# Executive Functioning and Attention in Scientific Trainees

Laurie Chaikind McNulty, LCSW-C
*NIH OITE Wellness Advisor*
*Clinical Social Worker*

Train-the-Trainers
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**TRAINING&**
**EDUCATION**
NATIONAL INSTITUTES OF HEALTH

laurie@jonahgreenandassociates.com
https://www.childandfamilymentalhealth.com/laurie-chaikind/

# What is Executive Function (EF)

- The "CEO" or "Air-Traffic Control System"
- Best understood as a set of skills
- Not mature until mid-20s



Each type of executive function skill draws on elements of the others.

- Planning
- Prioritizing
- Organizing (thoughts and environment)
- Time Management
- Flexible thinking
- Working Memory
- Emotion Regulation
- Self-Control/Inhibition
- Self-Monitoring
- Sustained Effort
- Task Initiation
- Problem Solving/Decision Making

# Types of Attention

- Selective attention
  - Attending to chosen stimuli while ignoring the others
- Divided attention
  - Attending multiple stimuli
- Sustained attention
  - Attention span
- Executive attention
  - Regulating our responses to make choices about what we attend to

Experiment by John Ridley Stroop to Show Automaticity of Attention

| Black | Green | Yellow | Red | Blue |
|---|---|---|---|---|
| Red | Black | Blue | Green | Yellow |
| Green | Yellow | Red | Blue | Black |

# Selective Attention

- The ability to direct our attention to the desired stimuli
- Critical factors in attention
  - Alertness
  - Filtering distractions
  - Shifting attention when needed
- Limited
- Related to our interest
- We have orienting reflexes
  - Strong novel stimuli
  - We can habituate or dishabituate to these stimuli
- Impacted by mental health factors

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4191471/

# Importance of EF in Biomedical Trainees

- Planning
- Prioritizing
- Organizing (thoughts and environment)
- Time Management
- Flexible thinking
- Working Memory
- Emotion Regulation
- Self-Control/Inhibition
- Self-Monitoring
- Sustained Effort
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# Seeing the Bigger Picture – Zoom Out

- What presents as an EF issue is often rooted in other concerns
  - Stress
  - Anxiety
  - Depression
  - High demands
  - Unrealistic expectations
  - Competing demands
  - General wellbeing
    - Sleep, nutrition, isolation
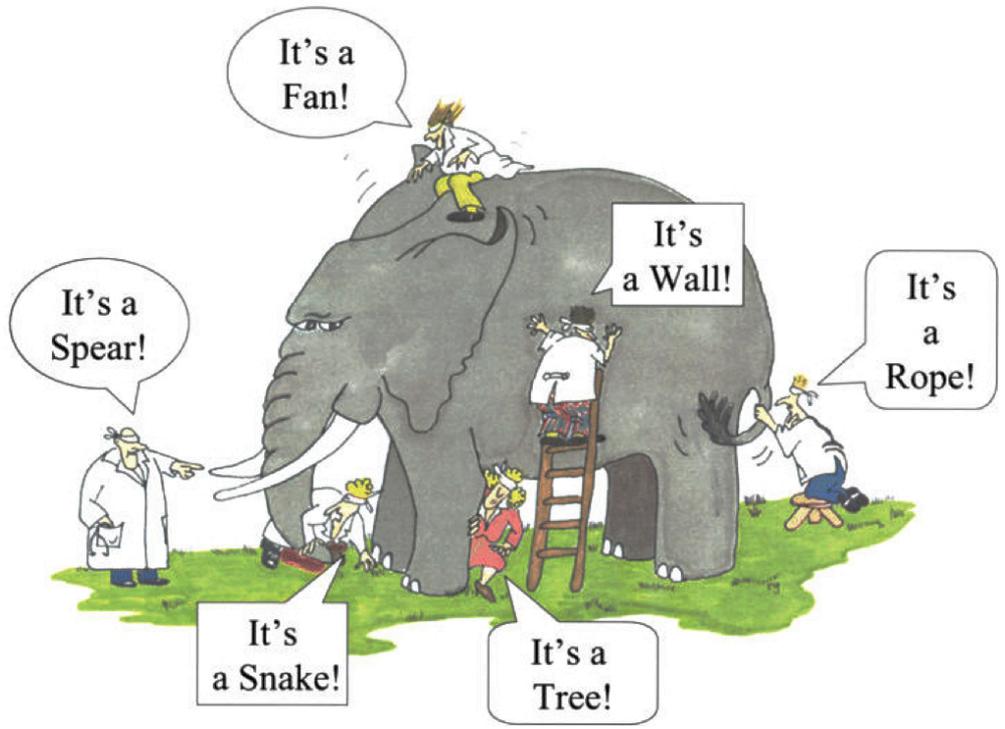
# Interplay of EF and Anxiety/Stress/Depression

