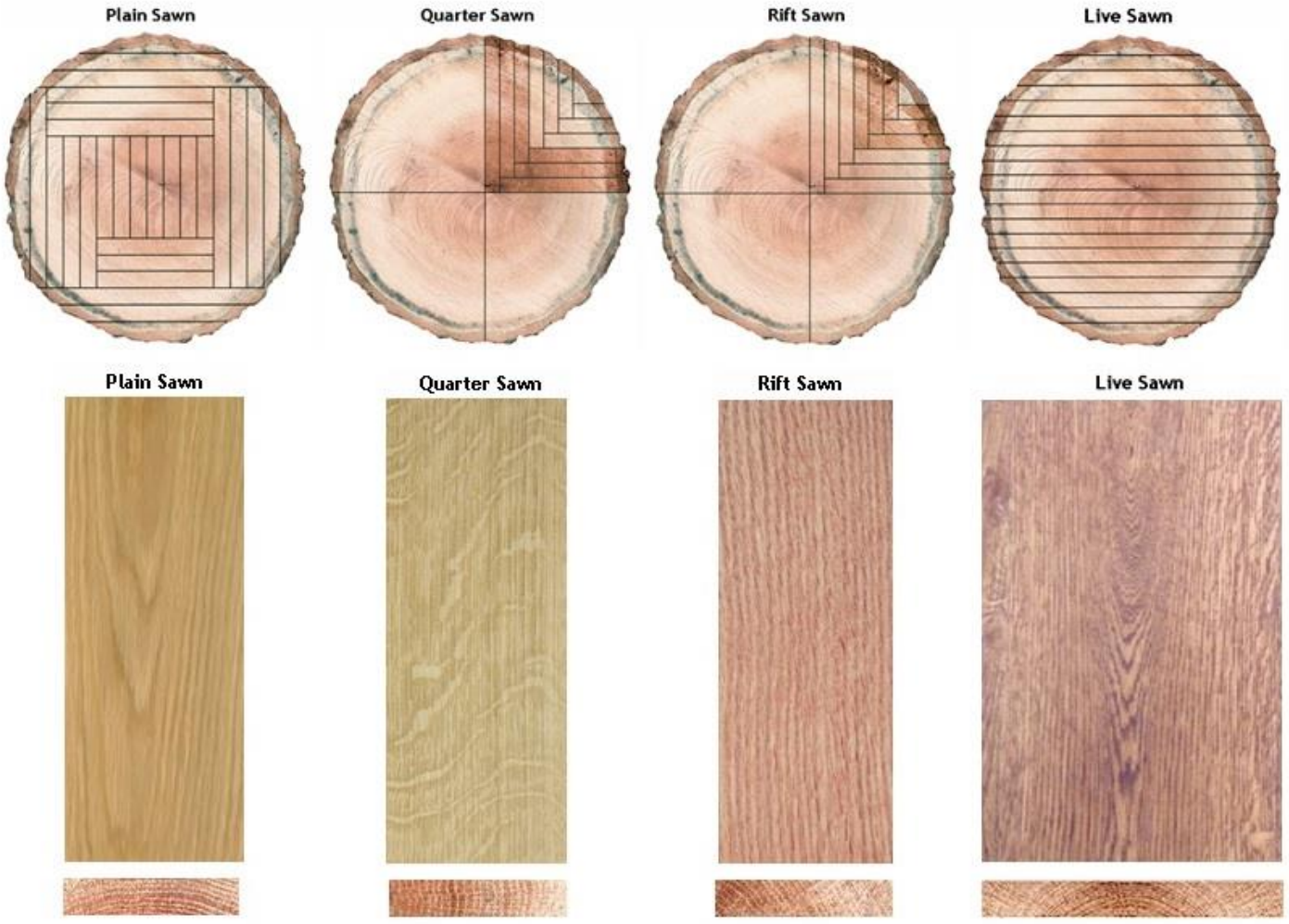
Exterior

Available

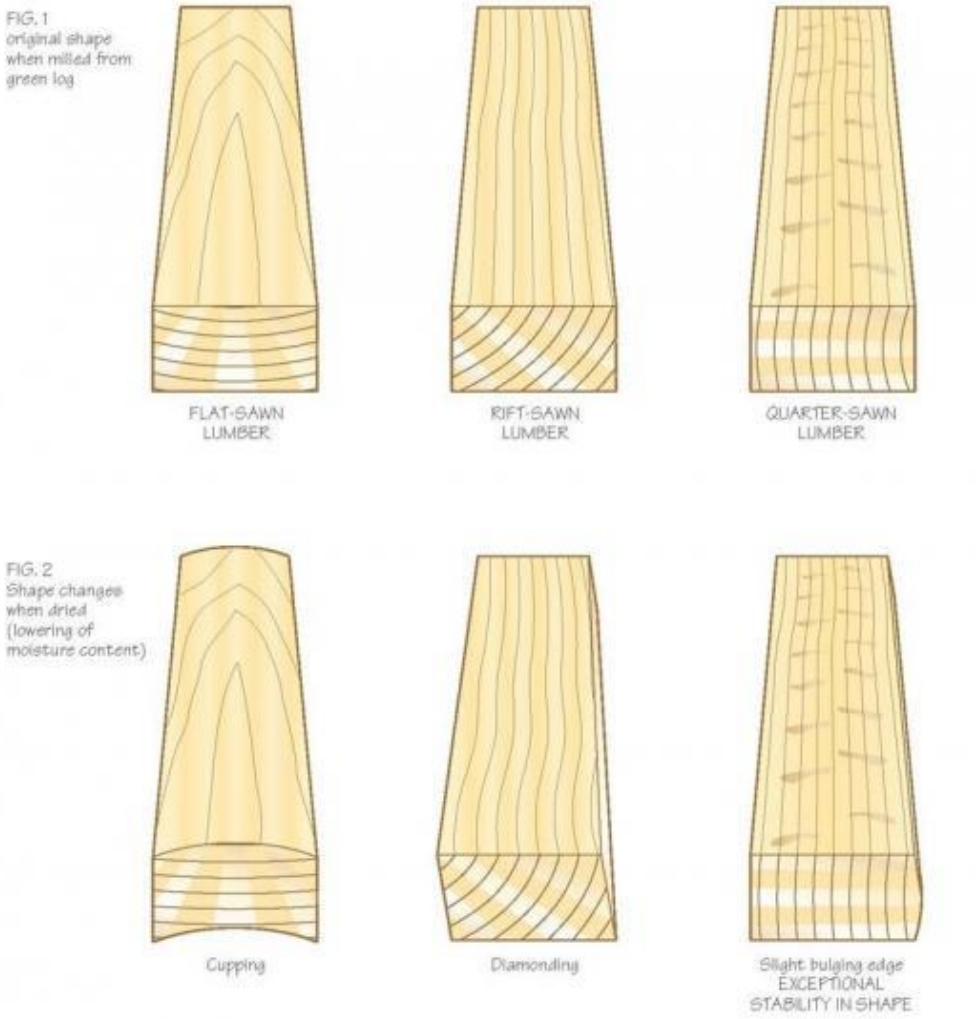
Sustainable


Plain Sawn
Quarter Sawn
Rift Sawn
Live Sawn


Quartersawn
Quartersawn
Riftsawn
Rift
Rift
Quarter
Quartersawn


Plain Sawn
Quarter Sawn
Rift Sawn
Live Sawn
Plain Sawn
Quarter Sawn
Rift Sawn
Live Sawn

Behaviors with Moisture/Drying



Use of Real Data - Percent Shrinkage (Seasonal)

