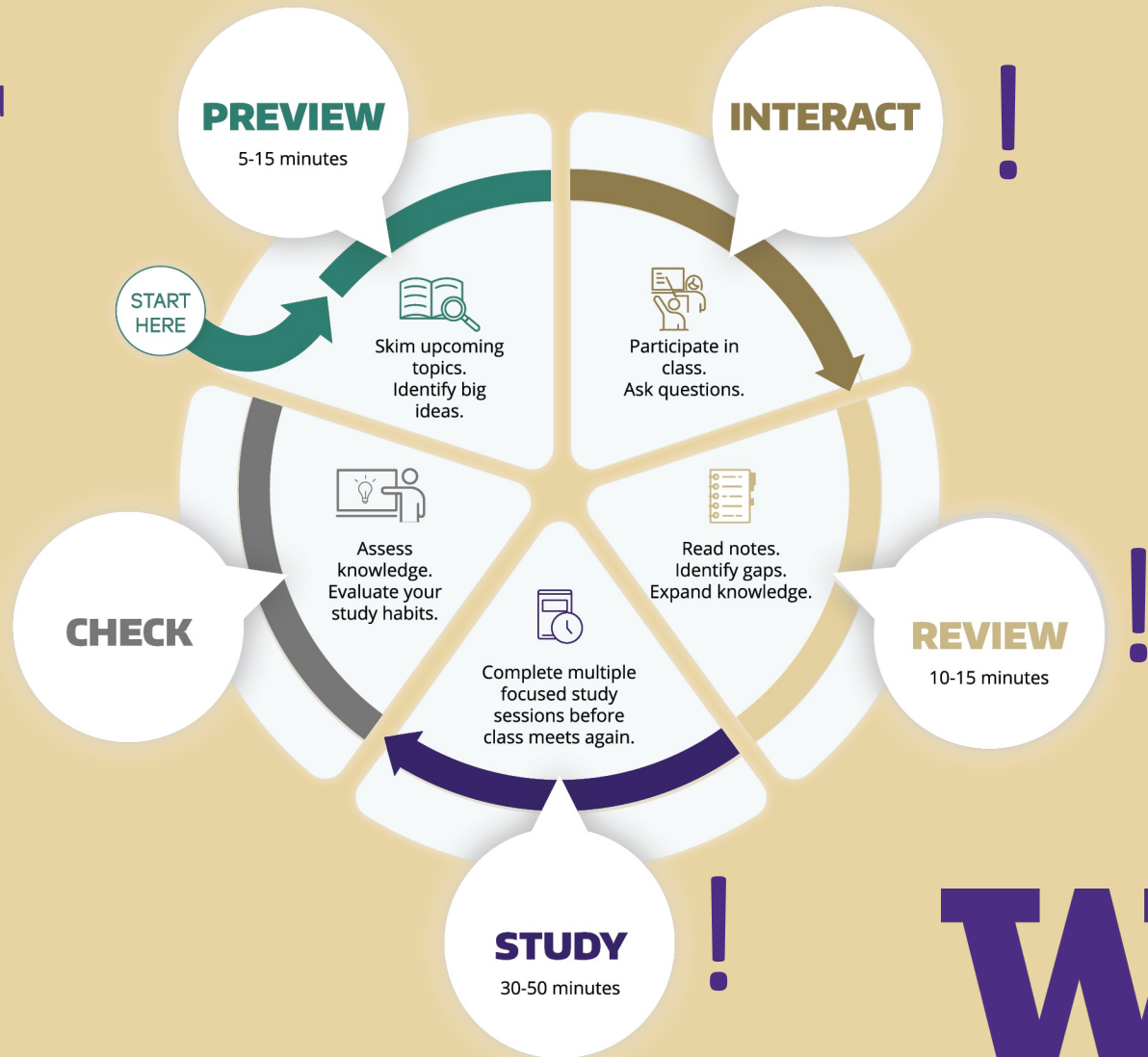# Catalyze Your Success

Understand Concepts and Improve Your Scores

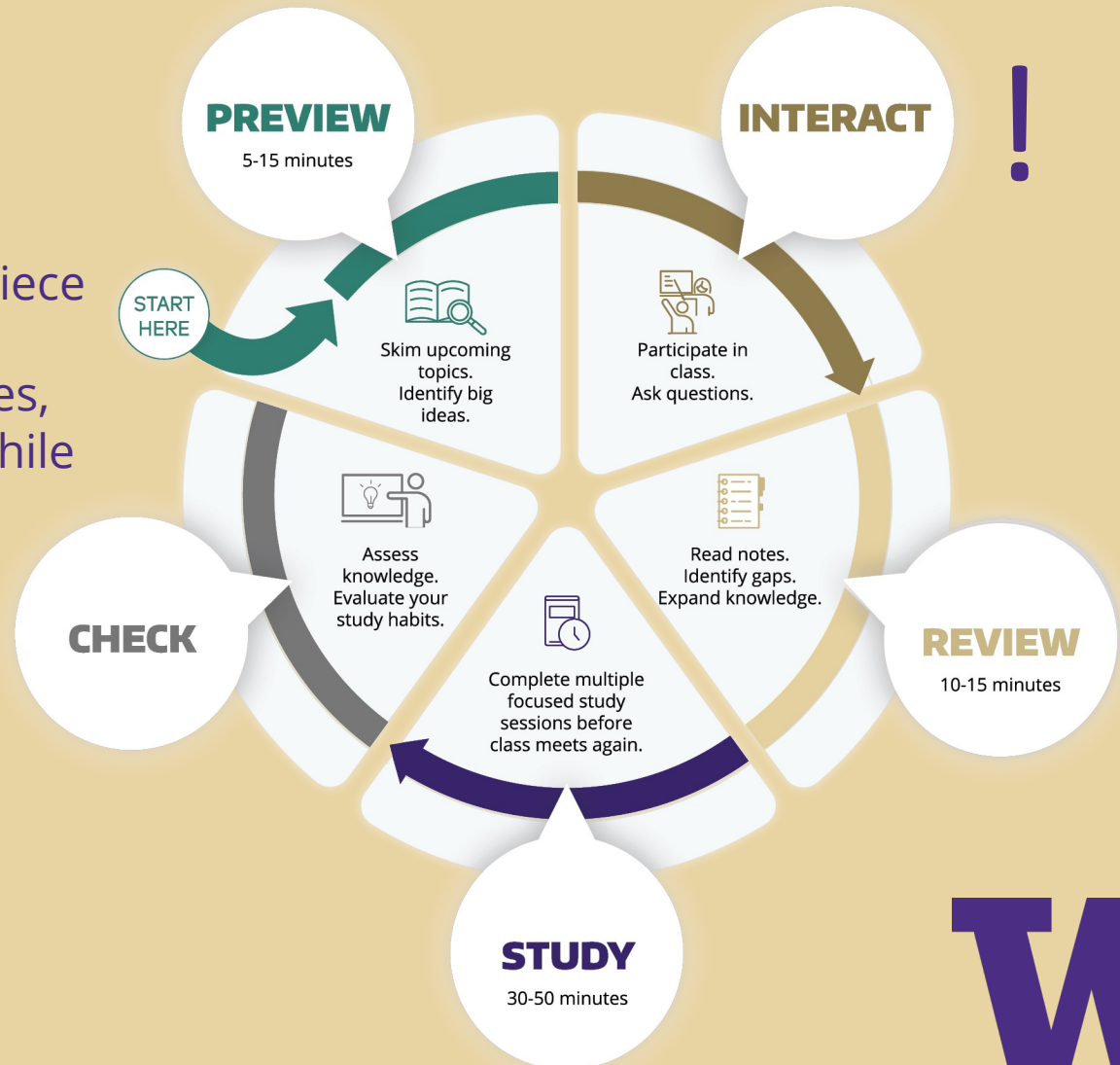Anna Merkulova (she/her) — amerk@uw.edu

W

Learning strategies

- Workshop 1: Preview and Interact

- **Workshop 2: Interact, Review and Study**

- Workshop 3: Check

Learning strategy #1: Interact

Today's strategies

- Interact:
  - Paraphrase each piece of information
  - Highlight, take notes, make flashcards while attending lecture
 - ask questions

Going to class and taking notes