- High rates of stress in science trainees
- EF interplay with mental health
  - Trauma/PTSD
  - Stress
  - Depression
  - Anxiety

*"Even quite mild acute uncontrollable stress can cause a rapid and dramatic loss of prefrontal cognitive abilities, and more prolonged stress exposure causes architectural changes in prefrontal dendrites." (Arnsten, 2010)*

Cognitive Distortions

Executive Functioning Difficulties
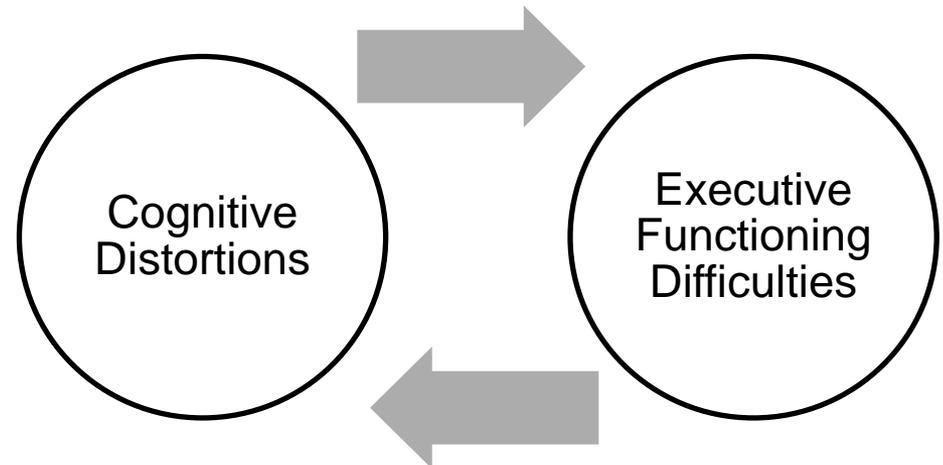
# Interplay of EF and Anxiety/Stress/Depression

- We know that EF is impacted by overall wellness in several ways including cognitive abilities, sustained attention, decision making, shifting attention

- And, this process is cyclical –
  - Targeting EF and stress at the same time can help decrease mental heath issues
  - Better EF can be a protective factor in better mental health
  - Greater EF skills leads to high sense of control and life satisfaction