Radial (Quartersawn)...Tangential (Flatsawn)… (R+T)/2 (Riftsawn) values

Northern White Cedar 2.2… 4.9… 3.5
Honduras Mahogany 3.0… 4.1… 3.5
Khaya 2.5… 4.5… 3.5
Redwood, 2d Growth 2.2… 4.9… 3.5
Western Red Cedar 2.4… 5.0… 3.7
Eastern Red Cedar 3.1… 4.7… 3.9
Atlantic White Cedar 2.9… 5.4… 4.1
Eastern White Pine 2.1… 6.1… 4.1
Teak 2.5… 5.8… 4.15
Incense Cedar 3.3… 5.2… 4.25
Alaska Yellow Cedar 2.8… 6.0… 4.4
Purpleheart 3.2… 6.1… 4.65
South American Cedar 4.0… 6.0… 5.0
Iroko 4.0… 6.0… 5.0
Sassafras 4.0… 6.2… 5.1
Okoume 4.1… 6.1… 5.1
Spanish Cedar 4.2… 6.3… 5.25
Black Cherry 3.7… 7.1… 5.4
Black Spruce 4.1… 6.8… 5.45
Tamarack 3.7… 7.4… 5.55
Baldcypress 3.8… 6.2… 5.6
Dark Red Meranti 3.8… 7.9… 5.85
Black Locust 4.6… 7.2… 5.9
Sitka Spruce 4.3… 7.5… 5.9
Sapele 4.6… 7.4… 6.0
Douglas Fir 4.8… 7.6… 6.2
Longleaf Pine 5.1… 7.5… 6.3
White Ash 4.9… 7.8… 6.35
Black Ash 5.0… 7.8… 6.4
Yellow Poplar 4.6… 8.2… 6.4
Rock Elm 4.8… 8.1… 6.45
Slash Pine 5.4… 7.6… 6.5
Apitong 4.6… 8.2… 6.5
Light Red Meranti 4.6… 8.5… 6.55
Black Walnut 5.5… 7.8… 6.65
Tangile 4.3… 9.1… 6.7
Western Larch 4.5… 9.1… 6.8
Angelique 4.6… 8.2… 7.0
Ipe 6.6… 8.0… 7.3
White Oak 5.3… 9.1… 8.0
Live Oak 6.6… 9.5… 8.0,
Greenheart 8.8… 9.6… 9.2

Some useful definitions...

