The Expert Skills Program

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"The purpose of an educational institution is to lead the students, who initially believe the educational institution is there to educate them, to the realization that they must educate themselves."

"They must …learn how to learn [*integratively*]…"

From Willis Hurst, MD, Medscape

[*and Pelley*]

They must educate themselves!

- But, why?
  - Residency application
  - Program directors expect adults on day one
    - Adults don't need adult supervision
- Well then, how *do* we educate ourselves?
  - Metacognition
  - Retrain your brain by learning about it

What is metacognition and why is it important?

- Metacognition is thinking about thinking: “meta” is a self-reference
- It is an absolute requirement for self-directed learning; everything else is teacher-directed
  - Residency attendings expect to teach you and they expect you to be self-directd
- Research shows metacognition increases both intelligence and academic performance

What is intelligence?

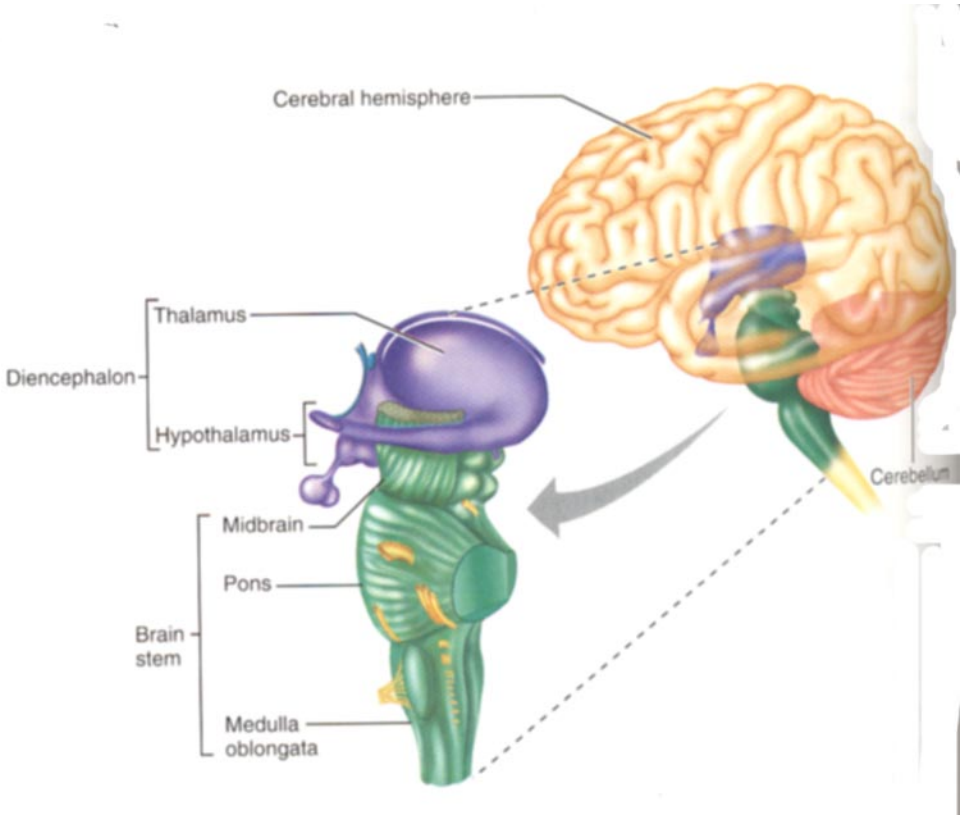
- At the signal, turn to a neighbor and describe how intelligence is measured.
- Try to include examples by explaining how:
  - An athlete is intelligent
  - A musician is intelligent
  - A physician is intelligent
- You have one minute then we will think about what you talked about

Main Points Today

1. Students need to transform themselves from receiver role to producer role.
   - Receiving information vs producing understanding
2. Deliberate practice produces expert learning skills.
   - Responsibility for learning lies with student.
3. The brain is wired to predispose thinking/learning “styles.”
   - Learning style is an insight for Deliberate Practice

Your Thalamus Distributes My Biochemistry Lectures To Your Cerebral Hemispheres

Thalamus volume setting is high or low (gain control)



Prefrontal Pause
(1 minute)

Getting In Touch With Your Thalamus

- Thalamus
  - Base of brain
  - Distributes all sensory information to higher centers
  - Thinking requires both sensory input and memory

Talk with a neighbor about how you do your best thinking:

- Talk it out first or,
- Think it through first

Low Gain vs. High Gain

- Talk it out – “low gain” thalamic activity; seeking more input; more active
  - Extraversion; low arousal level – too quiet
  - Lower cerebral blood flow, augmentation of “evoked response,” lower doses of sedatives
- Think it through – “high gain” thalamic activity; reducing input; more reclusive
  - Introversion; high arousal level – too loud
  - Higher cerebral blood flow, reduction of “evoked response,” higher doses of sedatives

Why is it important to know how the brain works?

Answer: It affects “Mindset” – and mindset affects performance

Mindset: The New Psychology of Success, Dweck, C., 2006

When do you feel smart?

- When you are learning
  - Studying for a test

Or,

- When you are flawless
  - Making a perfect score on a test

Growth vs Fixed Mindset

Growth mindset – "When you are learning."

- "You can always change how intelligent you are."

Fixed Mindset – "When you are flawless in performance."

- "You have a certain amount of intelligence and you can't change it."

Mindset Comparison

Fixed Mindset

- Success based on innate ability
- Failure is dreaded, feared.
- Least likely to succeed

Growth Mindset

- Success based on hard work and learning
- Failure is a challenge to adapt.
- ***Most likely to succeed***

Mindset goals are different

Fixed Mindset

- Look smart at all times – and all costs
- Effort is a bad thing.
- Setbacks reveal your deficiencies

Growth Mindset

- Learn at all times – and all costs
- Effort activates abilities.
- *Setbacks happen!*

So, what do you have to do to get the growth mindset?

- Learn about deliberate practice
- Learn about metacognition
  - Brain cortex specialization
  - Learning styles and cortical specialization
  - Sleep
  - Learn how to spend time
- Learn how to listen in groups

Growth Mindset Through Deliberate Practice

- Designed specifically to improve performance
  - Myth: “Practice makes perfect.”
  - Reality: “Perfect practice makes perfect.”
  - Reality: “Deliberate practice is perfect practice.”
- Deliberate Practice: Practice correcting weaknesses.
  - Deliberate practice requires self-awareness … and self-acceptance.
- Need to avoid automated behavior
  - Loss of focus and attention, esp. while reading

(K. Anders Erickson, “Deliberate Practice and the Acquisition and Maintenance of Expert Performance in Medicine and Related Domains.” Academic Medicine, 2004;79:October Suppl.70-S81.)

Deliberate Practice Characteristics

- Applied to limitation in skill
- Can be repeated a lot
  - Feedback continuously available
  - Most effective with experienced teacher
- Not work, not play – focused effort; demanding
  - Need to avoid automated behavior
  - Not much fun; motivation critical
- Highly demanding mentally; tiring
- Not aimed at minimum standards
  - Self-actualization is the standard
- 10 years, 10,000 hours – Gladwell, “Outliers”

Deliberate Practice for E/I

- If you are an introvert, how can you practice your extraverting skills?

Or,

If you are an extravert, how can your practice your introverting skills?

Take a minute and think and when you are ready talk to your neighbor about your decision.

Skill Development For Introversion

- Introverts
  - Practice saying out loud what you are thinking as you construct a concept map.
  - Motor output from the prefrontal cortex creates a moment of truth.
  - Integrate information to explain the decisions that go into map construction.
  - Repeated practice will prepare the introvert for dialogue in team learning settings.

