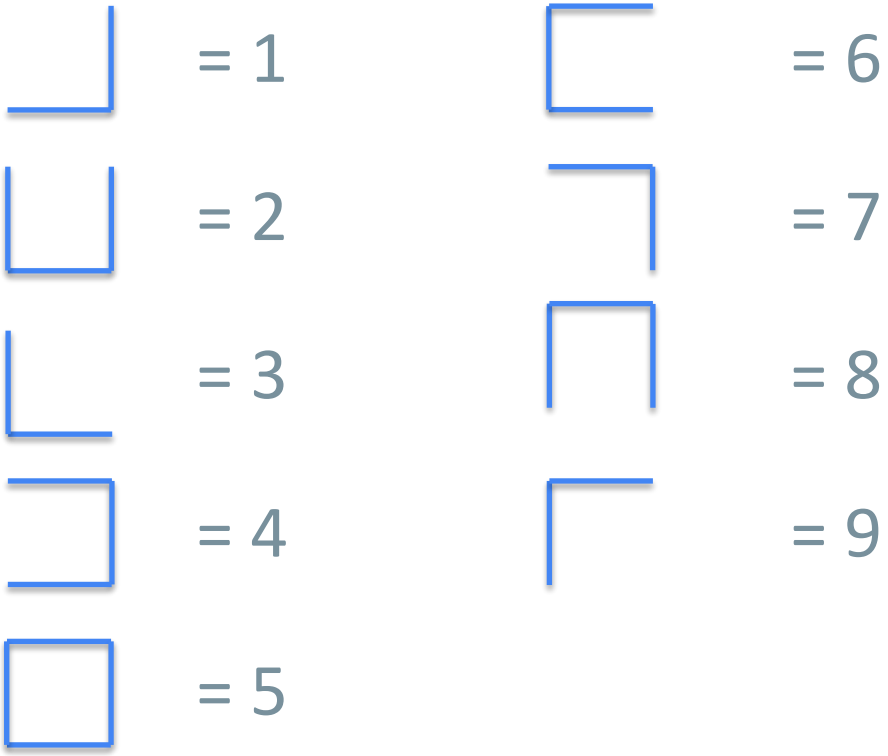
Constructivism
Flow Theory

CMSC 19929: Creating Computer Games for Learning

Designing Learning Experiences (Theory: Constructivism)

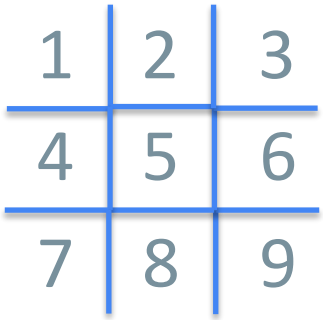


Challenge: Memorize this shape-number mapping (10 sec)

Designing Curriculum – Theory: Constructivism

What is this sequence?

Designing Curriculum – Theory: Constructivism



How about this version?

Designing Curriculum – Theory: Constructivism

What is this sequence?

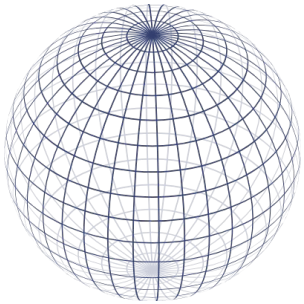
Constructivism

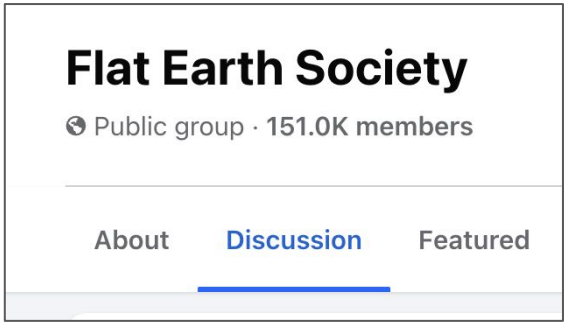
- All knowledge is **interpreted** through the lens of what is already known.
- New information causes us to add, modify, or discard old or new information.
- This is a very **active, reflective** process.

The individual matters

- Their previous knowledge provides a **lens** through which new knowledge is understood.
- Different learners may interpret the new information differently depending on their previous knowledge.