Science

Technology

Math

Engineering

Inquiry

PjBL

Project-Based Learning

PbBL

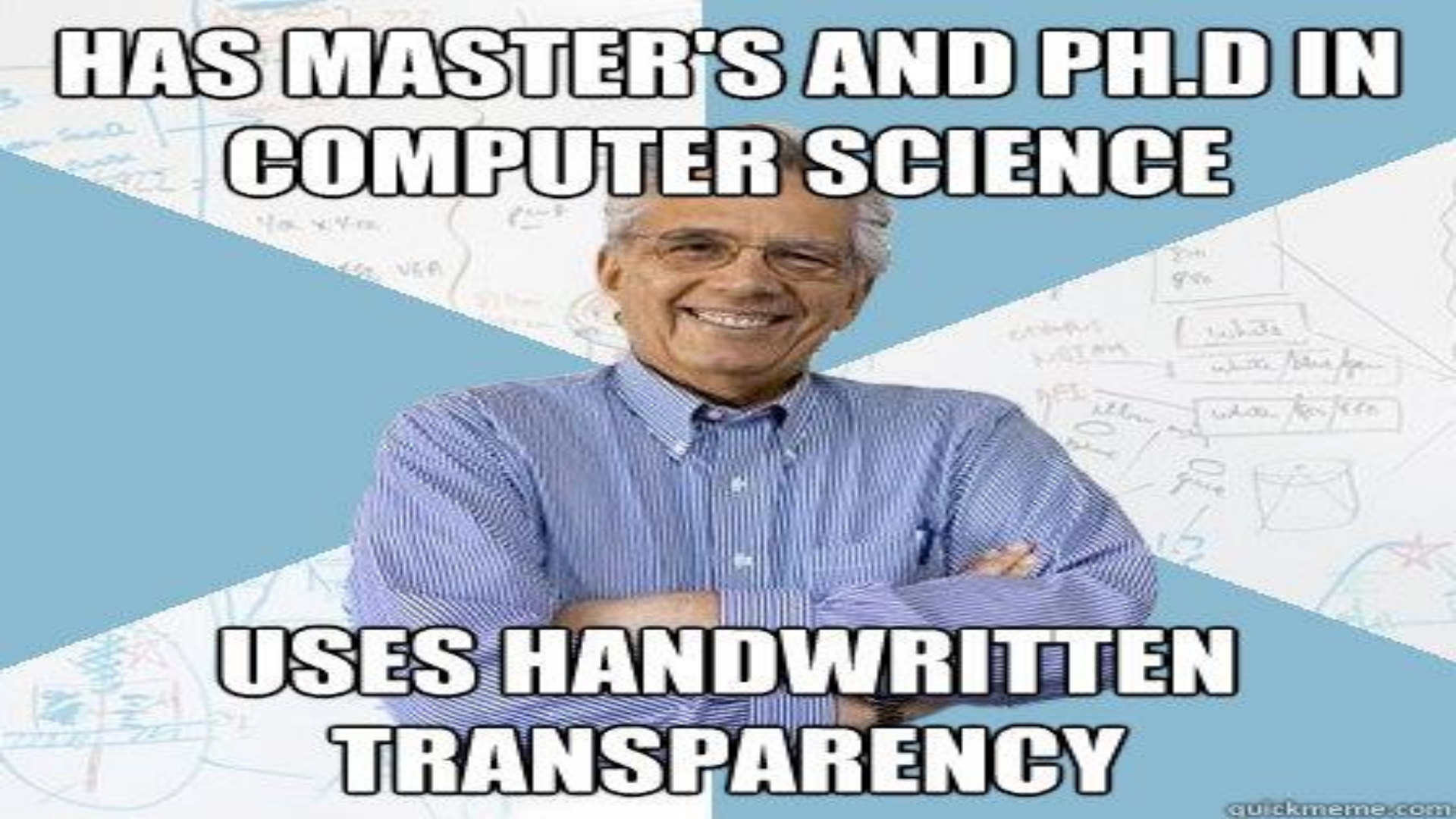
Problem-Based Learning

Operationalizing Definitions:

- Science
- Technology
- Engineering
- Math
- STEM
- STEM Education
- Integrative STEM Education

- Curriculum Mapping
- Standards
- Competencies
- End-of-Course Exams
- Inquiry-Based Education
- Project-Based Learning
- Problem-Based Learning

Science: Questions, Observation, Experimentation, Variables, Inference


HAS MASTER'S AND PH.D IN COMPUTER SCIENCE
USES HANDWRITTEN TRANSPARENCY
quickmeme.com

- Laptop computer
- Book
- Pencil
- Gloves
- Shoelaces
- Fluorescent lights
- Software
- Lipstick
- Toothpick
- Fingernail
- DVD Player
- Piano
- Singing
- iTunes download
- Name badge

Which represent technology?