> **come** to class: the more you interact with material, the better you understand it!

> take **notes** by hand

> **record** the lecture and listen to it at a later time

> **listen to yourself**: what is the most efficient way for **YOU** to grasp information

Learning strategy #2: Review

Today's strategies

- Review:
  - read lecture notes
  - Highlight, take new notes, make flashcards while reading
  - make cheat sheets
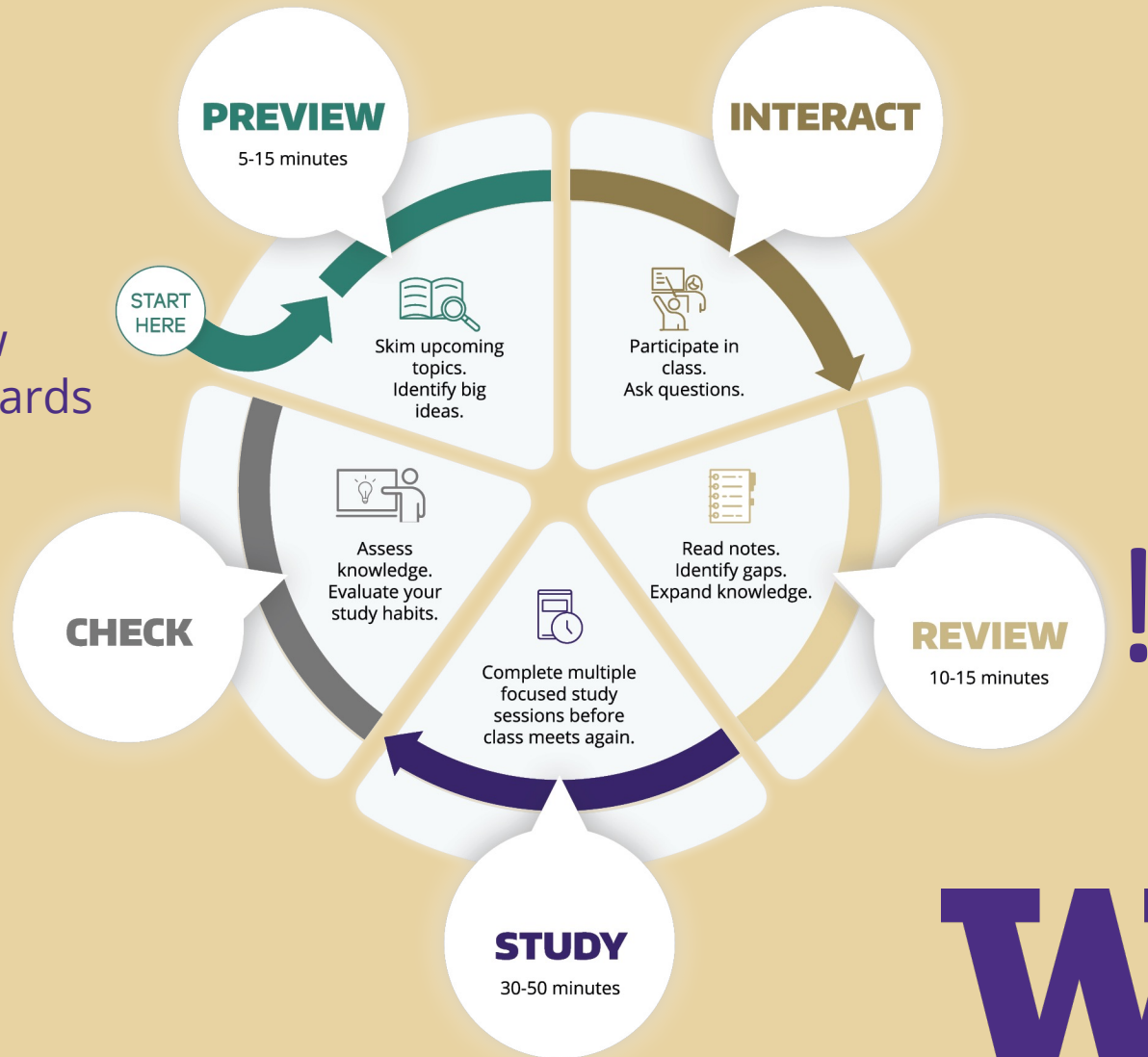
Using textbook (even if not required)