- *"The world is round."*
  - Pancake? Soccer ball? (4 y.o.)
  - Sphere? (8+ y.o.)
  - Nah… it's flat!





Instructor's Role

- Relate new knowledge to existing knowledge
  - Clarify any misconceptions (e.g., "the earth is flat")
- Provide active opportunities for students to integrate knowledge

Activity #1

- Share with your neighbor some examples of constructivism in your education **(5 min)**
- Discussion (**5 min)**
  - What are the strengths and weaknesses of …
  - How does … affect … ?
  - Explain how … helped you learn.
  - What types of learners is constructivist-style learning appropriate or not for?

Active Learning

- A **practical framework** for Constructivism **theory**

Defining features of active learning:

- Thinking deeply about something (analyzing, synthesizing, evaluating) rather than passive listening or memorizing
- More problem solving than passive learning

How does Active Learning occur?

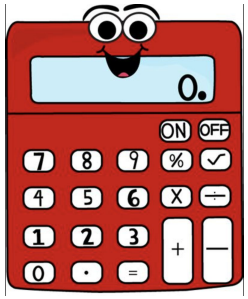
Active learning rarely occurs spontaneously, even in a very interactive environment like video games.

Some structure / guidance needs to be provide to “activate” the learning process!

Let's learn some computer system stuff

Classical Computers

How it started



How it's going

AI-generated images

Self-driving cars

Search engines

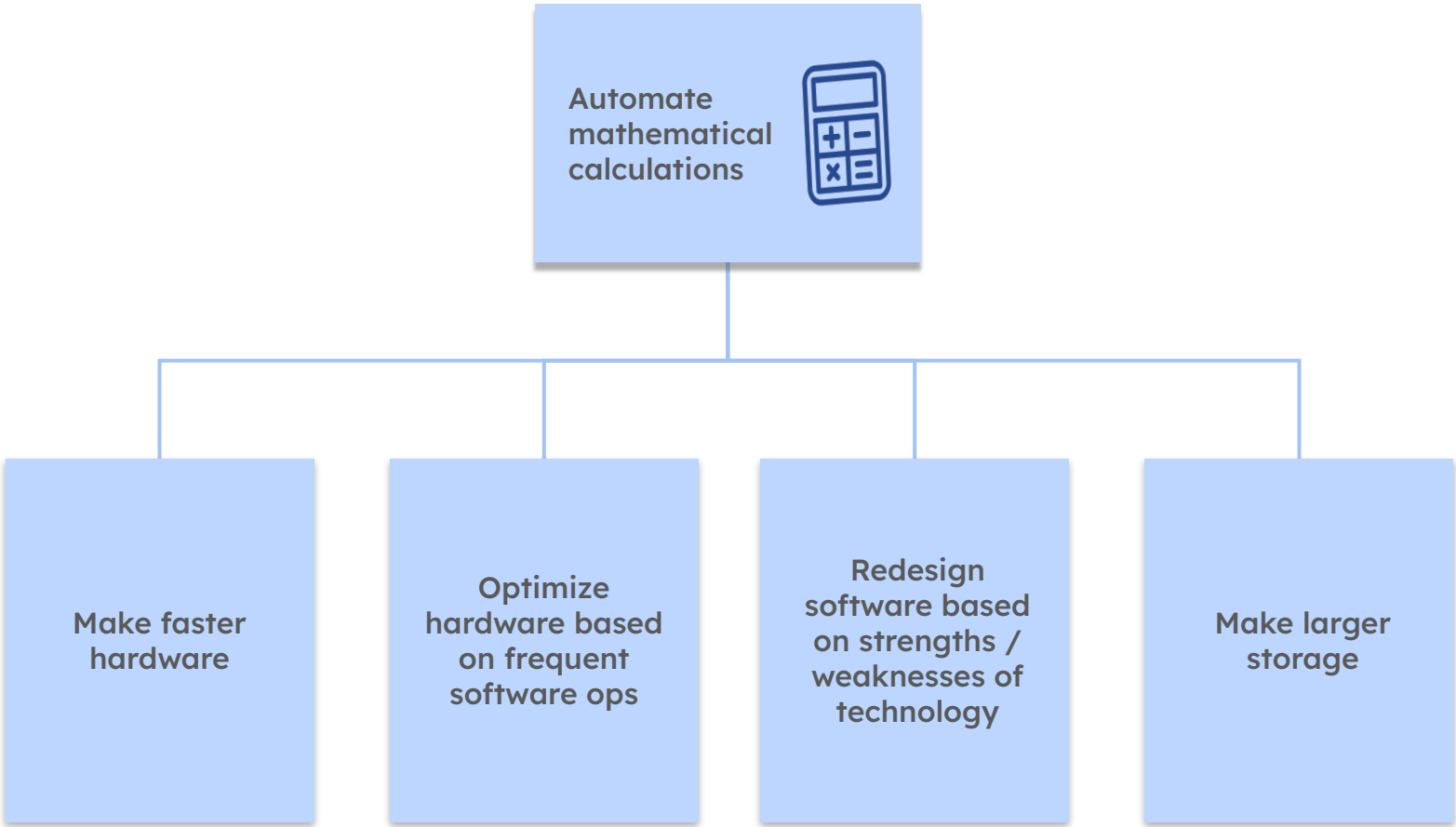
Genetic Analysis

Video games

Smartphones

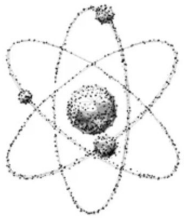
What are ways you use computers?

Historical Perspective: Classical Computing

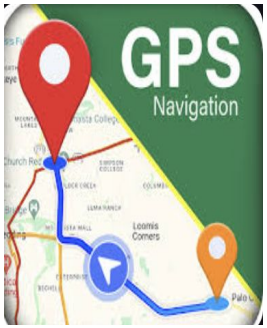


QUANTUM

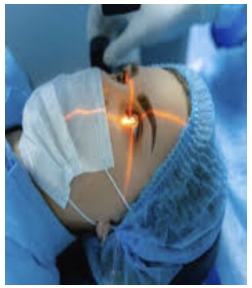
How it started



How it's going



GPS



Lasers

Small computers

MRI machines

The behavior of **thousands of atoms** that we observe with our eyes does not capture what happens in **individual atoms**

Quantum Computers

Wow! Look how *individual atoms* behave!

Look at all the *cool stuff* we can make!

Could we *compute* with it?

What can we compute *faster* than classical computing?

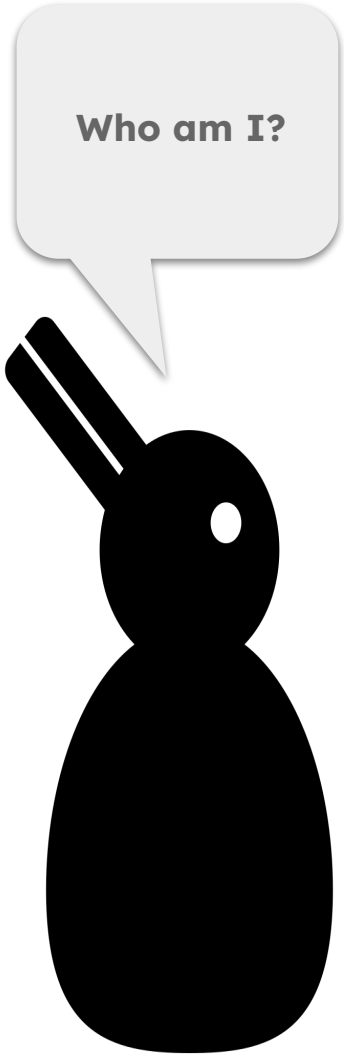
Quantum Computing: a hammer… looking for a nail!

Quantum Connection: Superposition

- Did everyone always agree on the meaning?

Each drawing has many possible interpretations.

In quantum science, **superposition** is when something has multiple possibilities at the same time.