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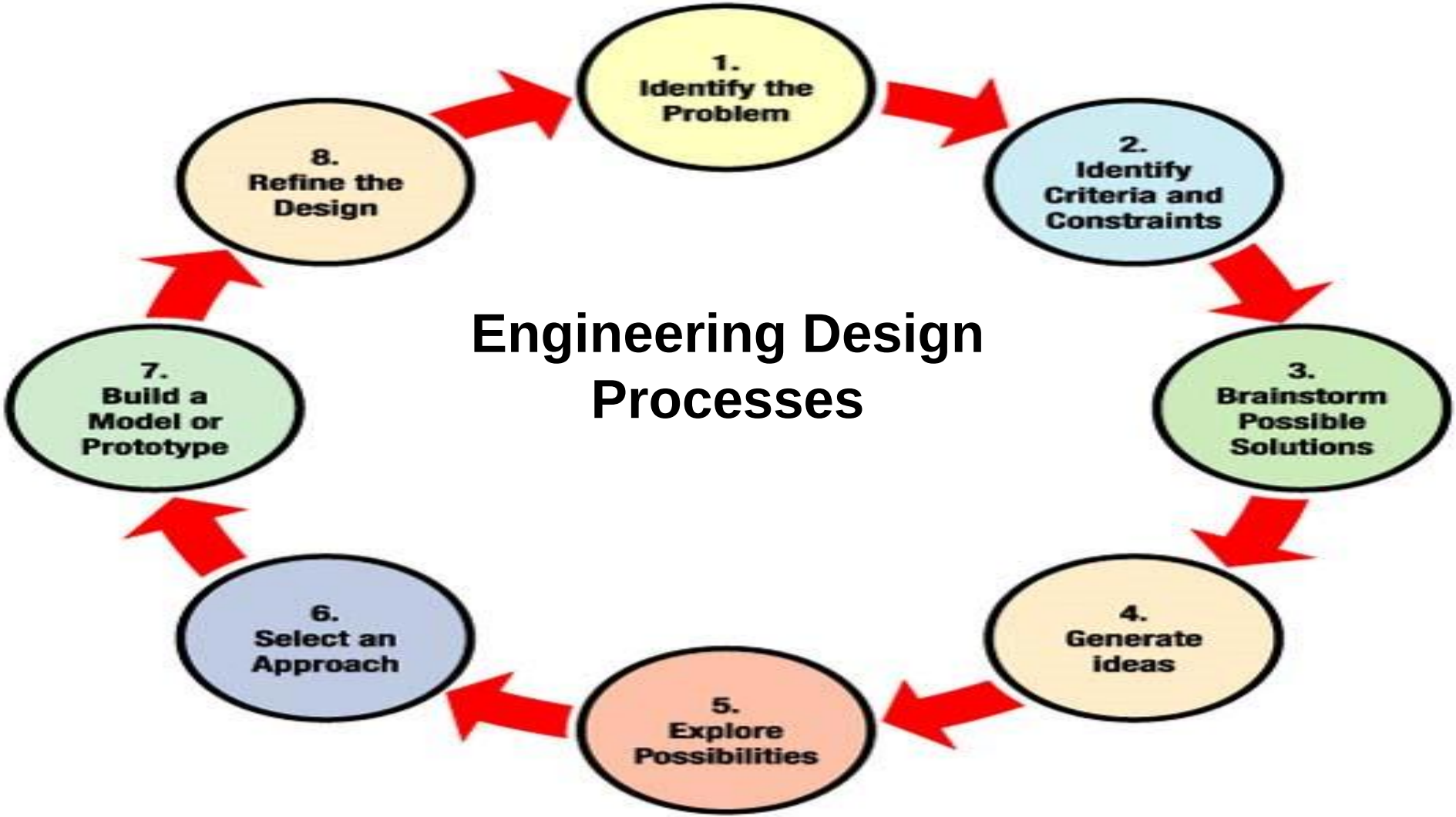
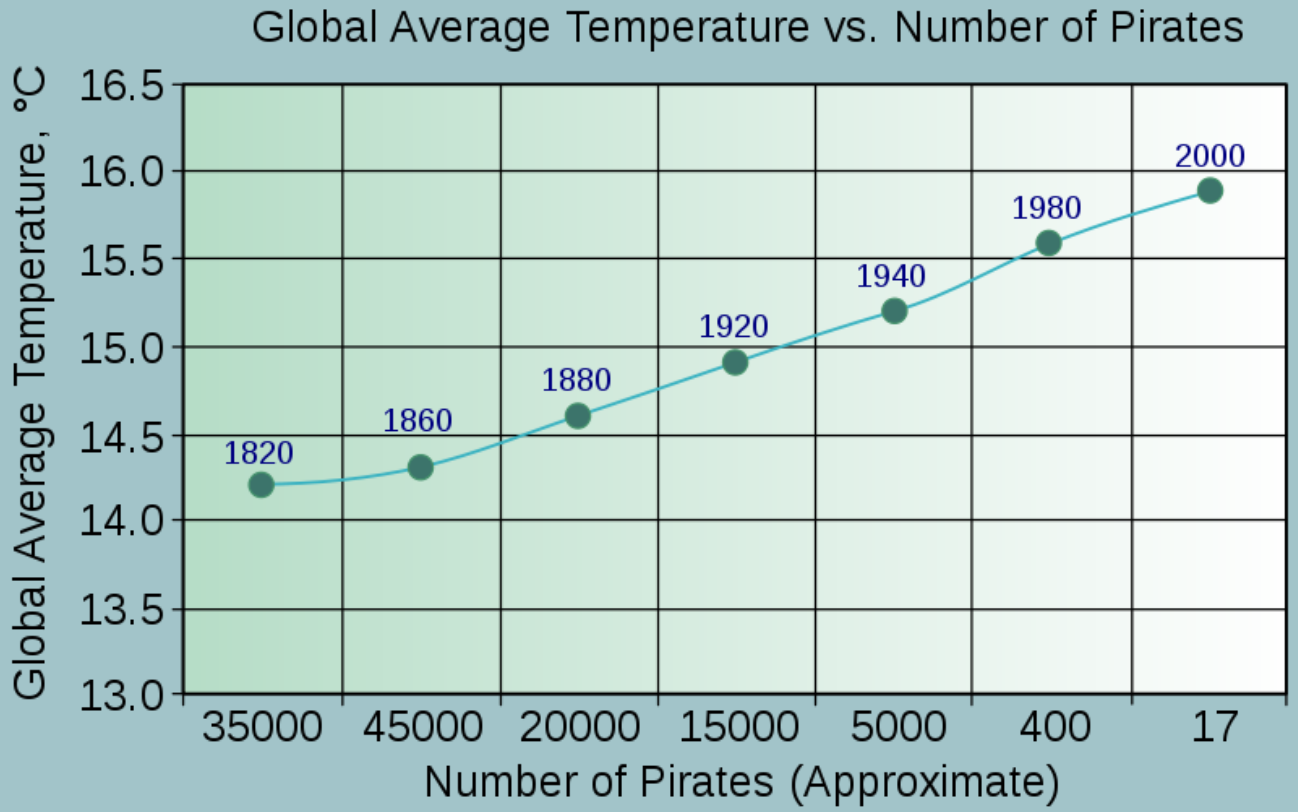

