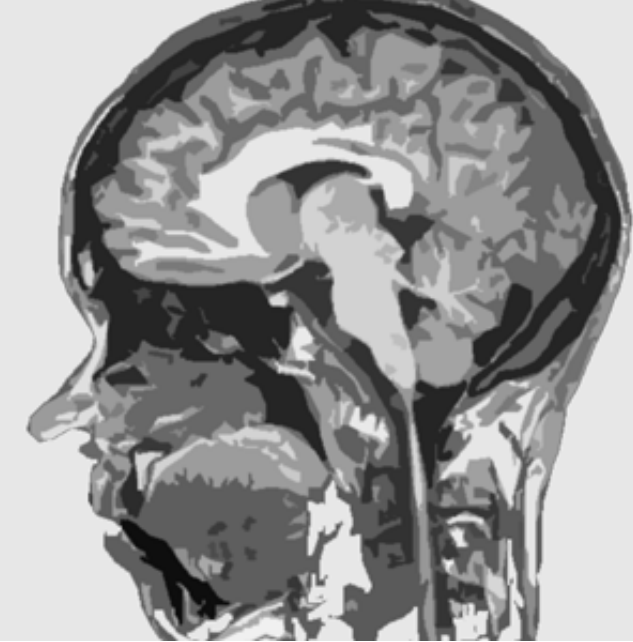
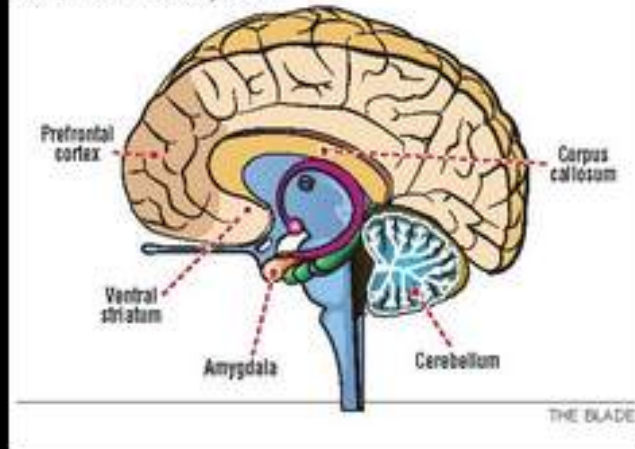




## THE ADOLESCENT BRAIN

The prefrontal cortex often is called the 'executive brain.' But it is not at peak performance until young adulthood. In the meantime, the ventral striatum region makes teenagers extra sensitive to rewards while the less-active amygdala region leaves them less sensitive to punishment and emotional consequence.



# APPLYING MINDSET IN PHYSICS TEACHING

Chandra Boon



BRANKSOME  
HALL

# Learners and Non-learners

*The illiterate of the 21st Century will not be those who cannot read or write, but those who cannot learn, unlearn and relearn.*

- Alvin Toffler



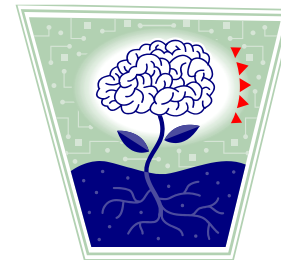
# Self-Theories/Mindsets

- Arises from studies in Social Psychology (Carol Dweck, et al.)
- People's beliefs about themselves (mindset) shape their lives by affecting their thoughts and actions
- **Your thinking can either lead to your development or limit it**

Fixed Mindset



Growth Mindset





# Fixed Mindset



## Belief

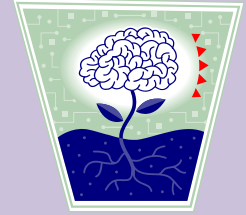
- Traits and abilities are fixed or unchanging
- Effort = low ability
- Mistakes must be avoided
- Failure = no ability

## Thoughts/Actions

- **Concerned about looking smart/able (show off)**
  - May feel superior/entitled
- **Challenge and risk avoided**
  - Feel helpless
- **Defensive about mistakes**
  - Externalize responsibility
- **Put themselves down**
  - May deny failure or cheat



# Growth Mindset



## Belief

- Based on belief that **abilities can be changed**, even increased
- Effort = growth
- Mistakes must be understood
- Failure = learning opportunity

## Thoughts/Actions

- **Concerned about learning**
  - Develop abilities through experience
- **Challenge is sought**
  - Feel empowered
- **Examine mistakes**
  - Seek constructive feedback
- **Reflect on strategies**

# Response to Challenge

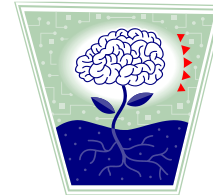
## Fixed Mindset

- Feel **helpless**
- Feel **dumb**
- Feel **inadequate**
- Lose confidence
- Challenge is **avoided**



## Growth Mindset

- **Increase effort**
- Seen as a way to **get smarter**
- Challenge is **motivating** – want to “figure it out”



# Mindset and Goals

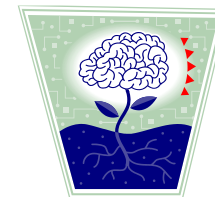
## Fixed Mindset leads to Performance Goals

- Goal is to **look smart**
- Performance = ability
- Poor performance means low ability and induces helplessness



## Growth Mindset leads to Learning Goals

- Goal is to **increase competence**
- Desire to learn new things and get smarter
- Poor performance leads to increased effort and changes in strategy





# Non-learning vs. Learning

## Non-learners Fixed Mindset

**Do not profit from mistakes or failures**

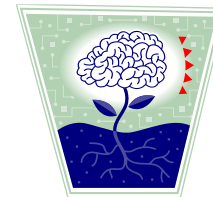
- Lack the coping skills
- Denigrate self or lay blame
- Ignore feedback
- Threatened by strengths of others



## Learners Growth Mindset

**Profit from mistakes or failures**

- Reflect on strategies and make adjustments
- Welcome feedback
- Inspired by strengths of others





# Fixed Mindset Leads to...



- **Higher levels of anxiety** in anticipation of a stressful event
- Increased fear of failure
- Greater self-esteem loss
- Depression after a negative event (like failure)
- Being less resilient and vulnerable.