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2907136/

# Stress Switches Our Brains from "Top-Down" to "Bottom-Up"



a **Prefrontal regulation during alert, non-stress conditions**

**DMPFC**
- Reality testing
- Error monitoring

**DLPFC**
- Top-down guidance of attention and thought

**rlPFC**
- Inhibition of inappropriate actions

**VMPFC**
- Regulating emotion

Striatum
Hypothalamus
Amygdala
NA
DA
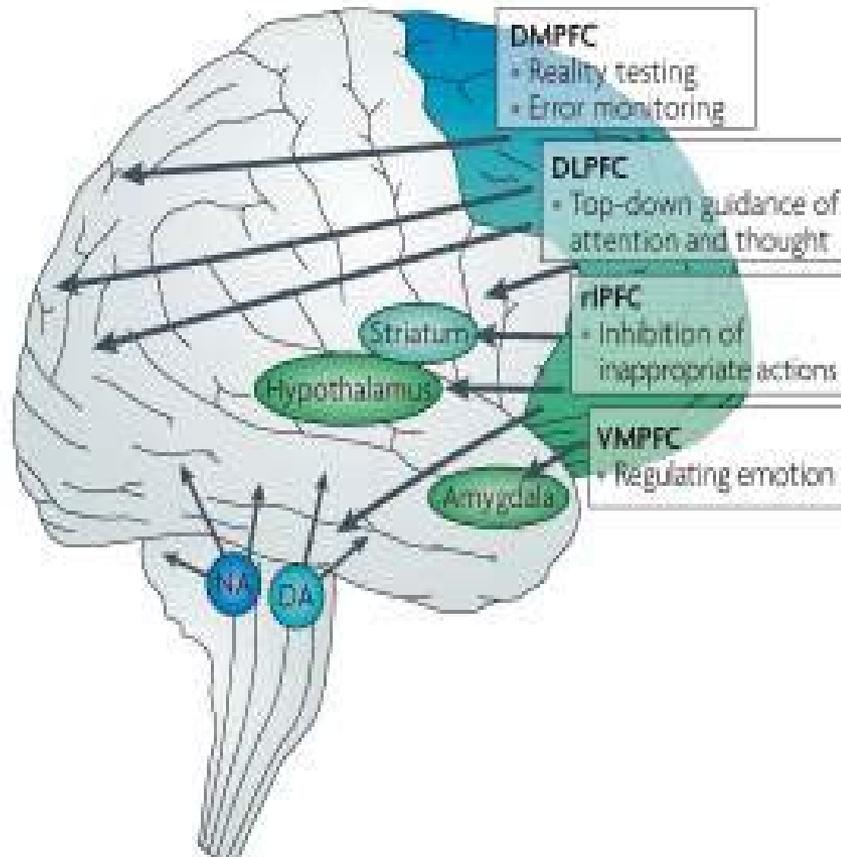
b **Amygdala control during stress conditions**

Loss of prefrontal regulation

Emotional habits
Striatum
Hypothalamus

Bottom-up attention
NA
DA
Amygdala
Emotional associations

Emotional reflexes

(Arnsten, 2010)
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2907136/
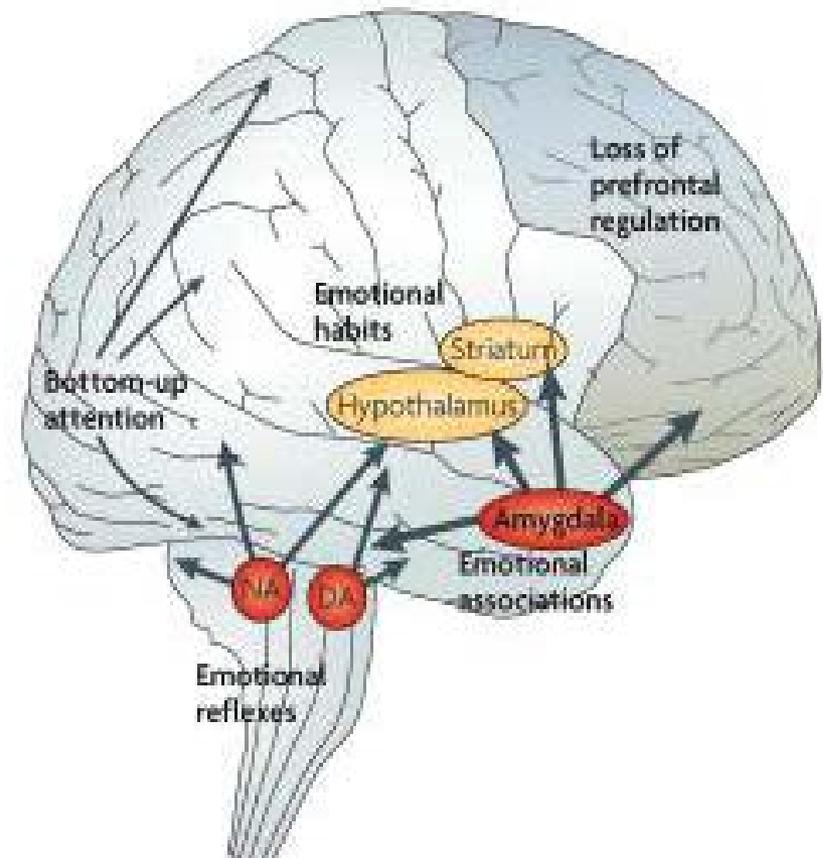
# A Word on Perfectionism

- Perfectionism is a way to protect ourselves – it stems from a drive to avoid negative feelings including "blame, judgement, and shame"
  - It is self-reinforcing as the more we try to be perfect, the worse we feel because we end up blaming ourselves – it sets us up to feel shame
- Perfectionism takes a few forms
  - Overwork
  - Work "paralysis" or avoidance/procrastination
- Perfectionism can present as executive functioning challenges
  - Can't get started, difficulty following through, becoming overwhelmed when making plans, procrastinating…others?
- Move toward *healthy striving* – can I still be successful without being so hard on myself, take risks, get started, etc?