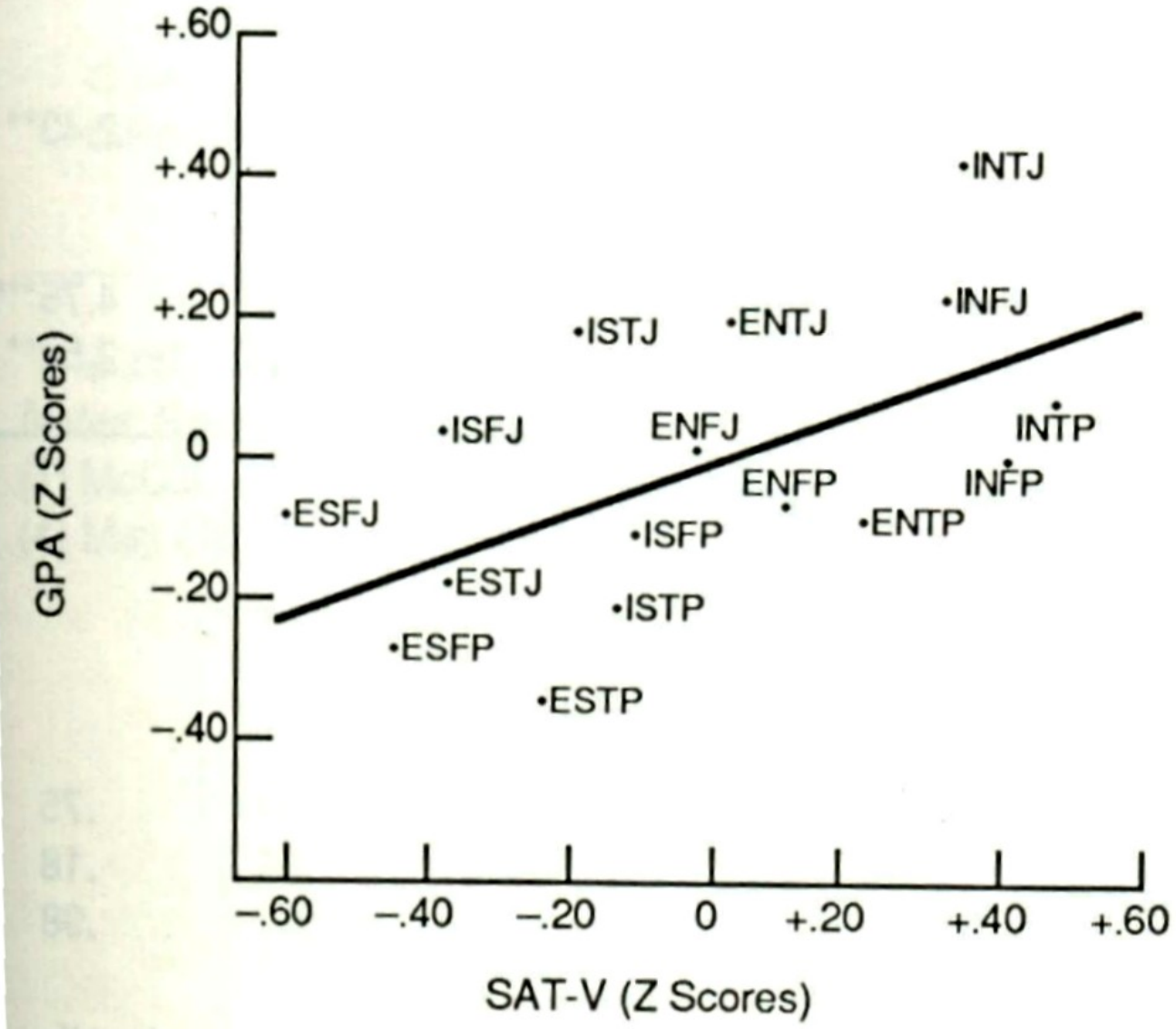
Skill Development For Extraversion

- Extraverts
  - Can also practice out loud, but not to say what they are thinking.
  - Say out loud your paraphrased version of what a study partner is thinking (or, stop a video and paraphrase what the teacher has just said.).
  - While the speaking part will be comfortable, the listening part will not.
  - Repeated practice, will prepare the extravert to interpret and to ask deeper questions.

Myers-Briggs Personality Types And Learning Style

- Preferences Influence how you learn.
- Produces self awareness
  - Critical first step in Deliberate Practice
- Affects academic performance
- Also affects:
  - Communication skills
  - Choice of specialty

Figure 8.3 Comparison of aptitude and achievement of the sixteen types in liberal arts



Myers-Briggs Personality Type – What It Is

- Mental Model; many others also useful
- Normal differences between people
- Persistent tendencies (choices)
  - Do not change once established
  - e.g. Folding your arms, throwing a ball, writing your name
- Comfort zone for thinking; requires less effort than the opposite
  - Use of opposite is a conscious effort

Myers-Briggs Personality Type – What It Isn't

- Not a measure of intelligence
- Not a "limitation"
- No negative aspects
- No psychopathology
- No stereotype

What Do Those Letters Mean?

- Four dimensions of preferences

  Extraversion (E) vs. Introversion (I)*

  Sensing (S) vs. Intuition (N)*

  Thinking (T)* vs. Feeling (F)

  Judging (J) vs. Perceiving (P)*

*Pelley's type

Prefrontal Pause

- Talk for a minute with your neighbor about what your preference might be:
  - Think better with “facts and specifics”
  - Think better with “big picture and connections”
- Try to give an example
- Does it worry you that there is another way to think?

Sensing (S) vs. Intuition (N)

- What information do you give the *most* attention to?
- Sensing types give their attention to specifics
- Intuitive types give their attention to the big picture
- Everyone does both, but only *one* is preferred.
  - Use of opposite is deliberate; not automatic