1.
Identify the Problem
2.
Identify Criteria and Constraints
3.
Brainstorm Possible Solutions
4.
Generate ideas
5.
Explore Possibilities
6.
Select an Approach
7.
Build a Model or Prototype
8.
Refine the Design
Engineering Design Processes

Math?


Global Average Temperature vs. Number of Pirates
Global Average Temperature, °C
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
1820
1860
1880
1920
1940
1980
2000
35000
45000
20000
15000
5000
400
17
Number of Pirates (Approximate)

What is Math

Math is the study of relationships between real things or imaginary things, based on logic.

What is Math (Mathematics)?

What is Algebra?

What is Geometry?

What is Trigonometry?

What is Calculus?

What is Statistics?

What is Multivariable Calculus?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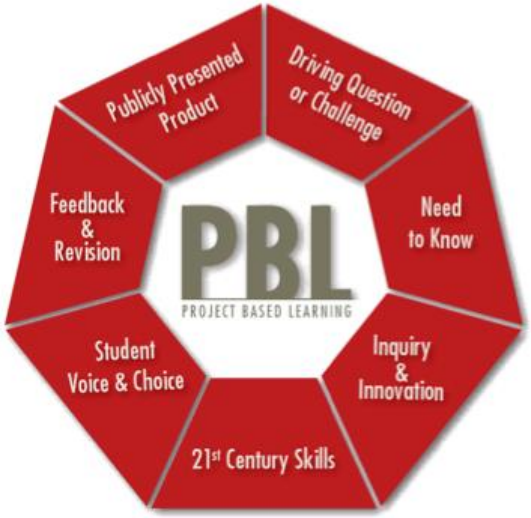
Project-Based Learning

Larmer and Mergendoller's 8 Essentials of PjBL (2011):

1. **Significant content**
2. **A need to know**
3. **A driving question**
4. **Student voice and choice**
5. **21st century skills**
6. **Inquiry and innovation**
7. **Feedback and revision**
8. **Publicly presented products**