# Where to start…?

- We often feel the urge to "problem solve" EF needs
    - Organizational tools
    - Calendars
    - Planning sheets

- But if we jump into that mode too soon, we may miss the core issues
    - "I can't get started"
        - Helping a student set timers vs. helping them relieve the pressure of trying to get everything "just right"
- Explore and validate the whole wellbeing of the trainees
    - Curiosity is key
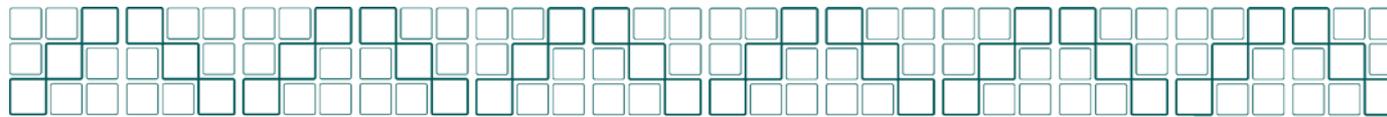
# Consider This… Where do you start?

A student comes in to see you and says that she is not ready for her thesis defense.  She has been struggling with time management for months and cannot seem to get herself started.  She stays up late and then sleeps in, ignoring all the alarms and alerts on her phone.  She cannot follow the schedule that she has written for herself, and "isn't motivated." When she writes, she cannot pay attention for longer than 30 minutes at a time and is easily distracted.  She avoids her advisor because she feels that she has nothing to show for her time. This was always an issue but has become particularly pronounced since the COVID-19 quarantine.  She lives alone, away from her family who lives abroad. She comes to you to ask about time management skills and to help her improve her motivation.

# First, Become Curious About The Wellness of the Whole Trainee

**Curiosity is Key**

- Curiosity decreases shame, increases your avenues for change, and helps you pinpoint areas to work on.
- Examples of curiosity:
  - *Are there underlying wellness issues?*
  - *Have the EF challenges been exacerbated recently?*
  - *What is their history with executive functioning?*
    - *What has worked for them in the past, and what have they tried that feels like it may be less helpful?*
    - *\*Note: We resist using tools when we become overwhelmed.*
  - *Is the trainee operating from bottom-up or top-down?*
  - *What parts of planning and follow through feel the hardest?*

# Bolster EF Skills Holistically

- Help trainees explore:
  - Current stressors
  - Cognitive load
  - Overall wellness
  - Reasonable expectations
  - Kind and realistic self-talk
  - Self-advocacy/assertiveness skills
  - Self-care practices
  - Emotional responses
  - Concrete executive functioning strategies
  - Support systems (formal and informal)

# Helping Trainees with Specific EF Skills

# "Concrete" Skills and Wellness Skills Work in Harmony When Addressing EF Needs
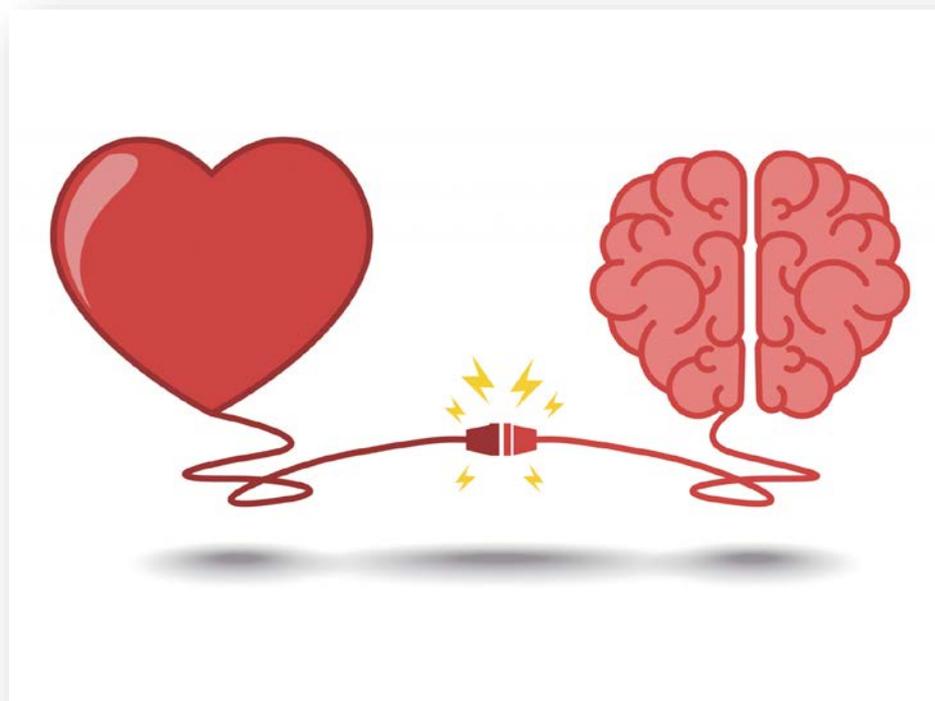
# Creating A Game Plan