> lecture notes may not have **all** the information needed to understand the concept

C_T   cat or cot?

> Use **Index/Table of contents** to help you navigate the book

W

Using textbook. Examples

TOPIC 1A The perfect gas

➤ Why do you need to know this material?

Equations related to perfect gases provide the basis for the development of many relations in thermodynamics. The perfect gas law is also a good first approximation for accounting for the properties of real gases.

➤ What is the key idea?

The perfect gas law, which is based on a series of empirical observations, is a limiting law that is obeyed increasingly well as the pressure of a gas tends to zero.

➤ What do you need to know already?

You need to know how to handle quantities and units in calculations, as reviewed in *The chemist's toolkit* 1. You also need to be aware of the concepts of pressure, volume, amount of substance, and temperature, all reviewed in *The chemist's toolkit* 2.

pascal	Pa	$1\,Pa = 1\,N\,m^{-2}$, $1\,kg\,m^{-1}\,s^{-2}$
bar	bar	$1\,bar = 10^{5}\,Pa$
atmosphere	atm	$1\,atm = 101.325\,kPa$
torr	Torr	$1\,Torr = (101\,325/760)\,Pa = 133.32...\,Pa$
millimetres of mercury	mmHg	$1\,mmHg = 133.322...\,Pa$
pounds per square inch	psi	$1\,psi = 6.894\,757...\,kPa$

* Values in bold are exact.

of pressure, the *pascal* (Pa, $1\,Pa = 1\,N\,m^{-2}$), is introduced in *The chemist's toolkit* 1. Several other units are still widely used (Table 1A.1). A pressure of 1 bar is the **standard pressure** for reporting data; it is denoted $p^{\ominus}$.

If two gases are in separate containers that share a common movable wall (Fig. 1A.1), the gas that has the higher pressure will tend to compress (reduce the volume of) the gas that has lower pressure. The pressure of the high-pressure gas will fall as it expands and that of the low-pressure gas will rise as it is compressed. There will come a stage when the two pressures are equal and the wall has no further tendency to move. This condition of equality of pressure on either side of a movable wall is a state of **mechanical equilibrium** between the two gases. The pressure of a gas is therefore an indication of whether a container that contains the gas will be in mechanical equilibrium with another gas with which it shares a movable wall.

The properties of gases were among the first to be established quantitatively (largely during the seventeenth and eighteenth centuries) when the technological requirements of travel in balloons stimulated their investigation. These properties set the stage for the development of the kinetic model of gases, as discussed in Topic 1B.

questions to motivate reading

Using textbook. Examples

the molecules present in the gas and the resulting current of ions is interpreted in terms of the pressure. In a *capacitance manometer*, the deflection of a diaphragm relative to a fixed electrode is monitored through its effect on the capacitance of the arrangement. Certain semiconductors also respond to pressure and are used as transducers in solid-state pressure gauges.

(b) Temperature

The concept of temperature is introduced in *The chemist's toolkit* 2. In the early days of thermometry (and still in laboratory practice today), temperatures were related to the length of a column of liquid, and the difference in lengths shown when the thermometer was first in contact with melting ice and then with boiling water was divided into 100 steps called 'degrees', the lower point being labelled 0. This procedure led

Note how the units (in this case, °C) are cancelled like numbers. This is the procedure called 'quantity calculus' in which a physical quantity (such as the temperature) is the product of a numerical value (25.00) and a unit (1 °C); see *The chemist's toolkit* 1. Multiplication of both sides by K then gives $T = 298.15\,\text{K}$.

