

During my talk about Problem Solving, educators will **hear** what I say, and will **see**...

- a **Talk-Power Point** with Just Enough Information to make it useful **during** a talk, and I will tell them about (and will “link to” in the Talk-Ppt) **two other info-sources**:
- a **Details-Power Point** with Plenty of Information; many slides have so much info that they won't be optimal **during** a talk (it's TMI) but these slides will be useful for deep studying **after** a talk, to help attendees construct deeper understandings, and
- **sections in the HomePage** of my website about **Education for Problem Solving**.

This is a **different kind of PowerPoint**. It's a collection of “samples” from the Details-PowerPoint. These are intended to help you understand some of the main ideas in my talk, including the two themes in its title,

Integrate Design Thinking with Science Thinking,

Build Transfer-Bridges (between School and Life) to Motivate Students

so when you're evaluating my talk-proposal you will recognize the careful thought I've invested in developing a coherent system of innovative ideas that I'm confident will help us improve our Education for Problem Solving, so I want to share the ideas.

The “sample-slides” are imported from a **Details-PowerPoint** and most have TMI, therefore...

iou – During March I'll build a stronger foundation with the core-ideas and logical structure in my website-**HomePage & Overview-PowerPoint**. **In April, I will make a Talk-PowerPoint** so I'll have time to revise-and-improve it before June, to make it more useful for sharing my innovative ideas in ways that will effectively communicate with fellow educators.

My bio says "I'm an enthusiastic educator (with a PhD in C&I) who wants to find co-enthusiasts." Therefore I want to begin my talk so participants are thinking "this will be exciting-and-fun."

I want them to become more enthusiastic, more excited about *learning* — including what they will be learning in my talk — and *teaching*. In our talk-proposal, you asked us to "describe the journey participants will take during your session. What will they do, what will they learn, and how will you ensure they are active contributors rather than passive observers?" I said...

We'll "begin before the beginning" with an on-screen slide showing two key features of my model for Design Process, and **a Mystery Question, and a tip for Discovery Learning** (study the diagram!) while I'm [walking among them and] asking "have you solved The Mystery?" and "what are the key features?" to establish a feeling that "**this will be exciting and fun.**" At the starting time, I will ask everyone the questions, and will supplement Their Discoveries with My Explanations, to show how **The Mystery Answer is a third key feature**. I'll continue explaining the model, along with a claim that it accurately describes the process used for "most of what people do in life." In a Friendly Challenge, I'll ask them to Evaluate (is it more justifiable to claim "most" or just many, some, or none?) and to Generate examples for why it isn't "all". They will discuss in small groups, then in the whole room. I'll explain WHY, because The Wide Scope lets us build motivational Transfer-Bridges. And the adventurous journey will continue.

Their Journey will "begin before the beginning" with an on-screen First Slide (choosing this is my focus in the next 4 slides) followed by explaining how "The Mystery Answer is a third key feature."

The next three slides are options I'm considering for the first slide of my talk. All are variations on the same theme, differing in their descriptions of Discovery Learning & Recognition Learning and (more important) because the 2nd & 3rd slides add a **hint** that will make The Mystery easier to solve, thus tending to reduce the satisfaction of solving it. But the hint will make it solve-able by more people, so more will experience the satisfaction of solving it. My decision about how to weigh these factors (that are in-conflict) will affect the "Journey" if I do a talk for STEM Innovation Summit.

Producing an "optimal balance" (between challenge and probable success) is one of the important goal-criteria when writing a mystery story, or designing an instructional activity. In the HomePage of my website - Education for Problem Solving - and in my Talk-PowerPoint, I briefly describe two aspects of designing an activity that is fun for students. An activity can be...

FUN intrinsically when a student **enjoys the experience** because they think the Problem-Topic is interesting, and their own Problem-Solving Actions are interesting. This will stimulate their curiosity, can inspire a love of learning.

FUN due to personal satisfaction when a student **anticipates success, and does succeed**. We want to help students develop confidence with a growth mindset. For achieving this goal, one useful teaching strategy is to design activities with a "just right" **level of optimal challenge** as in a good mystery story, so students won't be bored (if it's too easy) or discouraged (if it's too difficult), so they will be challenged but **they will succeed and they will enjoy the satisfactions of success**.

If you want to Learn by Discovering: **study only the first slide**, and try to solve the Mystery; if necessary, **after awhile study the second & third slides**, and use the hints to stimulate your thinking.

To understand my model for **Problem-Solving Process**,

- do **Discovery Learning** by studying **words & colors**, and **spatial relationships** (in the **Top** and **Bottom**, find the Problem-Solving Actions),

- **Reflect-and-Recognize** by reflecting on **Your Actions** when you “make something better” to solve a problem, and you will recognize that **The Diagram-Actions** are **Your Actions**,

- and **solve a mystery**: Why does the Cycle have a right-side arrow, pointing from Evaluate to Generate?



