Integrating STEM using
An Iterative
4 step Experiential ID Process
(4xEID)

Presented by

drBOB Appelman

*http://www.Indiana.edu/~drbob*

STEM LEARNING OBJECTS

- Design **Play Objects** for HS Science Experimental Center (Outside or Inside)

- Students will couple learning with these objects and coursework in STEM

- i.e. students will need to **manipulate and make decisions** using all the STEM skills

STEM LEARNING OBJECTS

- You've see these type of **play objects** before:
  - Children's Museums, and Science Museums
  - SciPlay
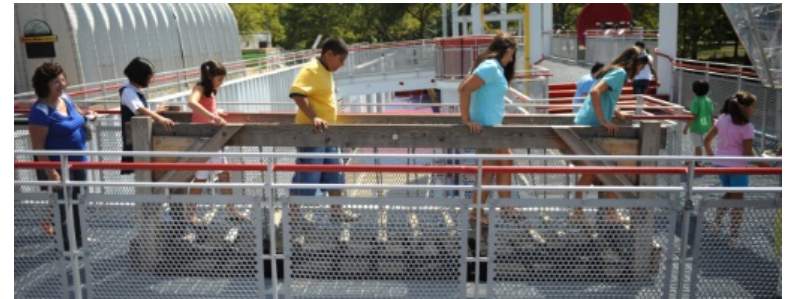
STEM LEARNING OBJECTS

- with the majority of these activities the learner finds them interesting and fun, BUT, the learning (or "take-away") is low

- This is because the **mechanics** of using the play object are designed for a short time-on-task, and with an expectation of reaching a relatively low level on the *Bloom, Krathwohl, Harrow Taxonomy Scale*

STEM LEARNING OBJECTS

Now let's get started!!!

An Iterative
4 step Experiential ID Process
(4xEID)

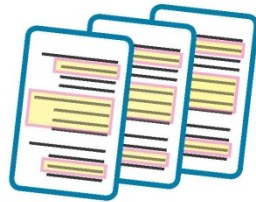# 4 STEP EXPERIENTIAL ID PROCESS

1

DEFINE & PRIORITIZE
GOALS

Define the **Needs** & **Goals** of the individual, student, group, teacher, community, organization, or institution.

2

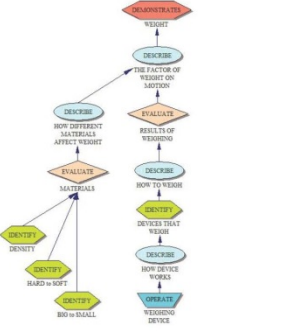## OPERATIONALIZE
CONTENT

Create a **Content Hierarchy**, **Prioritize** and **Target Levels of Learning**, and establish **Sequencing Flows**

3
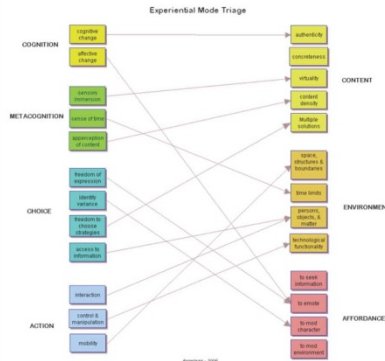
BRAINSTORM & MAP
EXPERIENCES

Brainstorm effective **Experiential Modes** for each **Learning Context**, & embed **Scenarios** & **Action Vectors**

4

OPERATIONALIZE
SCENARIOS

Create **Experiential Scenarios** that combine both **Action & Learning Vectors**; then build **Prototypes** and **Test**

Appelman 2011

Master Design Chart
Stakeholder GOALS

Stake Holder	1. RECALL	2. UNDERSTAND	3. APPLY	4. ANALYZE	5. SYNTHESIZE	6. EVALUATE	IMPORTANCE
INSTITUTION	2	5	5			5	17
							0
INSTITUTION UNIT	2	2	4	5	5		18
							0
UNIT MEMBERS			3	3			6
							0
CLIENTS			4			2	6
							0
SUBJECT-MATTER EXPERTS				5	5	5	15
							0
STAFF / FACULTY	3	5	5	5	5	5	28
							0
MANAGEMENT	2	2				4	8
							0
OPERATIONAL TEAMS	4	5	5	5	5		24
							0
OPERATIONAL SUBGROUPS	2	2	4	4	4	4	20
							0
INDIVIDUALS/USERS	2	5	5	5	5	2	24
							0

Master Design Chart CONTENT

	KEY CONCEPT	Action Verbs used in TASK description	1. RECALL			2. UNDERSTAND			3. APPLY						CONTENT TOTALS
		CONTENT	A	B	C	D	E	F	G	H	I	J	K	L	TOTALS
			IDENTIFY	DESCRIBE	RECOGNIZE	DISTINGUISH BETWEEN	GIVE EXAMPLE	PREDICT	DEMONSTRATE	DISCOVER	OPERATE	IMPLEMENT	COMPUTE	OUTLINE	
4	OBJECTS:	Big to Small	2	1		2									5
5	OBJECTS:	Hard to Soft	1	1		2									4
6	OBJECTS:	Density	3	1		2									6
7	MATERIALS:	Their EFFECT on WEIGHT		3				5	2						10
8	MATERIALS:	DIFFERENCES in SIZE		3				5	2						10
9	WEIGHING TOOLS:	Appropriate SCALE	1		1	1				1		2			6
10	WEIGHING TOOLS:	Functionality of Tool	1		1	1				1		2			6
11	WEIGHING TOOLS:	UNITS of Measure	1		1	1				1	3	2			9
12	WEIGHING TOOLS:	TOOL Operation		1							3	2			6
13	WEIGHING TOOLS:	Reporting Results		1								2	3		6
14	FALLING OBJECT:	UNITS of Measure	1		1	1				1		2	3		9
66		LEVEL TOTALS	79	110	98	104	116	78	61	102	6	21	40		