A note on good practice The zero temperature on the thermodynamic temperature scale is written $T = 0$, not $T = 0\,\text{K}$. This scale is absolute, and the lowest temperature is 0 regardless of the size of the divisions on the scale (just as zero pressure is denoted

On the thermodynamic temperature scale, temperatures are denoted T and are normally reported in *kelvins* (K; not °K). Thermodynamic and Celsius temperatures are related by the exact expression

$$T/\text{K} = \theta/°\text{C} + 273.15 \qquad \text{Celsius scale [definition]} \qquad (1A.1)$$

This relation is the current definition of the Celsius scale in terms of the more fundamental Kelvin scale. It implies that a difference in temperature of 1 °C is equivalent to a difference of 1 K.

Brief illustration 1A.1

To express 25.00 °C as a temperature in kelvins, eqn 1A.1 is used to write

$$T/\text{K} = (25.00\,°\text{C})/°\text{C} + 273.15 = 25.00 + 273.15 = 298.15$$

$p = 0$, regardless of the size of the units, such as bar or pascal). However, it is appropriate to write 0 °C because the Celsius scale is not absolute.

1A.2 Equations of state

Although in principle the state of a pure substance is specified by giving the values of n, V, p, and T, it has been established experimentally that it is sufficient to specify only three of these variables since doing so fixes the value of the fourth variable.

do not skip examples

W

Using textbook. Examples

The chemist's toolkit 2   Properties of bulk matter

The state of a bulk sample of matter is defined by specifying the values of various properties. Among them are:

- The **mass**, m, a measure of the quantity of matter present (unit: kilogram, kg).
- The **volume**, V, a measure of the quantity of space the sample occupies (unit: cubic metre, m^3).
- The **amount of substance**, n, a measure of the number of specified entities (atoms, molecules, or formula units) present (unit: mole, mol).

The amount of substance, n (colloquially, 'the number of moles'), is a measure of the number of specified entities present in the sample. 'Amount of substance' is the official name of the quantity; it is commonly simplified to 'chemical amount' or simply 'amount'. A mole is currently defined as the number of carbon atoms in exactly 12 g of carbon-12. (In 2011 the decision was taken to replace this definition, but the change has not yet, in 2018, been implemented.) The number of entities per mole is called **Avogadro's constant**, N_A; the currently accepted value is $6.022 \times 10^{23}\,mol^{-1}$ (note that N_A is a constant with units, not a pure number).

The **molar mass of a substance**, M (units: formally $kg\,mol^{-1}$ but commonly $g\,mol^{-1}$) is the mass per mole of its atoms, its molecules, or its formula units. The amount of substance of specified entities in a sample can readily be calculated from its mass, by noting that

$$n = \frac{m}{M} \qquad \text{Amount of substance}$$

A note on good practice Be careful to distinguish atomic or molecular mass (the mass of a single atom or molecule; unit: kg) from molar mass (the mass per mole of atoms or molecules; units: $kg\,mol^{-1}$). *Relative* molecular masses of atoms and molecules, $M_r = m/m_u$, where m is the mass of the atom or molecule and m_u is the atomic mass constant (see inside front cover), are still widely called 'atomic weights' and 'molecular weights' even though they are dimensionless quantities and not weights ('weight' is the gravitational force exerted on an object).

A sample of matter may be subjected to a **pressure**, p (unit: pascal, Pa; $1\,Pa = 1\,kg\,m^{-1}\,s^{-2}$), which is defined as the force, F, it is subjected to, divided by the area, A, to which that force is applied. Although the pascal is the SI unit of pressure, it is also common to express pressure in bar ($1\,bar = 10^5\,Pa$) or atmospheres ($1\,atm = 101\,325\,Pa$ exactly), both of which correspond to typical atmospheric pressure. Because many physical properties depend on the pressure acting on a sample, it is appropriate to select a certain value of the pressure to report their values. The **standard pressure** for reporting physical quantities is currently defined as $p^{\ominus} = 1\,bar$ exactly.

To specify the state of a sample fully it is also necessary to give its **temperature**, T. The temperature is formally a property that determines in which direction energy will flow as heat when two samples are placed in contact through thermally conducting walls: energy flows from the sample with the higher temperature to the sample with the lower temperature. The symbol T is used to denote the **thermodynamic temperature** which is an absolute scale with $T = 0$ as the lowest point. Temperatures above $T = 0$ are then most commonly expressed by using the **Kelvin scale**, in which the gradations of temperature are expressed in kelvins (K). The Kelvin scale is currently defined by setting the triple point of water (the temperature at which ice, liquid water, and water vapour are in mutual equilibrium) at exactly $273.16\,K$ (as for certain other units, a decision has been taken to revise this definition, but it has not yet, in 2018, been implemented). The freezing point of water (the melting point of ice) at $1\,atm$ is then found experimentally to lie $0.01\,K$ below the triple point, so the freezing point of water is $273.15\,K$.