Organize your space and your thoughts

Routinize as much as possible | Food, Commute, Chores, Exercise, Tidying, Writing Time, etc.

Create reminder systems

Set priorities with reasonable expectations

Think about timelines as small steps | Small goals with meaningful breaks
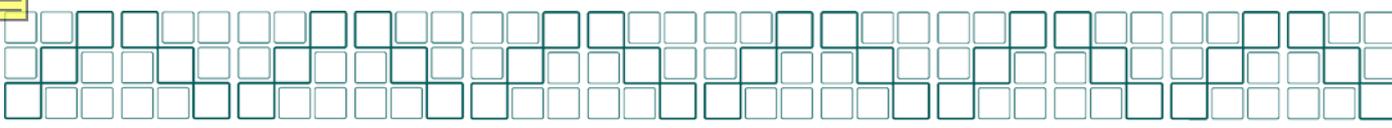
# Planning and Prioritizing

## Overall Wellbeing

Worry

Depression

Anxiety

Avoidance

Numbing

Overwhelmed

Fear of disappointing others

Perfectionism

Imposter fears

Fear of decision making

Assertiveness fears

## Concrete EF Strategies

Routines

Rewards

Breaks

Apps

Calendars

Appropriate deadlines

Phone reminders/alerts

Lists

Identifying what is most important

Support system

# Remaining Flexible

**Cannot Control**

**Wish to Control**

**Can Control**

*Helping to recognize what is in their control, no matter how small, can increase flexible thinking, follow through, and problem solving.*

Modified from Kelly Donahue, Ph.D.

# Working Memory

- Think about what gets in the way of working memory
  - Stress, high cognitive load, competing demands, etc.

- Concrete tools:
  - Reminders and alarms
  - Shared calendars
  - Written reminders
  - Organization apps
  - Create routines
  - Support systems
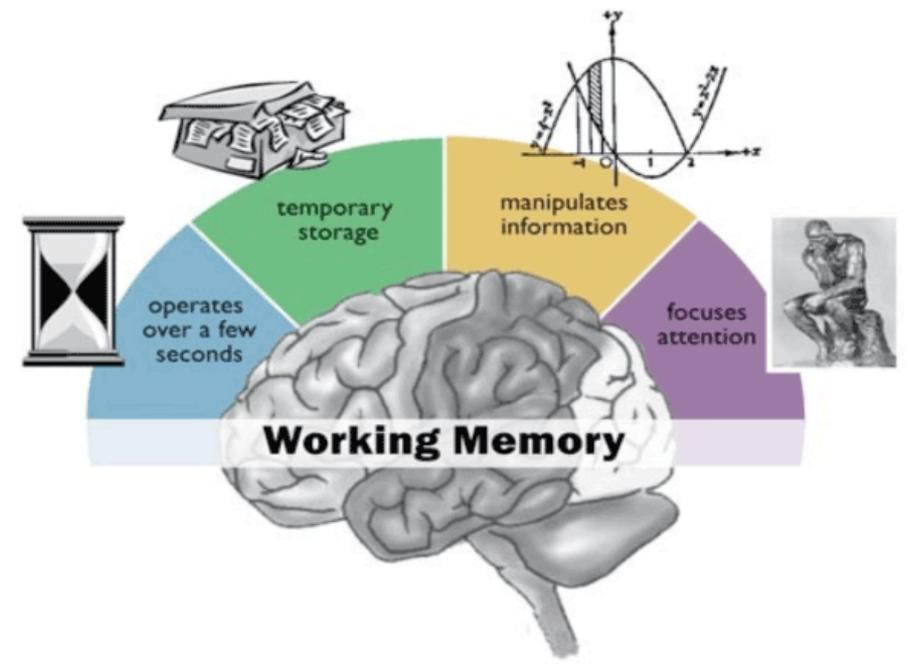
# Self-Monitoring