Content Hierarchy

Game Mechanics: Actions 3 4

(#)	**STATIC**	• When a player first enters a scene • When a player must analyze the situation • When a player is busy looking, listening, or reading • When a player is "outside" the game
(#)	**INPUT**	• When a player hears and understands audio • When a player reads and understands text • When a player interacts with people, places, and/or things that provide meaningful information
(#)	**STRATIGIZE**	• When a player encounters new information or experiences, and stops for metacognition or strategy formation • When a player enters into interaction with other elements within the game and then initiates action based on that information • When the path of action can be observable as a pattern that suggests a strategy
(#)	**ACTION**	• [Action Vector] When a player takes action to move within the environment, to interact, to emote, to fire weapons, or in general anything observable that the player does • [Learning Vector] When a player takes actions that correspond to progress within the game that match those goals within the Master Design Chart
(#)	**T & E EXPLORE**	• When a player is moving randomly or unpredictably within the game environment • When a player is looking for something and must search in a number of locations
(#)	**INTERACT**	• When a player interacts with people, places, and/or things • When a player touches, picks up, or stores items in the environment • Interaction may range from shooting, throwing, hitting, touching, confronting, dialoging with, driving a vehicle, or simply moving along side or following another character.

Game Mechanics: Rules

- **GOAL:**
- To work through the operation of the play object as quickly as possible
- To determine the most appropriate strategy to execute the operation of the play object
  - Analyze the physics involved
  - Analyze the way the physics were engineered
  - Determine which math formula should be used
  - Determine how to operate the technology to execute the appropriate solution
- **TURN** (per player):
  - 1. Choose an individual, group, or competition play mode
  - 2. Follow instructions that are posted for each mode
  - 3. operate the technology to receive input items into the main control interface
  - 4. initiate the execute button
  - 5. analyze the results observed
  - 6. replay from #1 if desired

Play Object : Newton's Law of Motion

- **A sphere is supported by a long wire creating a PENDULUM**
- **The sphere may be raised and held at the end of it's path by a magnet**
- **When the magnet is released the pendulum swings**
- **Estimate where the pendulum will swing to at both ends**
- **Add a slight force at the beginning of the swing and estimate how this will change the path**

3

4

	INPUT	1. Observe the instructions on the control board
		
		2. On the LCD screen: is a formula $T = 2\pi\sqrt{1/g}$
		    a) and formula **g = (9.8 m/sec)²**
		    b) **Π** = _____
		    c) Period(T) = 2 X π X **SQ Root** of the length of the pendulum (_____) / g

	ACTION	The player uses the on-screen calculator to enter the numbers into each space of the formula and receives an answer when s/he selects (SUBMIT)
	INPUT	The PENDULUM SWINGS and an indicator displays the time it took for the ball to travel the distance (d²).

Play Object : Waves, Time, & Measurement

- **In a RIPPLE TANK, periodic waves are being generated from the center**

- **Using a STROBOSCOPE, adjust it's frequency until the waves appear motionless**

- **Determine the correct frequency and enter it into the formula**

- **Calculate the speed of the waves**

Play Object : Space & Measurement

- **Determine the height using TRIANGULATION**
- **Determine distance from object**
- **Enter the distance into the formula**
- **Sight through scope to determine angle**
- **Enter the angle into the formula**
- **Find and enter the *tanget* of the angle**
- **Enter the result of the formula**
- **Submit the result**

3

Play Object : Functions & Scaling

- **Using the INVERSE-SQUARE relationship, calculate light intensity on a flat surface**

- **Based on your calculations from the data presented; Move a surface between two lights to a position where the light intensity on one side is 4 times the intensity of the other side.**

- **Submit when ready**

Play Object : Motion Along a Path

- **Two objects travel at different speeds**
- **The faster object stops for a short period**
- **Calculate which object will arrive first from the data provided**
- **Submit your answer**
- **press the run button**

Play Object : Vectors

- **From a high platform,
2 equally shaped balls drop**

- **One ball is 4 times the density of the other**

- **One ball is projected sideways**

- **Calculate when the balls
will reach the bottom**

- **Calculate how far away from the platform
the projected ball will fall**

CONTENT   LINKS

3

Play Object : Mass, Elements

- **Determine the DENSITY, VOLUME, and MASS of 3 objects of different size and material**

- **Estimate the results of placing each into a vat of water**

- **Place the objects into the vat**

- **Record the results and compare to your estimate**

Play Object : Nature of Gas

- **A cylinder is filled with gas and enclosed by a PISTON attached to a platform**

- **As weights are placed on the platform the piston lowers in the cylinder and compresses the gas**

- **Calculate the pressure increase,
  from the data presented,
  for each weight**

An Iterative
4 step Experiential ID Process
(4xEID)

drBOB Appelman

http://www.indiana.edu/~drbob