Suppose a sample is divided into smaller samples. If a property of the original sample has a value that is equal to the sum of its values in all the smaller samples (as mass would), then it is said to be **extensive**. Mass and volume are extensive properties. If a property retains the same value as in the original sample for all the smaller samples (as temperature would), then it is said to be **intensive**. Temperature and pressure are intensive properties. Mass density, $\rho = m/V$, is also intensive because it would have the same value for all the smaller samples and the original sample. All molar properties, $X_m = X/n$, are intensive, whereas X and n are both extensive.
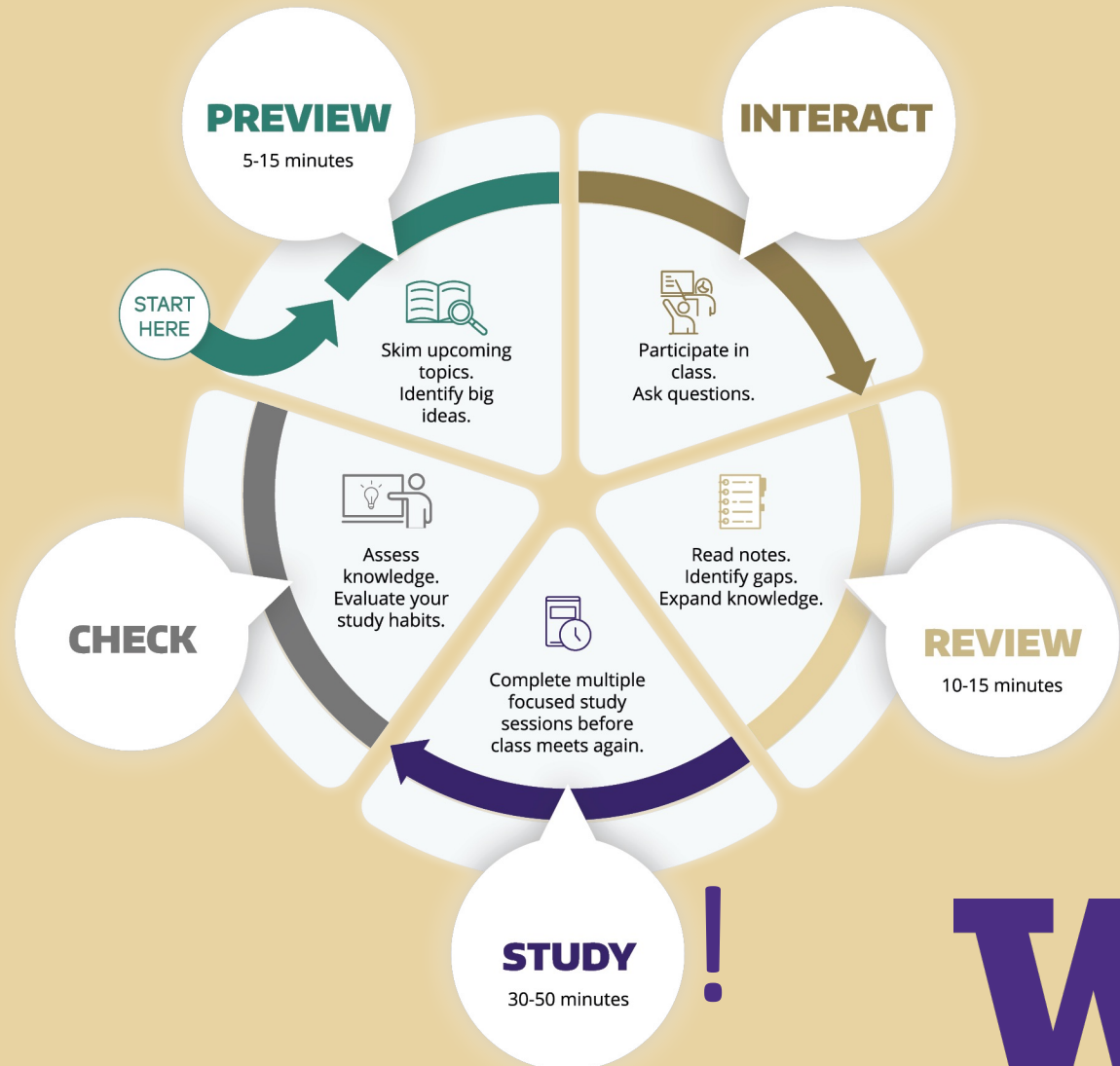
concept of temperature explained in the context

Learning strategy #3: Study

Today's strategies

- Study:
  - set study goals
  - focused study sessions

How to be efficient?

FOCUSED STUDY SESSION

PLAN
1-2 minutes

Set a specific goal.

STUDY
30-50 minutes

Engage with material.

Utilize effective learning strategies.

Think critically.