*Help trainees create a list of questions they can ask themselves*

- *How am I feeling?*

- *Where are my stress points?*

- *How much do I want to accomplish this week?*
  - *Is this realistic?*

- *What signals do I need to look for that tell me I may need to change course?*

- *What are the pros and cons of how I am handling things now? What would it be like to change course?*

- *How can I handle it if a problem arises?*
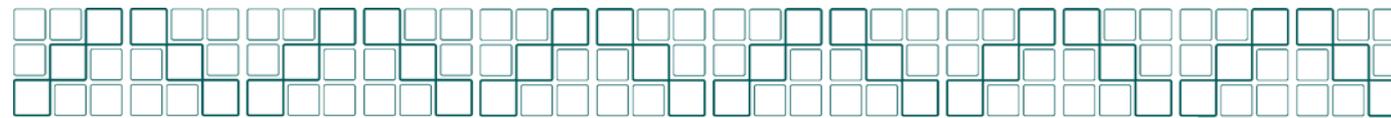
# Self-Monitoring

- *How can I handle it if a problem arises?*

- *How can I use my support system?*
  - *What gets in the way of accessing support?*

- *Do I have worries about giving other's status updates, or even sharing what I'm working on?*

- *Who can I go to get helpful feedback?*

- *What are the yardsticks I want to use to determine how much progress I'm making?*

- *What are reasonable expectations for myself?*
  - *Short and long term*

- *What are realistic ways that I can check in on my own progress?*

- *How often do I need feedback?*
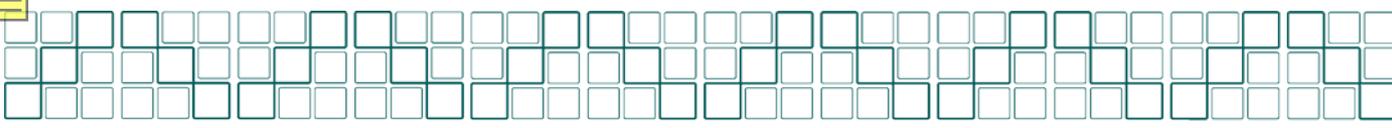
# Task Initiation: Getting Started

## Overall Wellbeing

Worry

Depression

Anxiety

Avoidance

Numbing

Overwhelmed

Fear of disappointing others

Perfectionism

Imposter fears

Fear of decision making

Assertiveness fears

## Concrete EF Strategies

Routines

Rewards

Breaks

Apps

Calendars

Clear expectations

Phone reminders/alerts

Lists

Deadlines

Support system/accountability
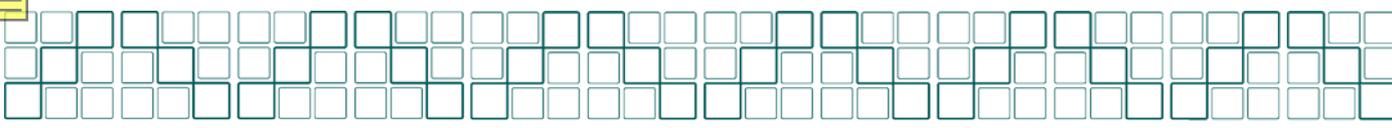
# Impulse Control/Response Inhibition



**<u>S</u>**top

**<u>T</u>**ake a breath

**<u>O</u>**pen up your mind → Review your options

**<u>P</u>**ick the option that feels right to you

# Self-Care Wellness Tools

- Sleep
  - Routines, turn of electronics, meditate, write down worries, change your routine 10 minutes at a time
- Exercise
  - Free classes online, walks, be gentle on yourself
- Nutrition
- Mindfulness
  - Journaling, Meditation, Creative Thinking
  - Recognizing your feelings (disappointment, overwhelmed, sad, worried) without judging them
  - "How do I feel?" instead of "How should I feel?"
- Healthy Relationships
- Mental Health

https://www.stresshealth.org/what-can-i-do/