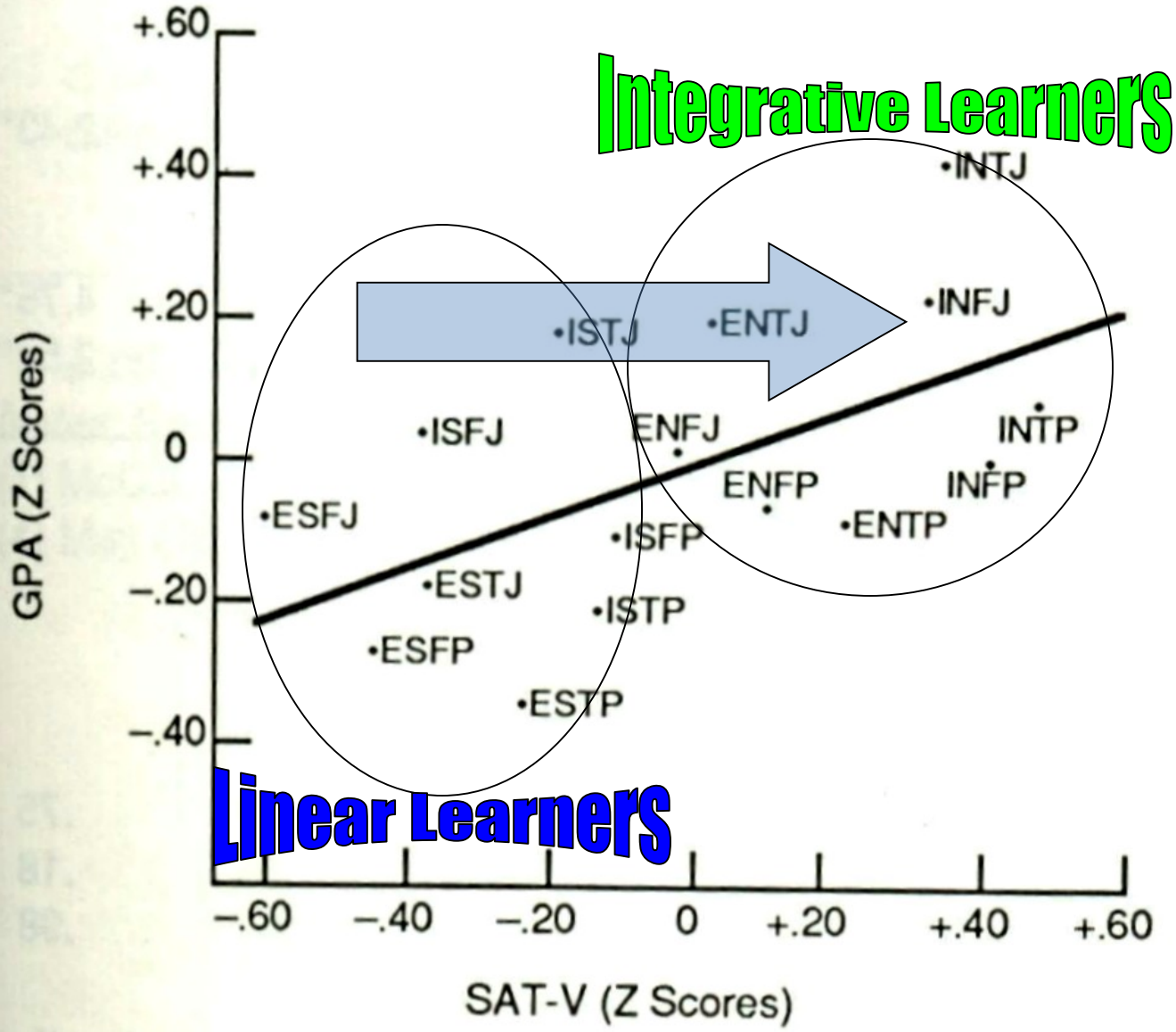
Test Taking Style

- N style
  - Seek answer that matches big picture
  - Rule out answer choices
    - Don’t fit pattern
    - Big picture learning establishes patterns
- S style
  - Seek answer that matches memorized knowledge
  - Re-read question to stimulate recall
  - Memorization learning requires recognition

Memorization vs. HOTS

- Memorization
  - Recall: remembering facts/details and their "organization" (list the symptoms of heart attack)
  - Preferred by sensing types
- Higher Order Thinking Skills (HOTS)
  - Grouping: "organizing" facts into patterns
  - Comparing: relationships between patterns (explain the causes of chest pain)
  - Preferred by intuitive types

Figure 8.3 Comparison of aptitude and achievement of the sixteen types in liberal arts



Thinking (T) vs. Feeling (F)

- How do you react to new information?
- Thinking types consider the logical implications.
- Feeling types consider the impact on people.
- Everyone does both, but only *one* is preferred.
  - Use of opposite is deliberate; not automatic

Judging (J) vs. Perceiving (P)

- How do you manage your life?
- Judging types prefer to be planned, organized (joy of closure).
- Perceiving types prefer to be flexible, adaptive (joy of discovery).
- Everyone does both, but only *one* is preferred.
  - Use of opposite is deliberate; not automatic

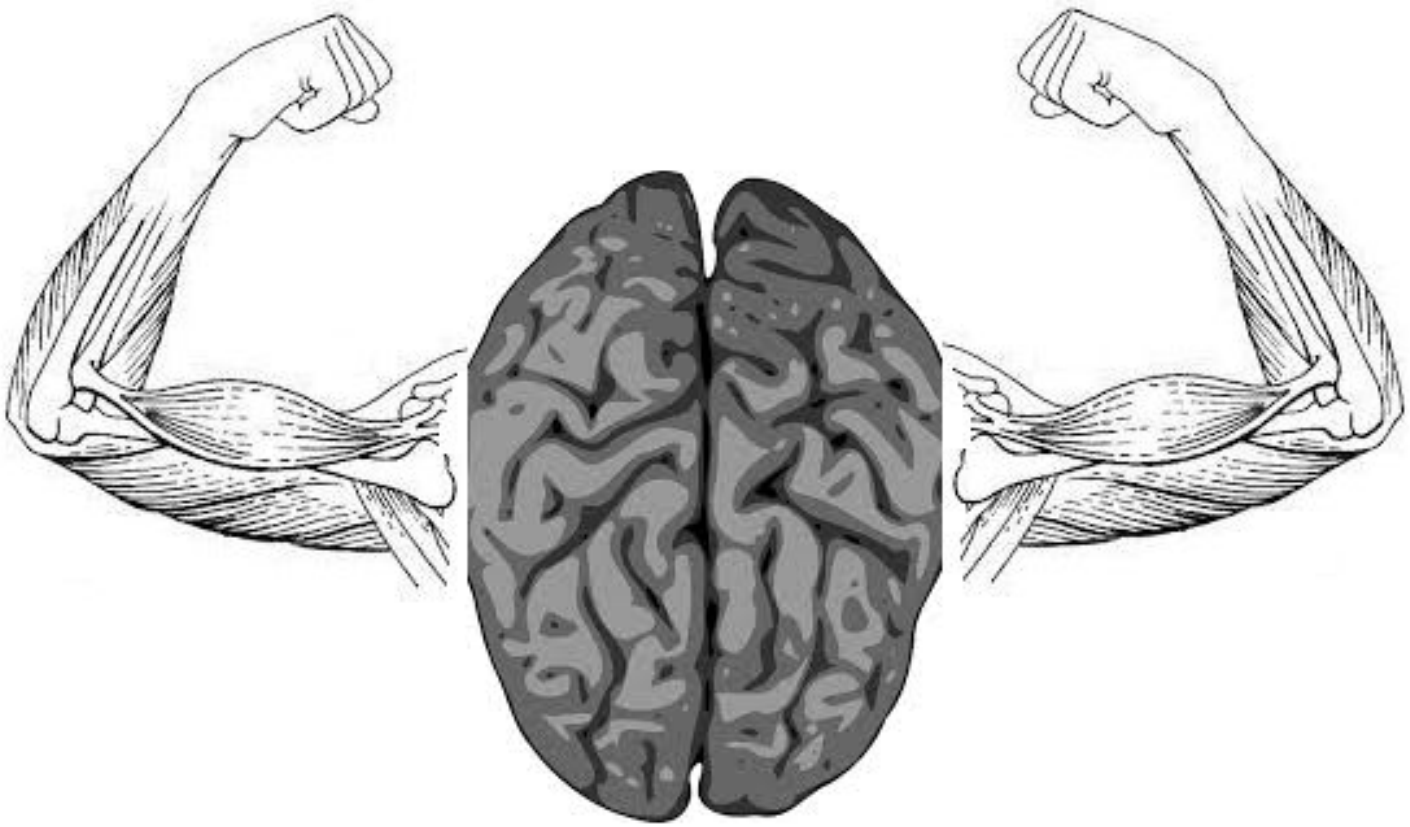
How Do Preferences Relate To Learning?

- Extraversion: Good at initiating
  - think out loud and then think alone
- Introversion: Good at reacting
  - think alone and then think out loud
- Sensing: Enjoy using what already learned
  - bring details but neglect relationships
- Intuition: Enjoy learning new things
  - bring patterns and relationships but missing some details

How Do Preferences Relate To Learning?

- Thinking: Learn best when given a clear and objective rationale
  - give and receive objective criticism
- Feeling: Learn best when given personal encouragement
  - bring harmony; sensitive in communication
- Judging: Value orderly use of information
  - complete tasks at expense of new information
- Perceiving: Value inquiry and discovery
  - postpone tasks to acquire more information

Can We Change Our Own Brain?



Developing Expert Skills – Transforming The Brain

- How do we change our brains?
- Learning efficiency: What is the “illusion of memory?”
- What does brain anatomy tell us about how we learn?
- Clinical skill areas of the brain

How does forgetting help us?