BREAK
5-10 minutes

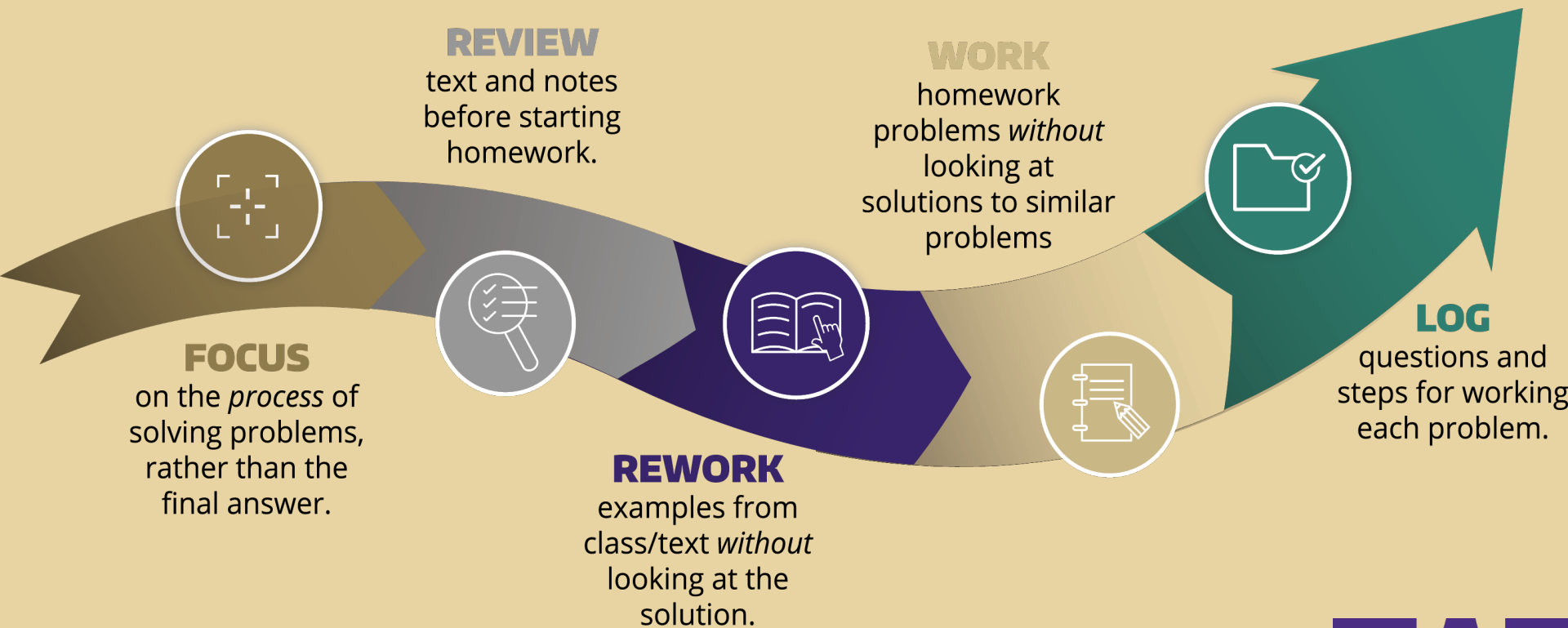Step away.

Clear your mind.

RECAP
5 minutes

Summarize.

Wrap-up.

CHOOSE

Continue studying?
Take a longer break?
Change tasks or subjects?

W

Doing homework

REVIEW
text and notes before starting homework.

WORK
homework problems *without* looking at solutions to similar problems

FOCUS
on the *process* of solving problems, rather than the final answer.

REWORK
examples from class/text *without* looking at the solution.

LOG
questions and steps for working each problem.

W

Doing homework
(NOT using solved examples as a guide)

> Homework and example problems are the **opportunities** to **test yourself**

> treat each problem as a **test** question, and/or **quest**

> **learn** from your mistakes – you won't lose points if you make a mistake **now**

W

Is that all?

Upcoming workshops
- – Solidify Knowledge and Improve your Scores

Last thing: if you don't implement a new strategy in 48 hours, you'll probably not use the strategy

W

Cookie lab manual

FLOWCODE

PRIVACY.FLOWCODE.COM
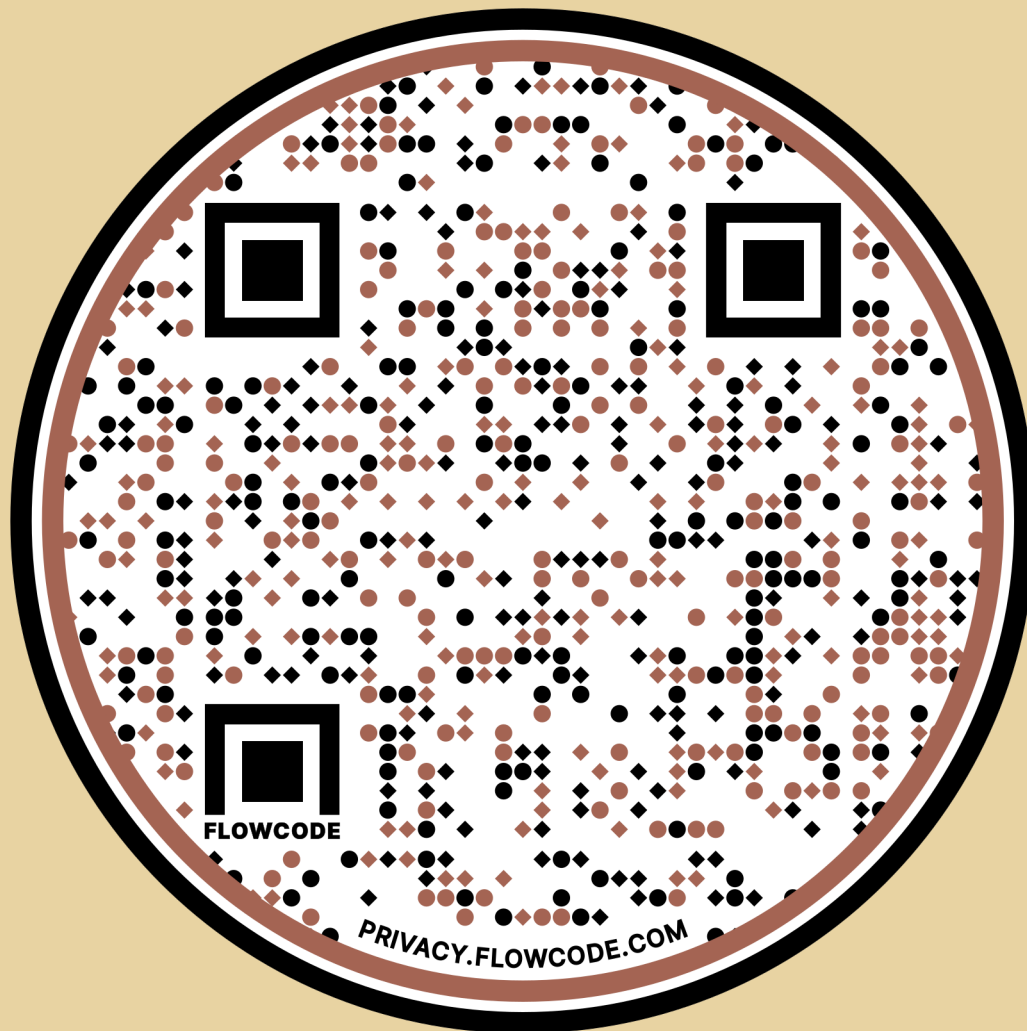
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Test anxiety