STEM Habits of Mind

Critical Thinking
Predictions
Using Data
Analysis and Evaluation
Real-World applications
Observation
Creative or Innovative Solutions
Communication and Documentation
Collaboration
Reflection
Problem-Solving
Making Mistakes

Model for engaging students

- Invest in student-focused pedagogies
  - Gardner, Dewey, Vygotsky, Piaget and Duckworth
- Connect with students as individuals
  - Tap motivational and emotional curiosity
- Consider Developmental Factors
  - Understand brain research

Scientific Methods & Engineering Design Processes

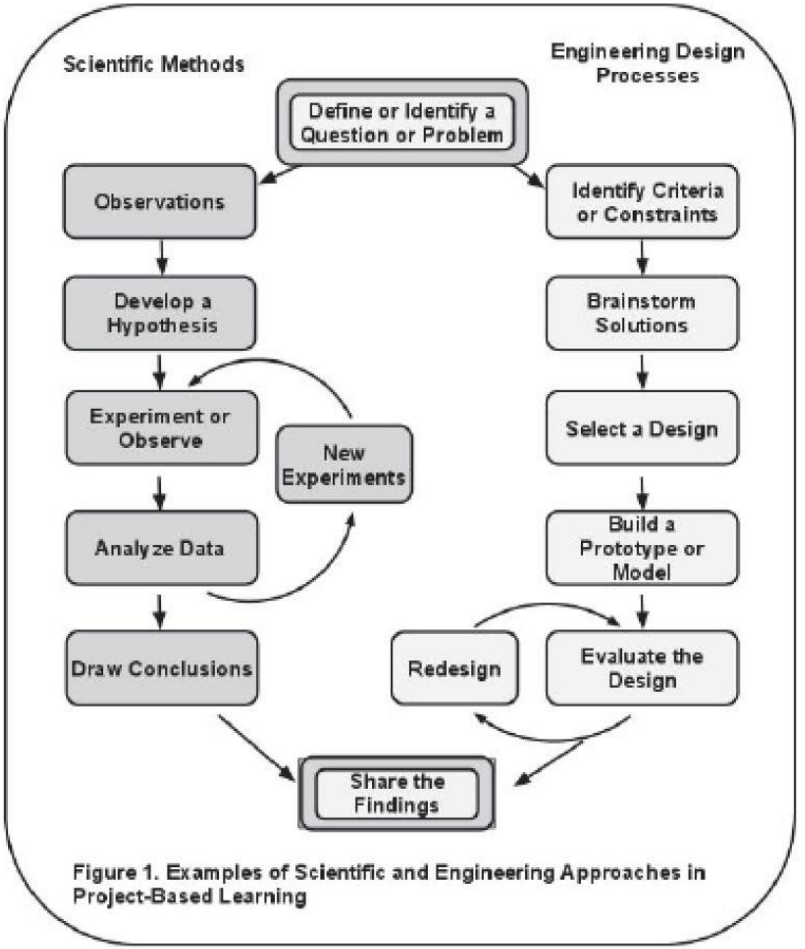


Figure 1. Examples of Scientific and Engineering Approaches in Project-Based Learning

Zone of Proximal Development

A difference exists between what a child can do on his/her own and what the child can do with help.