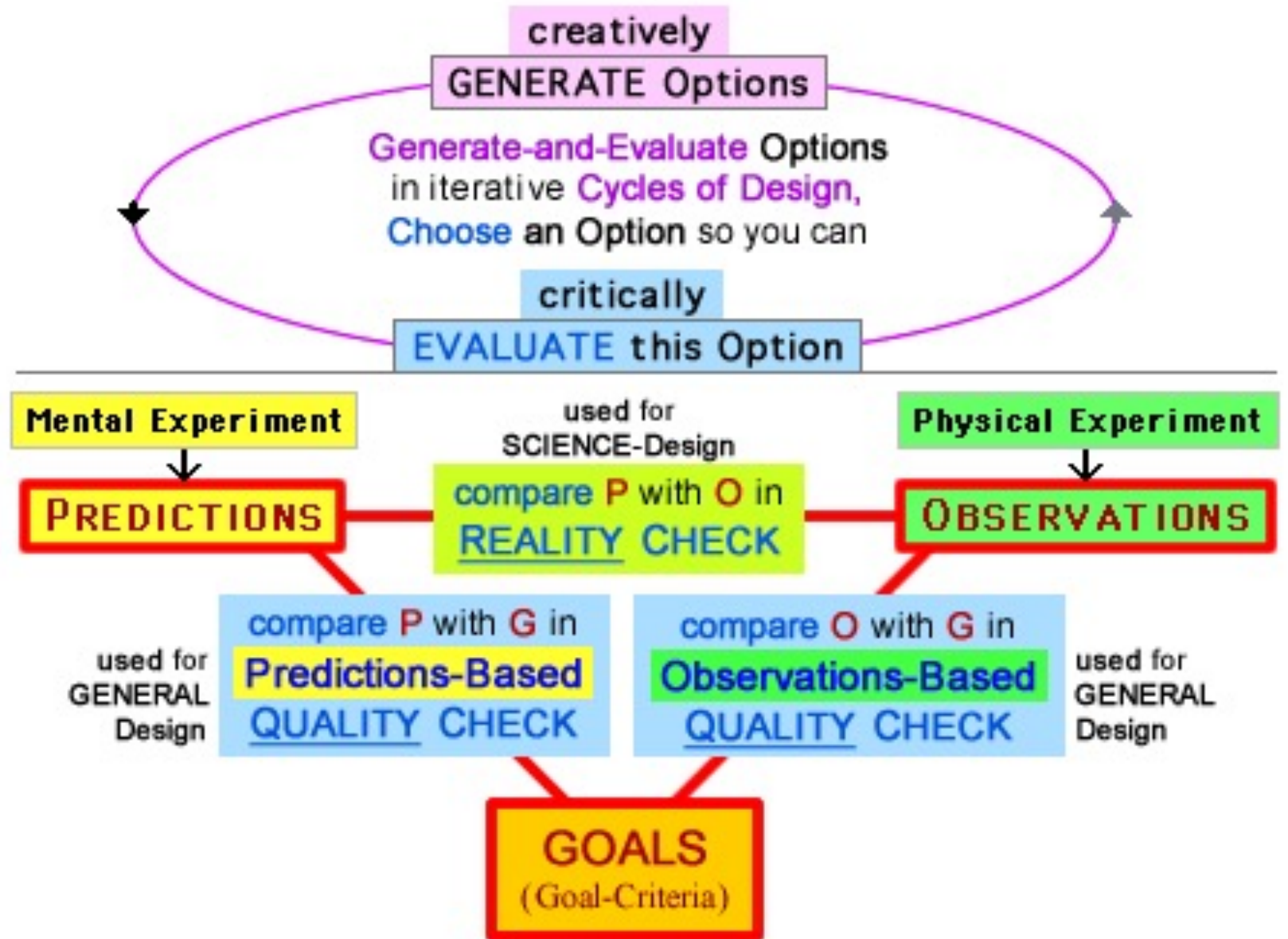
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- do **Discovery Learning** by studying **words & colors,** and **spatial relationships,**
- do **Reflect-and-Recognize:** reflect on your experiences, and you will recognize that **The Diagram-Actions** are **Your Actions,**