> studies show that stress can lead to short-term memory loss and impede long-term memory retrieval (Frodl & O`Keane, 2013; Kim, Lee, Han, Packard 2001; Phelps 2004)

> how to reduce anxiety and build confidence?

> let`s see what the connection between emotions and motivation is

Connection between emotions and motivation

Increased **motivation** → Increased learning

Increased success

Positive **emotions**

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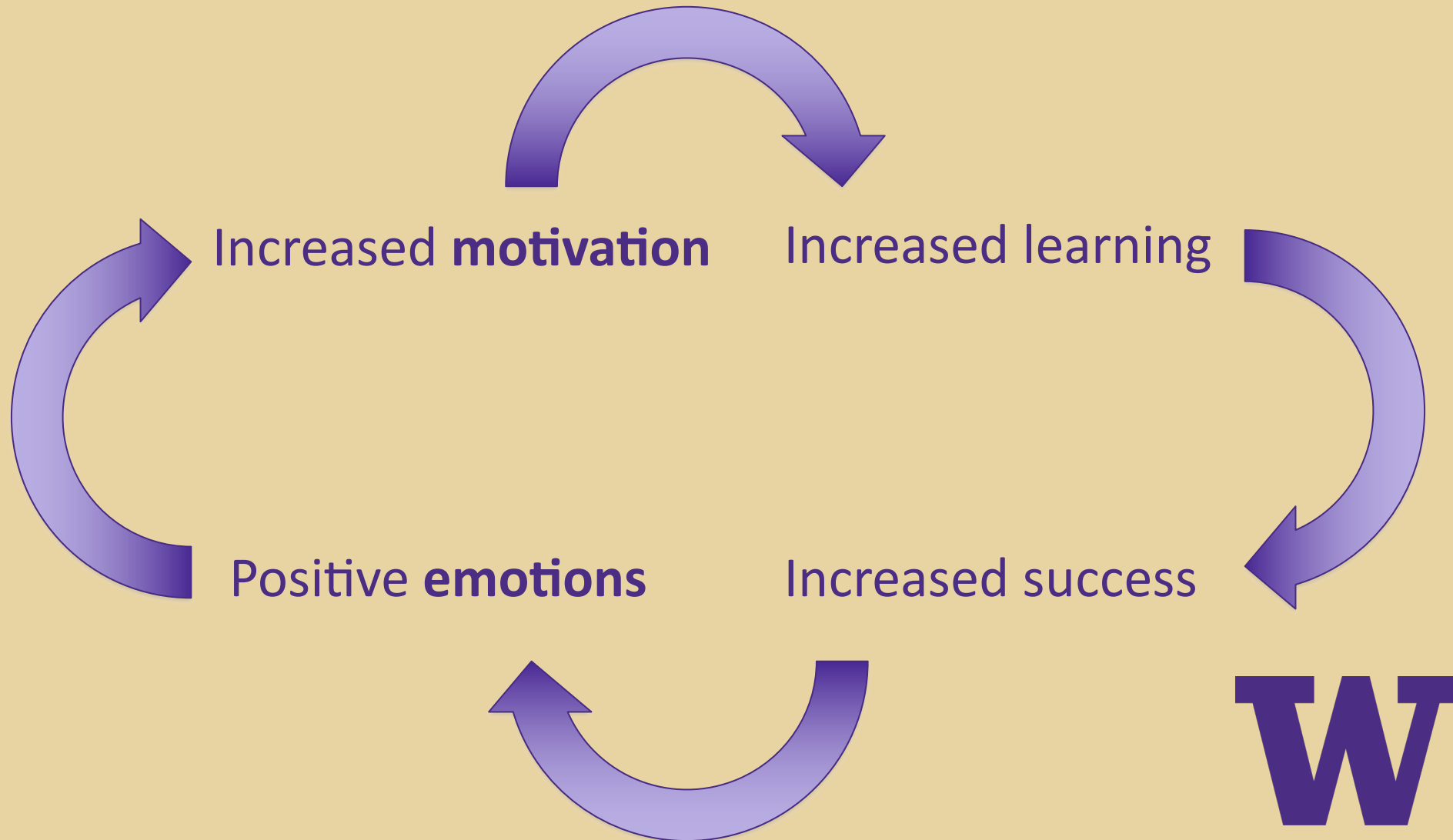
What affects motivation?