Quantum Connection: Uncertainty

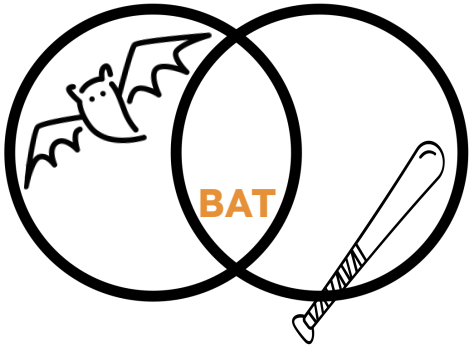
- When you looked at a drawing, did you ever feel unsure about how to interpret it?

This feeling is called **uncertainty**.

Quantum scientists experience uncertainty because they can't guarantee the outcome of something in superposition.

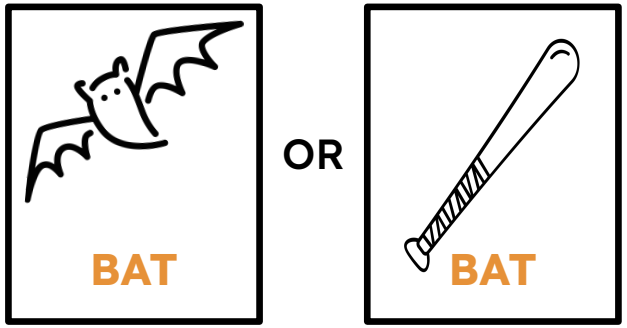
Quantum Connection: Measurement

When something in superposition is **measured**, it forces a decision to be made. After measurement, there is only ONE interpretation.



BEFORE MEASUREMENT

(superposition of two interpretations)



AFTER MEASUREMENT

(one interpretation)

Quantum Connection: Classical Computers

Classical computers use **bits** to store information.

➔ Bits can only store a value of 0 or 1.

Classical computers were designed to calculate “the correct” answer to a problem.

0

1

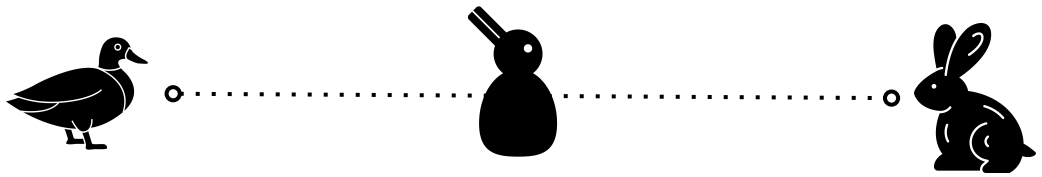
Quantum Connection: Quantum Computers

Quantum computers use **quantum bits** (**qubits**) to store information.

➔ Like bits, qubits can store a value of 0 or 1
➔ Qubits can hold a superposition of 0 and 1 at the same time!

Quantum Computers use **superposition** & related concepts to keep track of many possible solutions - AT THE SAME TIME!

But sometimes they get the WRONG ANSWER!



0 **0** AND **1** **1**

Activity 2: Quander

Play Qupcakery (10 min.)

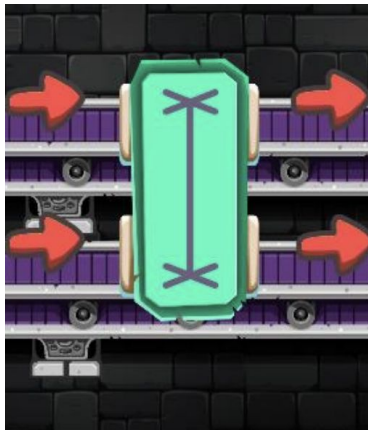
Molly: The main character of the Quander games. In Tangle's Lair she helps Tangle unlock doors by simplifying circuits.

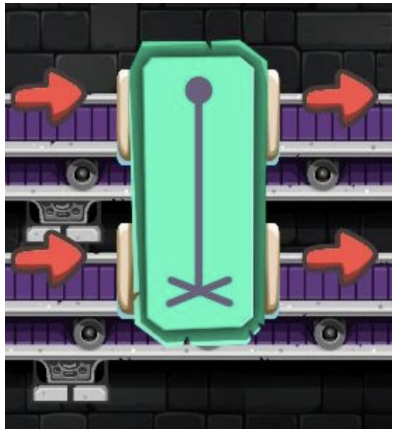
Tangle: Molly's best friend and cat. Caused an explosion while building a quantum computer and locked herself out of her lair.