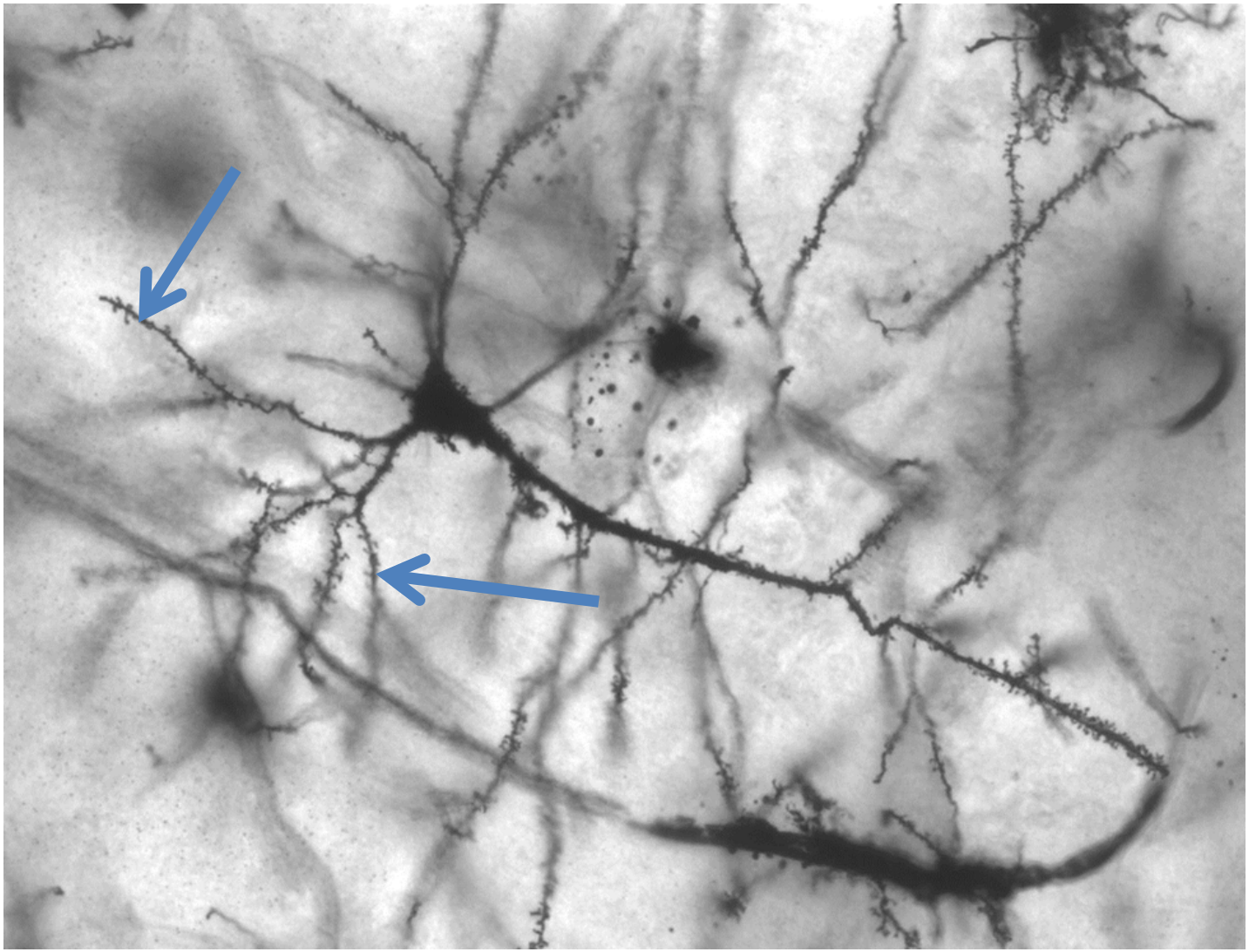
Talk to a neighbor about the following two questions.

1. What would happen if we didn't forget anything?
2. How do we know what to forget – and how do we forget it?

Sleep Helps Us Forget - or, Learn

- Forgetting Can Be A Good Thing
  - Neurologic protection: no cluttering with irrelevant information.
- The brain is designed to forget.
  - New synapses grow during the day.
  - Unneeded synapses pruned overnight; saves energy
  - Valuable synapses strengthened into long term memory (= consolidation)

“Grow Baby, Grow”



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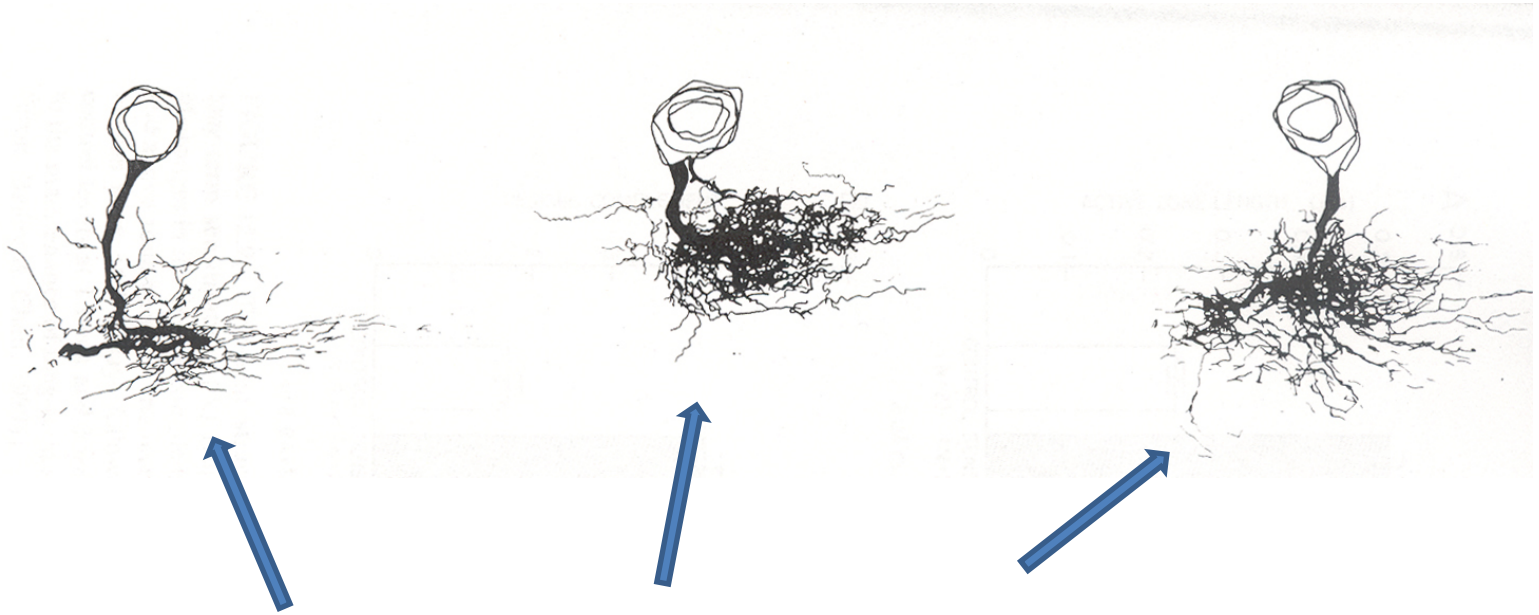
To Sleep, Perchance To Replay

- Replay of activity
- Non-dreaming deep sleep
- Emotional only
- Pruning of unimportant experience
- Valuable experience consolidated

Can You Find The Sittin' And Readin' Dendritic Tree?



Sittin' and readin'