> **Value.** How important do I find this goal?

> **Nature of the environment.** Do I feel supported?

> **Belief in the ability to succeed.** Do I feel I can design and follow a course of action to meet this goal?

How to improve motivation?
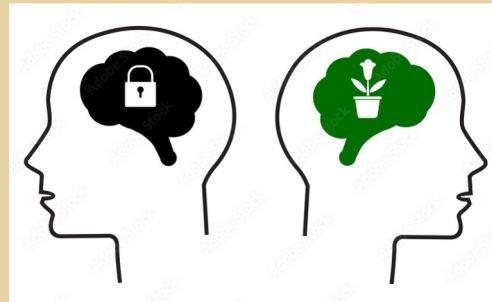
> use learning strategies to build academic success

How to improve motivation?

> use learning strategies to build academic success
> cultivate a mindset that your intelligence can grow

W

How to improve motivation?

> cultivate a mindset that your intelligence can grow

"Fixed" Mindset	"Growth" Mindset
I'm not good at this.	What am I missing?
I give up.	I'll use a different strategy.
It's just good enough.	Is this my best work?
This is too hard.	This may take some time.
Who am I to be smart, talented … ?	Who am I not to be?
My plan failed. It's over.	There's always a Plan B.
Why can't I do it like [someone else you admire]?	What do they know that I don't know? I will learn from them.

W

How to improve motivation?

> use learning strategies to build academic success
> cultivate a mindset that your intelligence can grow
> engage in positive, healthy self-talk

How to improve motivation?

How to improve motivation?

> use learning strategies to build academic success

> cultivate a mindset that your intelligence can grow

> engage in positive, healthy self-talk

> hard to improve external circumstances – easier to work on things that you can control. Attribute positive and negative results to your behavior

W

How to improve motivation?

> use learning strategies to build academic success

> cultivate a mindset that your intelligence can grow

> engage in positive, healthy self-talk

> hard to improve external circumstances – easier to work on things that you can control. Attribute positive and negative results to your behavior

> know your learning style preferences (visual, auditory, read/write, kinesthetic)

W

How to improve motivation?

> know your learning style preferences (visual, auditory, read/write, kinesthetic)

Visual Learners
- Learn best by reading and converting printed material into symbols.

Aural Learners
- Learn best by actively listening to information.

Read/Write Learners
- Learn best by reading and writing information.

Kinesthetic Learners
- Learn best by practical application of the information.

https://nursing.lsuhsc.edu/AcademicSuccessProgram/LearningStyles.aspx

Study strategies for different learning style preferences

Visual Learner (prefers pictures, charts, diagrams, graphs, etc.)		
In Class	**While Studying**	**During Exams**
• Underline important points • Highlight with different colors • Use symbols, charts, graphs	• Underline notes and text • Highlight notes and text (in color) • Summarize with images and concept maps	• Recall pictures • Draw concept map of essay • "Dump" formulas/diagrams

How to improve motivation?

> use learning strategies to build academic success

> cultivate a mindset that your intelligence can grow

> engage in positive, healthy self-talk

> hard to improve external circumstances – easier to work on things that you can control. Attribute positive and negative results to your behavior

> know your learning style preferences (visual, auditory, read/write, kinesthetic)

> get adequate rest, nutrition, and exercise

W

Study strategies for different learning style preferences

Visual Learner (prefers pictures, charts, diagrams, graphs, etc.)		
In Class	**While Studying**	**During Exams**
• Underline important points • Highlight with different colors • Use symbols, charts, graphs	• Underline notes and text • Highlight notes and text (in color) • Summarize with images and concept maps	• Recall pictures • Draw concept map of essay • "Dump" formulas/diagrams

Study strategies for different learning style preferences

Aural or Auditory Learner (prefers hearing information)		
In Class	While Studying	During Exams
• Attend lectures, discussions, and tutorials • Tape lecture for later	• Discuss material in study group • Summarize notes, then read out loud • Read onto tape, then listen back	• Listen to inner voice to recall information • Talk out question under breath

Study strategies for different learning style preferences

Reading/Writing Learner (prefers reading or writing about information)		
In Class	While Studying	During Exams
• Create lists and headings • Take complete lecture notes	• Identify key words and associate them with details • Reread notes and text and summarize them in writing • Reread and summarize old tests • Answer (in writing) the review questions	• Use key words to trigger more complete answers • At the beginning of the exam, write out important lists • Essay – write thesis, then outline

W

Study strategies for different learning style preferences

Kinesthetic Learner (prefers moving, touching, visualizing movement, or hands-on activities to learn information)		
In Class	While Studying	During Exams
• Use all senses • Participate in labs and field trips	• Trial and error is important – can learn from mistakes • Create personal examples • Use pictures to illustrate notes • Stand, move, walk • Study in an exam-like environment	• Remember examples • Stretch or move to jog memory