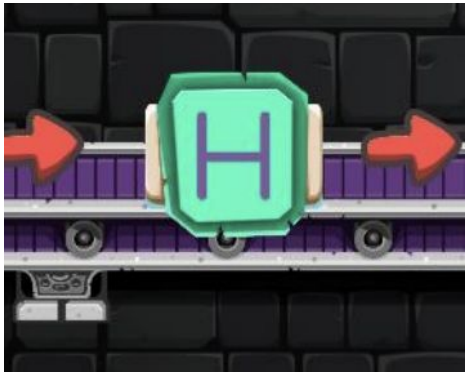
https://quander.cs.uchicago.edu/Lite

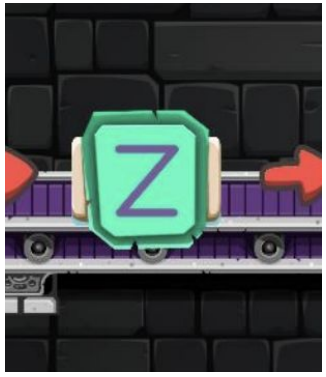
Activity #2: Quander Reflection

What have you learned from playing **Qupcakery**?









For you game design project

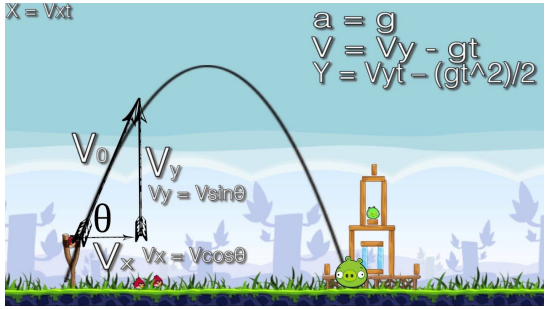
EMOTIONS

Evoked Emotions

LEARNING

Learning Outcomes

Acceptable Range



Authentic integration of learning into users' gameplay experience!

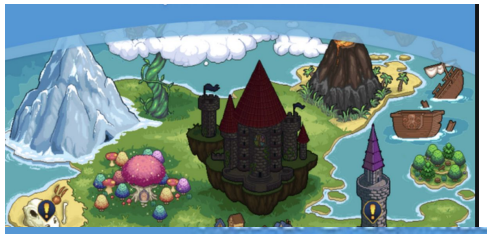
Inauthentic Integration: Prodigy

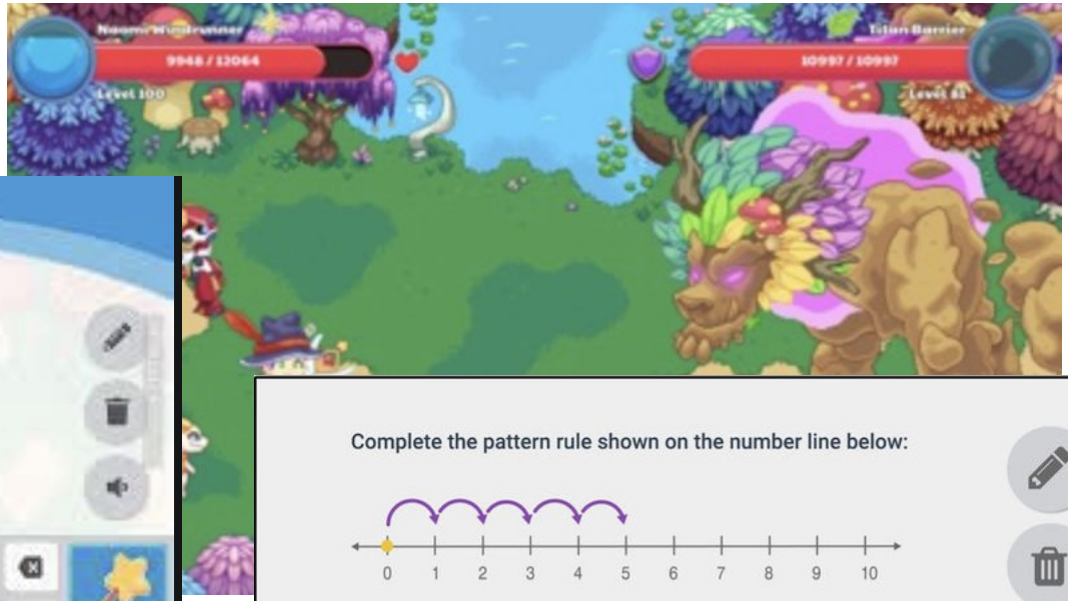
Pokémon-style game: Players act as wizards, exploring a fantasy world, catching pets