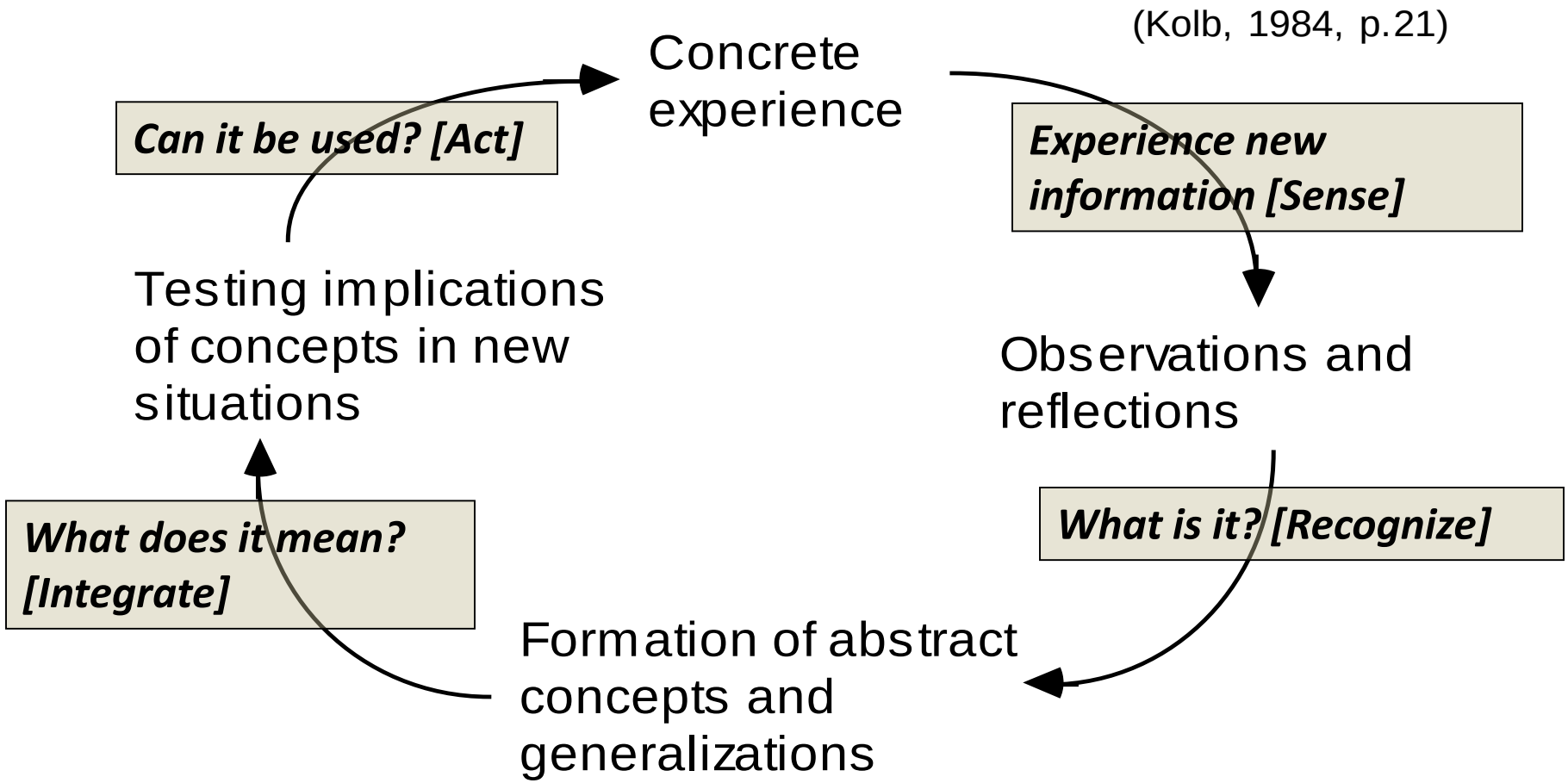
1. Complete learning cycle
2. Sleep (5 REM cycles)

- Control left, long-term potentiated (LTP) cells sensitized right
- Tree of LTP markedly increased (hippocampus "rehearsal").
- Dendritic trees are "processing power."
- Prefrontal dendritic growth increases analytic skill.

Where Do Dendrites Grow?

Everywhere

Experiential Learning Cycle
Achieving Long Term Potentiation



Clinical Diagnosis As Experiential Learning

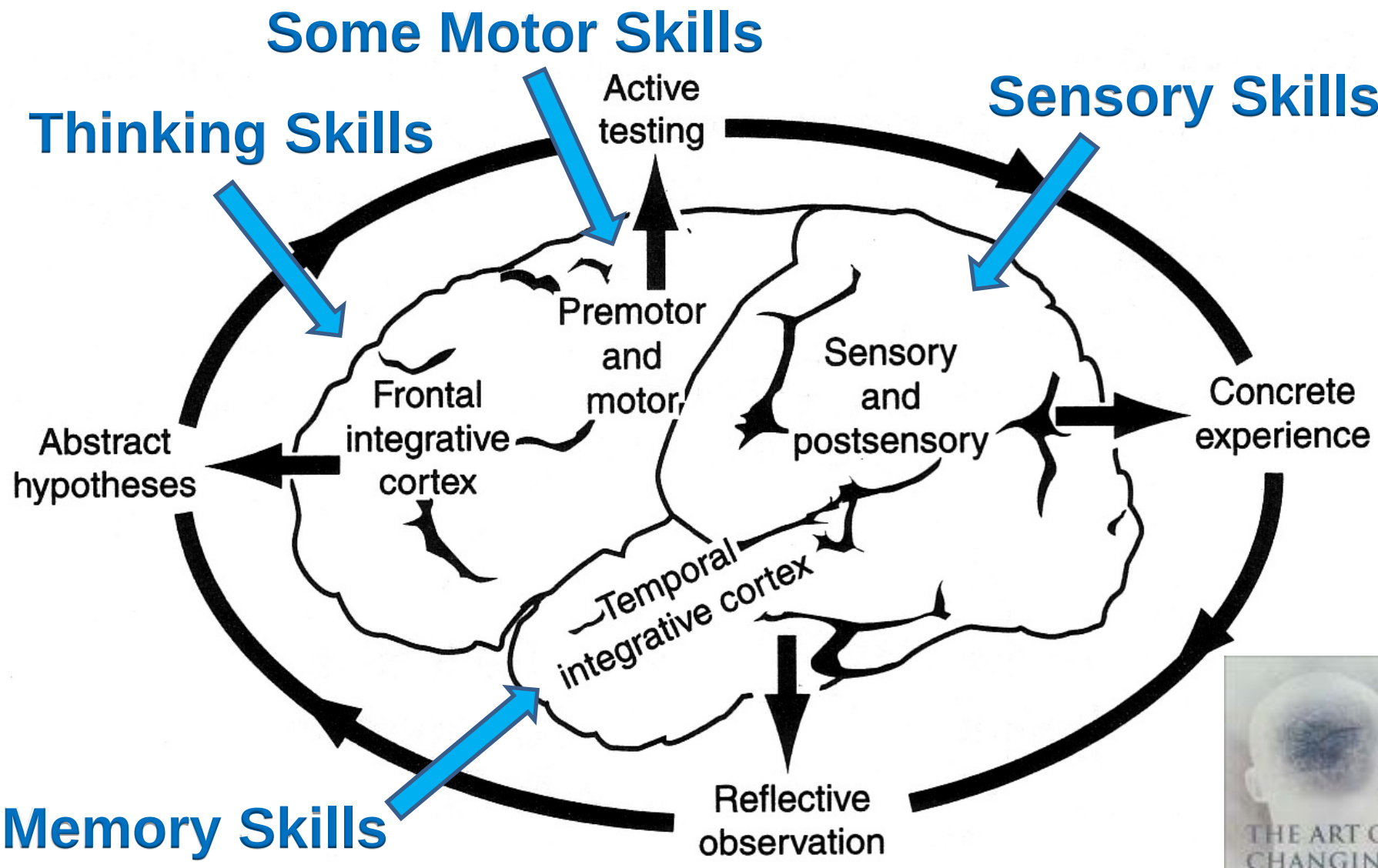
Experiential Learning

- Concrete experience
- Reflective Observation
- Abstract Hypothesis
- Active Testing

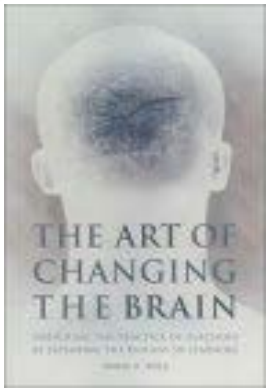
Clinical Diagnosis

- Patient Data
  - History/Physical/Labs
- Interpret Data
  - Basic science bkgd
- Create Differential Dx
- Establish Diagnosis and Treat