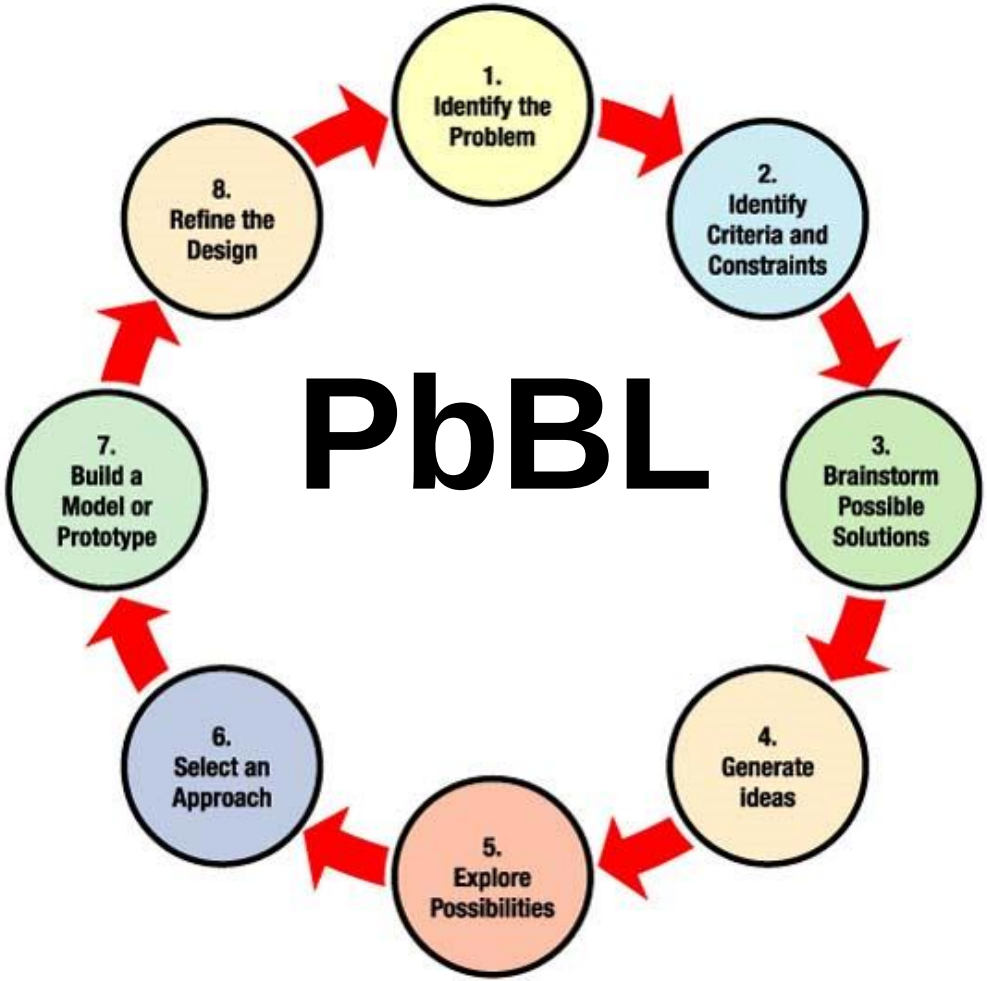
Frontispiece of Lev Vygotsky and facing title page from the original Russian edition (1934) of *Thought and Language*

What is Inquiry?

- Begins with students' questions and their prior knowledge and experience.
- By seeking answers to their questions, students may discover new, related questions and a sense of wonderment to continue the process.
- This usually involves experimentation or research; in either case, the student is responsible for designing the investigation.

Five E's / Six E's

- Engage
- Explore (Experiment)
- Explain
- Elaborate
- Evaluate
- Extend


PbBL
1. Identify the Problem
2. Identify Criteria and Constraints
3. Brainstorm Possible Solutions
4. Generate ideas
5. Explore Possibilities
6. Select an Approach
7. Build a Model or Prototype
8. Refine the Design

A Look at Entrepreneurs

In 2007, QuickBooks surveyed more than 1,300 small business owners. Here's how they responded:

How entrepreneurs say they would have been described as kids:

What's the most important characteristic for a successful entrepreneur?

Age when they started their first business:

Top reasons why people start their own businesses:

85% of small business owners are sole proprietors

43% of entrepreneurs are the oldest of their siblings

More than 77% do not have business degrees

Sources: inc.com | allbusiness.com

Recognizing Processes, Systems, Patterns

Polymathy

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Outline of applied science

From Wikipedia, the free encyclopedia

The following outline is provided as an overview of and topical guide to applied science:

Applied science – application of scientific knowledge transferred into a physical environment.

Contents [hide]

Energy, Ecology, and Sustainability

Follow-up:

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Slides: goo.gl/UJCYr7