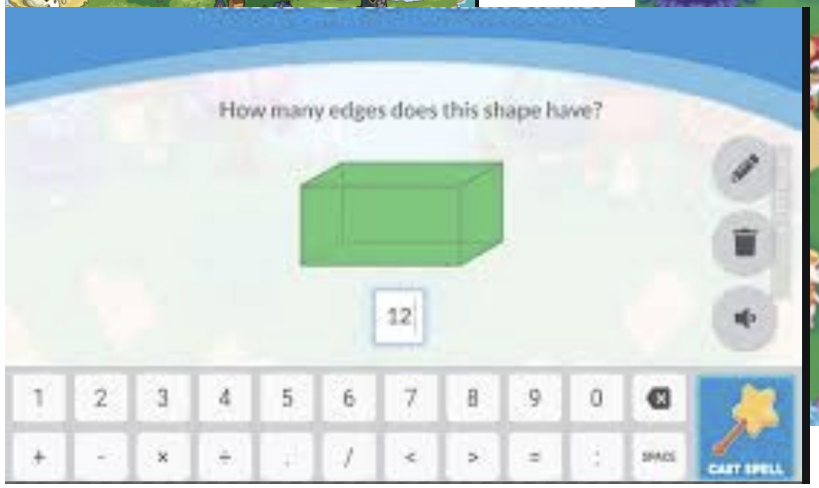
Inauthentic Integration: Prodigy

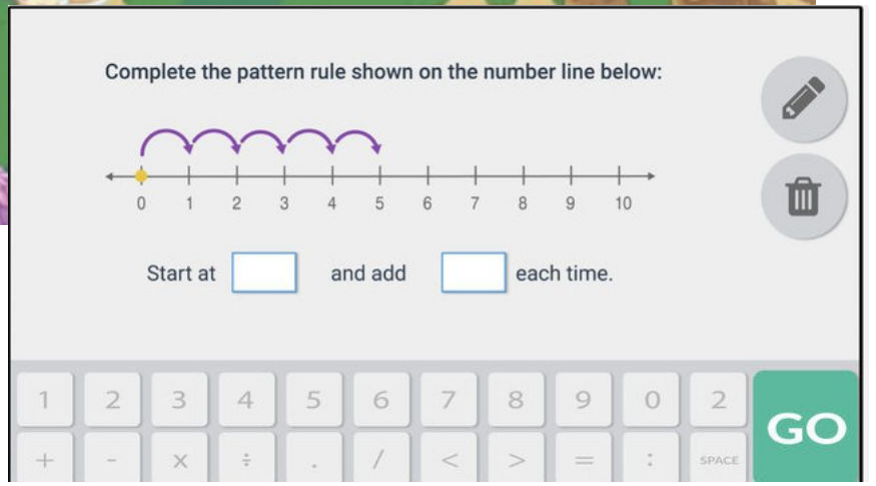
Inauthentic Integration: Prodigy

Inauthentic Integration: Prodigy









Combat by solving math problems :)

Theory: Flow (“in the zone”)

Definition: A psychological state in which individuals become *fully absorbed* in an activity, experiencing *optimal engagement and enjoyment*.

When does flow occurs? A task is difficult enough to stretch one’s capabilities without causing them to feel overwhelmed or anxious.