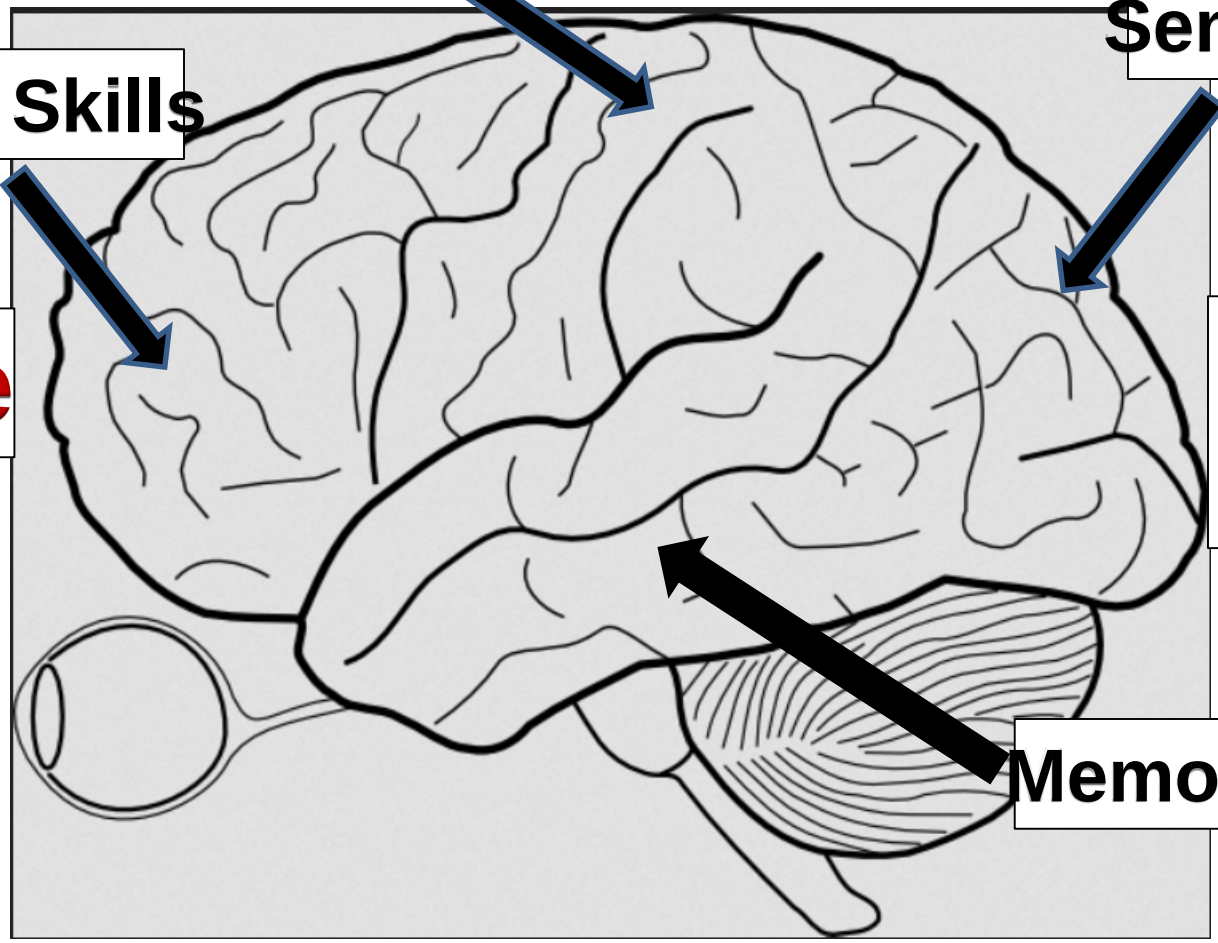
Experiential Learning By The Brain



Adapted from Zull, 2002, The Art of Changing the Brain



Back To The Future



Short Circuits

Experiential Learning Cycle

- It is easy to bypass frontal processing
- Frontal processing = decision making + action

Complete Processing

- Concept mapping and question analysis (group study) prevent "short circuits."

- Short Circuit Examples
  - "Looking at" reading: occipitotemporal activity
  - "Hearing": parietotemporal activity

- Complete Circuit
  - "Looking for" reading
  - "Listening for" in lecture
  - Increased attention; informed decisions

Recap – Back To The Future

- Temporal (back) processing
  - Facts, grouping, memorized patterns
  - From lectures, books, other resources
  - Information resource for prefrontal decision making
- Pre-Frontal (future) processing
  - "Discovered" patterns, inferences, evaluation of options
  - Dialog requires a decision based on a rationale, Broca's area is integrative
  - ALWAYS BE MAKING A DECISION!

What's Your Favorite Lobe?

- What information do you give the *most* attention to?
- Sensing types; Temporal emphasized
  - Primarily sensory experience
  - Specifics, routine procedure
- Intuitive types; Pre-frontal emphasized
  - Primarily predictive experience
  - The big picture, relationships, predictions
- Both are needed for clinical reasoning

Neurobiological Effects of Concept Mapping

- First, a look at concept mapping
- Neurobiology of learning with concept maps
- Deliberate Practice and concept maps

Which one is “what works for you?”

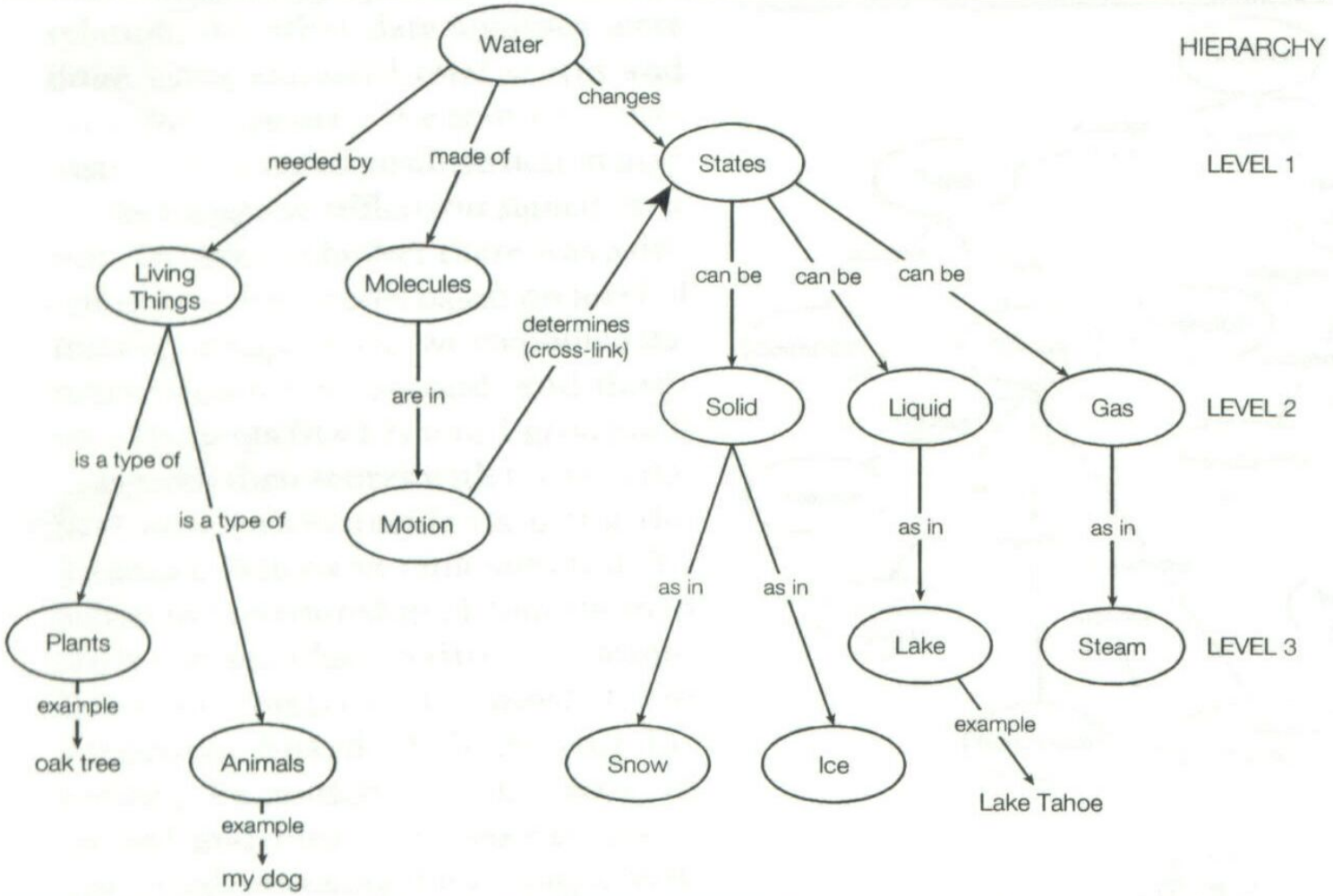
1. Inspectional (analytical) reading
   - “Looking for”
2. Outlining
3. Paraphrasing
4. Cluster construction
5. Comparing
6. Verbalizing (group or individual)

- All of these develop the prefrontal cortex.
- All of these are found in ESPeak Mapping.