**The fixed mindset limits development**

# Self-Theories and Bright Girls

According to the research, **bright girls** are particularly prone to

- Having a **fixed** mindset
- Having a **helpless** response to challenge
- Choosing easier tasks to **avoid errors**



# Action Research in Education

*“Action Research is a process of systematic inquiry into a self-identified teaching or learning problem to better understand its complex dynamics and to develop strategies geared towards the problem’s improvement.”*

- Inquiry undertaken by a practitioner in a field
  - Not limited to education
- Participatory Action Research
  - Students participate

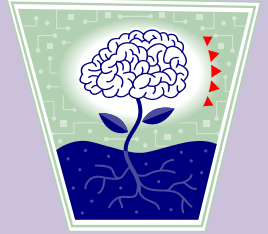


# Anxiety in Physics



- Anxiety can be very high in Physics class
  - Can be a barrier to learning
  - Can be first time students are really challenged
- Physics anxiety studies – emphasis on cognitive aspects rather than affect (until recently)
- Action research and participatory action research

# Project



*How does teaching a growth mindset affect anxiety in Grade 10 girls taking Grade 11 Physics?*

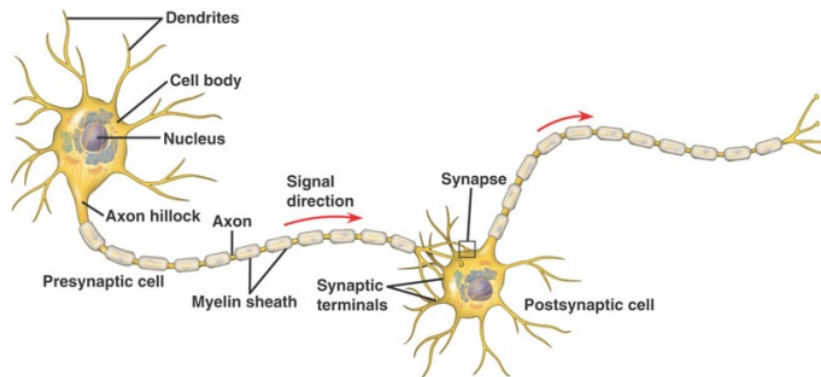
## Method

- Survey about anxiety
- Teach lesson on brain, learning, and mindset
- Help students focus on use of **strategies** for learning and dealing with anxiety arising from confusion and test anxiety
- Mentorship – G10s mentor G8s during exam prep

# Brain and Learning



- **Learning causes new connections** between neurons
- New learning causes lasting physical changes in your brain as **connected neurons** form “**pathways**”
- Brain-based strategies: “**Practice makes permanent**”
  - Practicing new learning reinforces pathway leading to retention



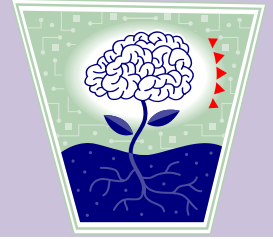
# Brain and Learning

- Research shows that your brain structure and interconnections are changeable, not fixed
- Your brain and intelligence develop during learning
- Fixed mindset is a false and limiting belief

*Intelligence arises as the brain reasons, plans and solves problems.*



# Main Message to Students



Apply the **growth mindset to your learning:**

- Make **every task** a **learning task**, even tests and the final exam!
- **Embrace challenges** and **develop your intelligence**
  - When you find a task difficult, **increase effort**
- Use **strategies** that works for you to **reduce anxiety**
- **Think about your thinking**
  - **Avoid** self-talk that is **belittling** when challenged
  - Instead, **adjust strategies** or ask for help when you're stuck



# The Challenge: Anxiety

- Teach students to take a growth-minded approach to dealing with anxiety
- **Physical response** – nervous system
- Focus on **strategies**
  - Breathing exercises
  - Writing fears on paper before test
  - Sufficient sleep



# Mentorship

- G10 students act as “Mindset Mentors” in G8 exam prep sessions
- Help students see exam-writing as a skill that can be developed (growth-minded approach)
- Mentorship designed to benefit both G8s and G10s



# Results



- **Deceptively simple framework** - misconceptions and skepticism arose
  - Positive thinking
  - Open-mindedness }  $\neq$  **Growth Mindset**
- **Students need opportunities to**
  - process their understanding of the mindset framework
  - Reflect on effectiveness of strategies

# Results



- Students love learning about their brain!
- Some students applied it in the short term, others in the long term
- Shared with peers
- Mentorship helped students internalize the framework
- **Transformational** for some students
  - Shifted from performance goals to learning goals
  - Reduction in anxiety and test anxiety

# Student Perspective

## **Interview Questions – One year later**

Did you find the mindset framework valuable?

Did you apply a growth mindset to your learning in the short and long terms?

Did the mindset framework have an impact on anxiety?