Mihály Csíkszentmihályi (1975)

Theory: Flow (“in the zone”)

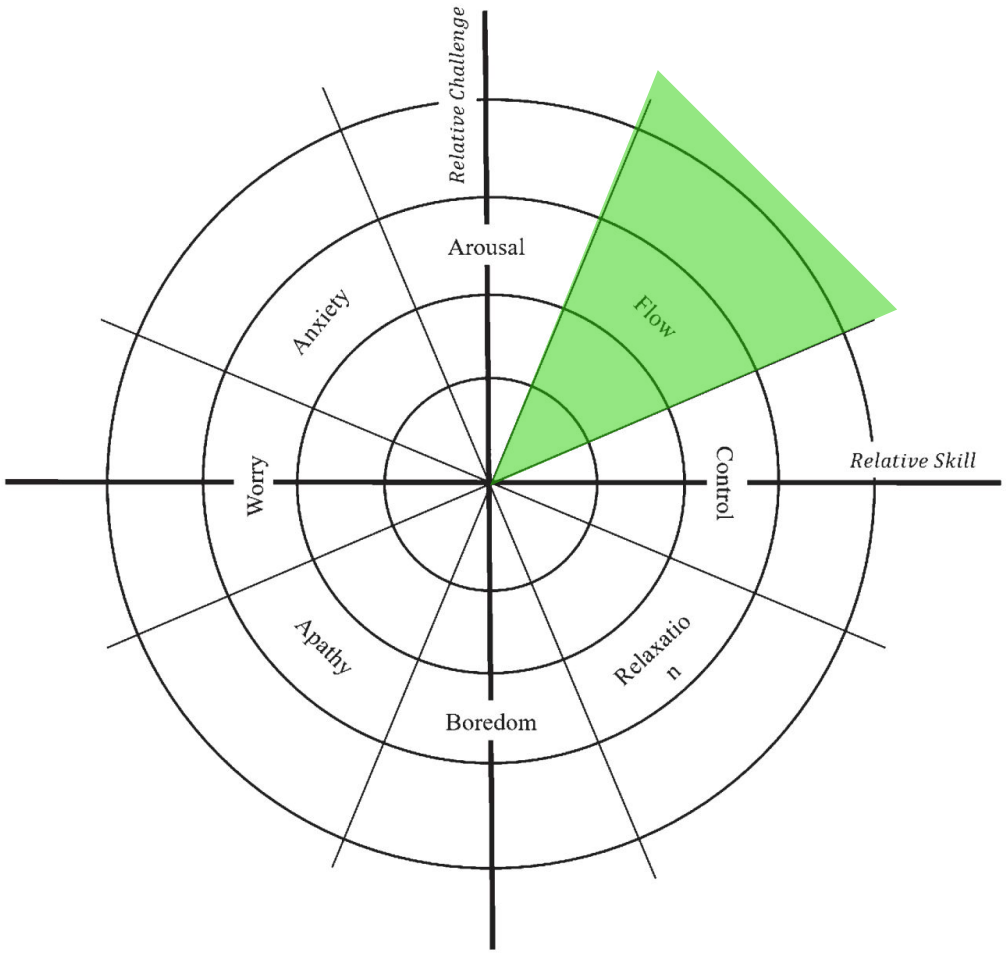


Figure 1: The Eight Channels of Flow Theory.

Figure from Acland (2020)

Key components of a Flow experience

1. Challenge-skills balance
2. Action-awareness merging
3. Clear goals
4. Immediate and unambiguous feedback
5. Concentration on the task at hand
6. Sense of control
7. Loss of self-consciousness
8. Autotelic experience
9. Transformation of time

How games achieve different components of flow? (challenge-skills balance)

- Multiple difficulty modes (easy, medium, hard, expert)
- Feedback mechanisms (e.g., rock meter, a score multiplier, a star power meter, sounds, visuals)
- Rewards (e.g., points, stars, in-game money, and unlockable songs)

A: Highway
B: Score/Multiplier/Combo Meter
C: Star Power Notes
D: Chord
E: Rock/Star Power Meter

How games achieve different components of flow? (clear goals)

- **Overarching goals:** Can win in one of four ways, but gaining a Domination, Science, Cultural or Religious Victory
- **Micro-goals:** Many small goals to achieve and track throughout the game (e.g., keep your citizens happy, unlocking key technologies, using spies to steal tech)
- **Clear feedback mechanisms:** visual indicators, tooltips, notification, audio cues

Activity #3

Get together with your project group members to brainstorm some potential features you could use in your game to keep players “in the zone”.

If you work solo, get together with someone who also work solo.

Resources: https://tinyurl.com/GameFlowArticle