Anatomy Of A Concept Map

- Key terms enclosed in “bubbles”
- Fact = two connected bubbles
- Connections can contain verbs
  - describes concept relationship
- Branch points represent groupings and organization
- Cross-links are comparisons and cause-and-effect; integrative thinking

Figure 1. Example Concept Map



Example map of *water* demonstrating the basic components of hierarchical concept maps. Note the cross-link (bold arrow) between the concepts *motion* and *states*. Reproduced with permission from Cambridge University Press.[14]

Overview of ESPeak Mapping

List – **Group** – **Compare** - **Share**

1. **List** important terms
2. **Group** by major topic
3. **Compare** by drawing cross-links
4. **Share** by speaking your map as a lecture

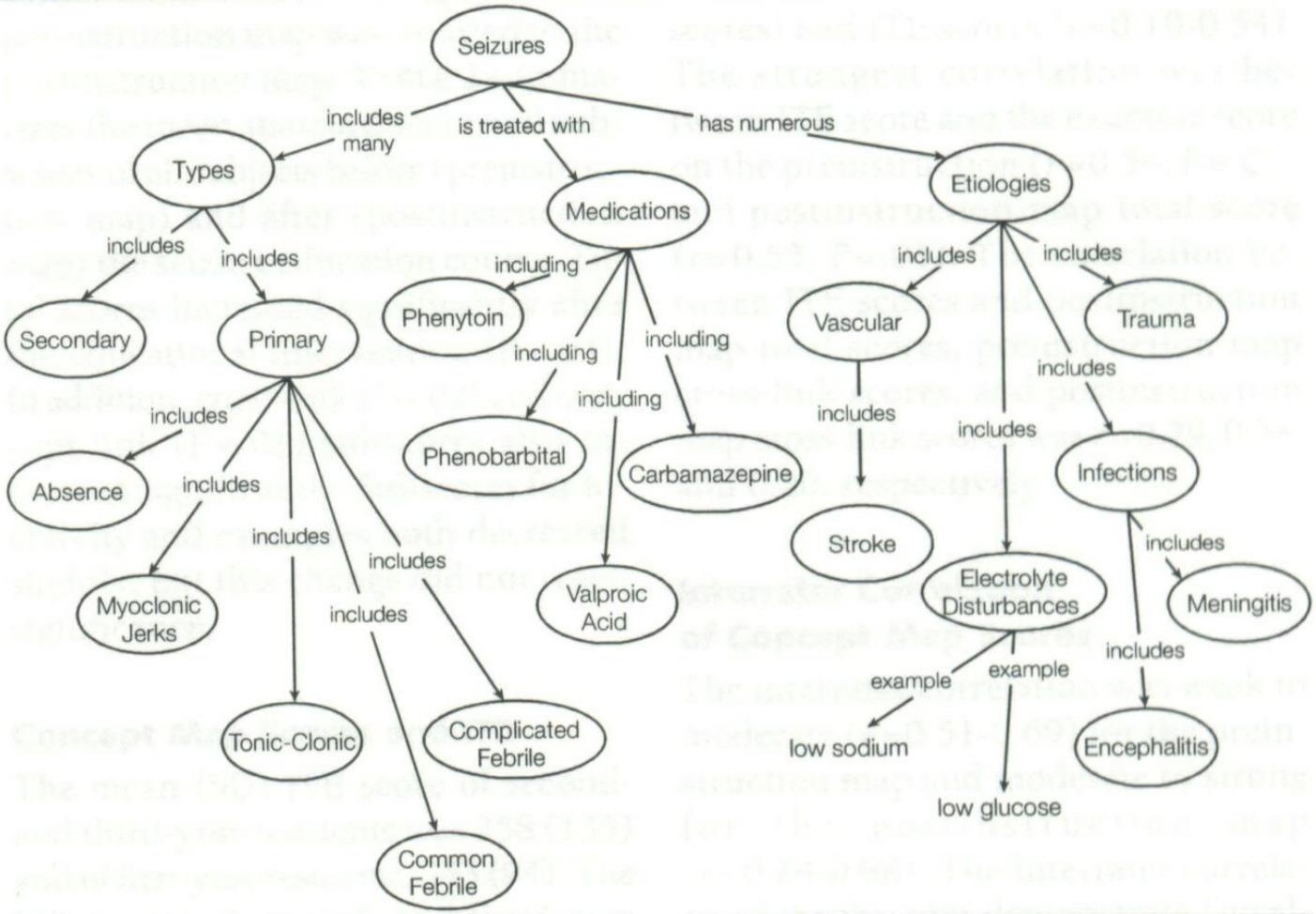
All four steps require use of Deliberate Practice during reading

Cells and Organelles

I. General Definitions
II. Cell Membranes
  A. Composition of cell membranes: Lipids
  B. Composition of cell membranes: Proteins
  C. Classifications and functions of cell membrane proteins
  D. Glycocalyx
  E. Freeze fracture
III. Nucleus
  A. Chromatin
  B. Nucleolus
  C. Nuclear envelope
  D. Nuclear pores
IV. Endoplasmic Reticulum
  A. Smooth ER (sER)
  B. Rough ER (sER)
V. Polysomes
VI. Golgi Apparatus (Complex)
  A. Function
  B. Structure
  C. Regions of Golgi apparatus
  D. Sorting in the trans-Golgi network (TGN)
VII. Proteosome
VIII. Lysosomes
  A. Contents
  B. Morphology

1. List of the most general categories (terms, topics
2. Early grouping of subtopics
3. Subtopics will have sub-subtopics in the notes – look for them!
4. You can add to groups later on when they are discovered

Figure 2. Low-Scoring Concept Map



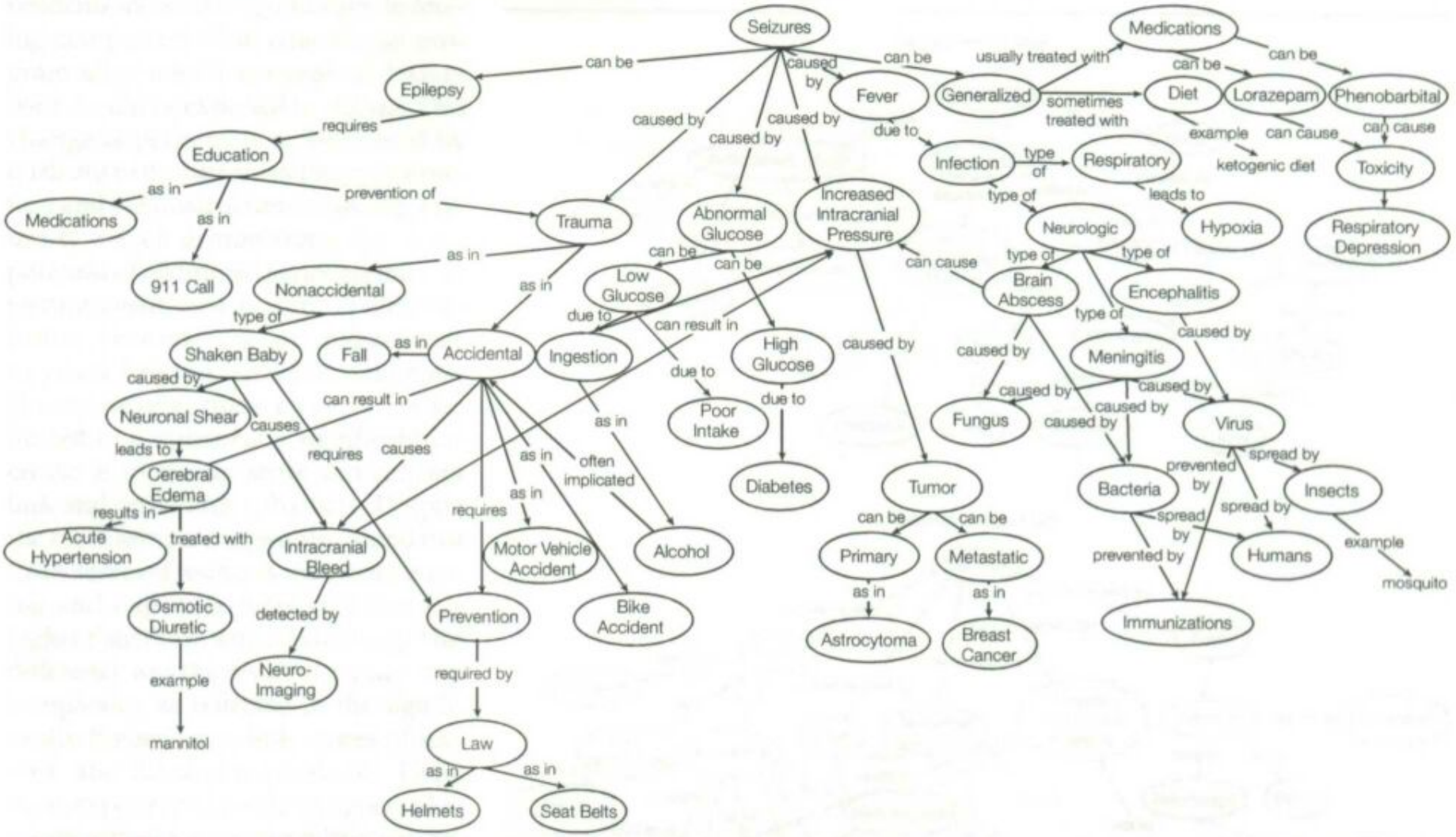
Reproduction of a hand-written concept map of *seizures* by a first-year resident. Note the absence of cross-links and the consistent use of 2 to 3 levels of hierarchy, resulting in a low score.

Concept Mapping and DP

- One of the following will be harder to do than the others

1. **Focus and attention**
   - (sensory/temporal/prefrontal)
2. **Identifying the grouping terms**
   - (prefrontal/temporal)
3. **Identifying subtopics**
   - (prefrontal/temporal)
4. **Organizing relationships**
   - (prefrontal/temporal)
5. **Drawing the map**
   - (prefrontal/motor)

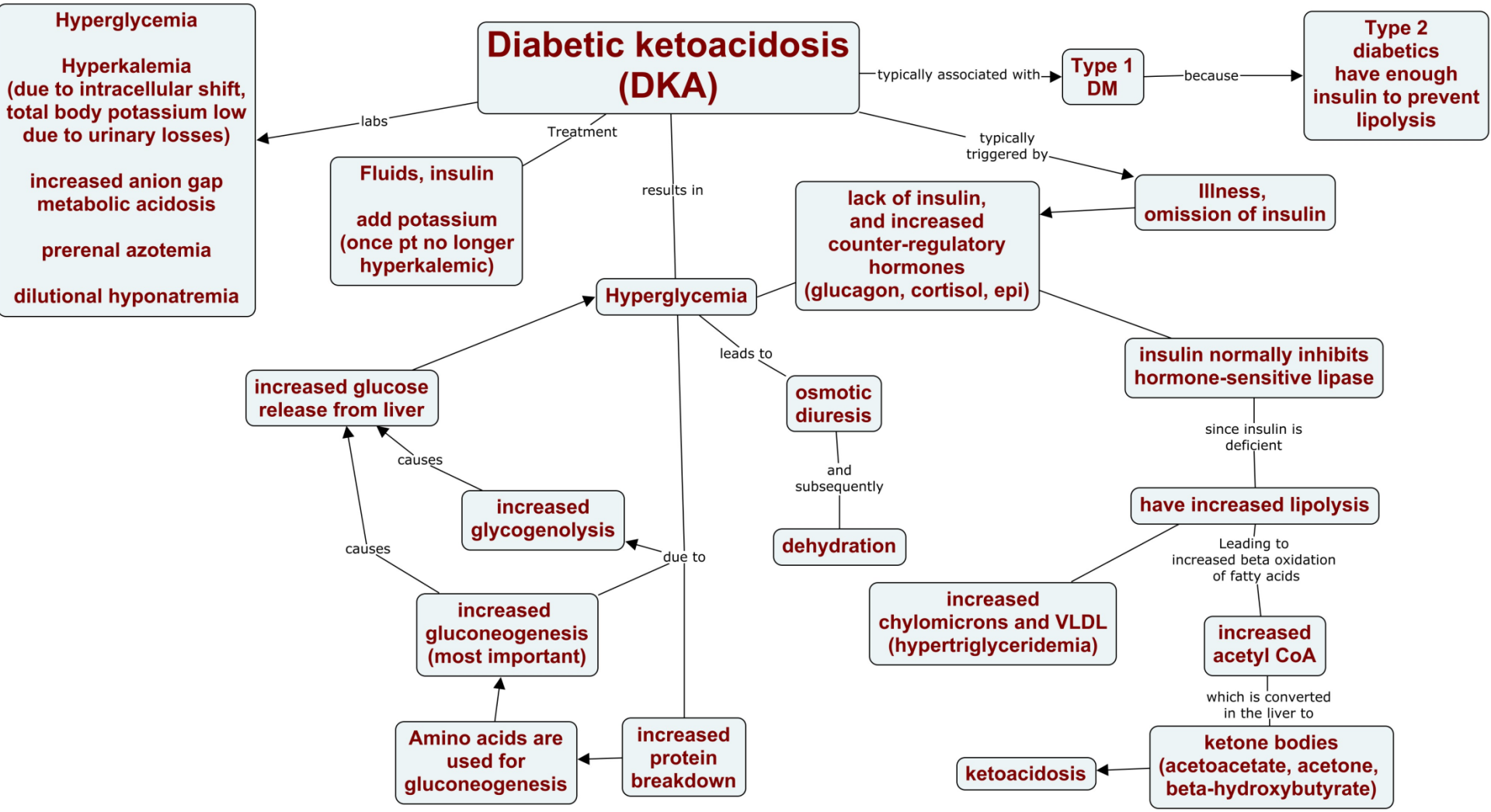
Figure 3. High-Scoring Concept Map



Reproduction of a hand-written concept map of *seizures* by a resident in the second- and third-year group. Note the complexity of the map as manifested by frequent cross-links and the consistent use of 5 to 7 levels of hierarchy, resulting in a higher map score.

DP Outcomes From Concept Mapping

- Slow at first as most-limiting brain function undergoes development
  - Limiting function is identified and practiced
- Faster processing during consolidation of skill areas
  - Capacity to make decisions faster
  - Capacity to access long term memory faster
- Capacity to retain fact (declarative) memory increased
- Transfer of skill to other problem solving venues


Diabetic ketoacidosis (DKA)
typically associated with
Type 1 DM
because
Type 2 diabetics have enough insulin to prevent lipolysis
labs
Hyperglycemia
Hyperkalemia (due to intracellular shift, total body potassium low due to urinary losses)
increased anion gap metabolic acidosis
prerenal azotemia
dilutional hyponatremia
Treatment
Fluids, insulin
add potassium (once pt no longer hyperkalemic)
results in
typically triggered by
Illness, omission of insulin
lack of insulin, and increased counter-regulatory hormones (glucagon, cortisol, epi)
Hyperglycemia
leads to
osmotic diuresis
and subsequently
dehydration
insulin normally inhibits hormone-sensitive lipase
since insulin is deficient
have increased lipolysis
Leading to increased beta oxidation of fatty acids
increased acetyl CoA
which is converted in the liver to
ketone bodies (acetoacetate, acetone, beta-hydroxybutyrate)
ketoacidosis
increased chylomicrons and VLDL (hypertriglyceridemia)
increased glucose release from liver
causes
increased glycogenolysis
causes
due to
increased gluconeogenesis (most important)
Amino acids are used for gluconeogenesis
increased protein breakdown

More About Maps

- Remember that maps are living documents; they grow as you learn
- Maps don’t have to include everything
- Maps are the best study notes
- Maps allow you to compare your thinking
  - …and improve it!

Recap

- Experiential learning “flows” through the cortex
  - Always completed through action
  - Personality type reflects time allocation.
- Experiential learning develops both:
  1. Cognitive memory
  2. Critical thinking skills
- Long-term memory is external evidence of dendritic tree growth (temporal cortex).
- Critical thinking (analytic) skill is external evidence of dendritic tree growth (prefrontal cortex).