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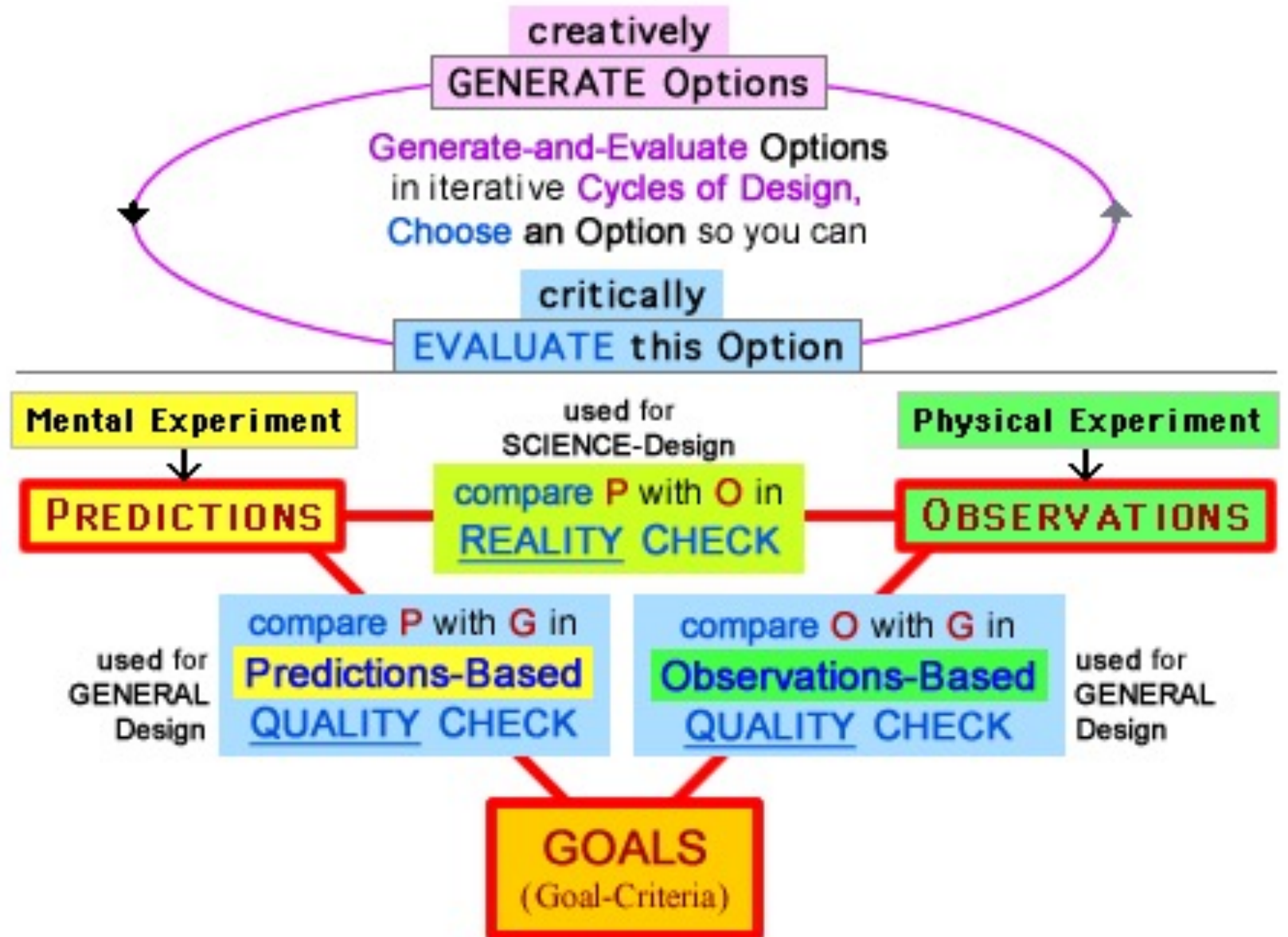
hint: What action is essential (and why) in the Top & Bottom? How does it connect these Parts?



I considered making a slide with the same info as above but with a stronger hint (it's below) but I soon decided that this would make it too easy to solve the mystery.

I could choose a First Slide by using only Predictions (now I would choose the 2nd Slide) but I also will use Observations — by asking people to study the 1st Slide and try to solve the mystery, then (if it's necessary) the 2nd & 3rd Slides — and this info will help me choose wisely.

hint: How do you respond if there is not a close match between Predictions & Goals?



Solving the Mystery: There is a right-side arrow (from Evaluate to Generate) because

in a Quality Check, IF there **is a close match**
between Predictions and Goals,
This Option has high Quality
(with Quality defined by your Goals)
so This Option might be a good Solution.

But what can you do if there **is not a close match**?

IF there **is not a close match** between Predictions and Goals, ask
“What are the mis-matches? what are the causes of mis-matching?”
and “How can I revise This Option to get a closer evaluative-match?”
and in this way your creative Generation of a New Option
is guided by your critical Evaluation of the Old Option, and it also
is motivated by Evaluation that shows a need to Generate a better New Option.

In a typical Cycle of Design
first you **Generate** and then Evaluate
(shown by left-side arrow); and (shown by right-side arrow)
later you **Evaluate** and then Generate,
to continue an iterative Cycle of **Generate-Evaluate-Generate-Evaluate-...**

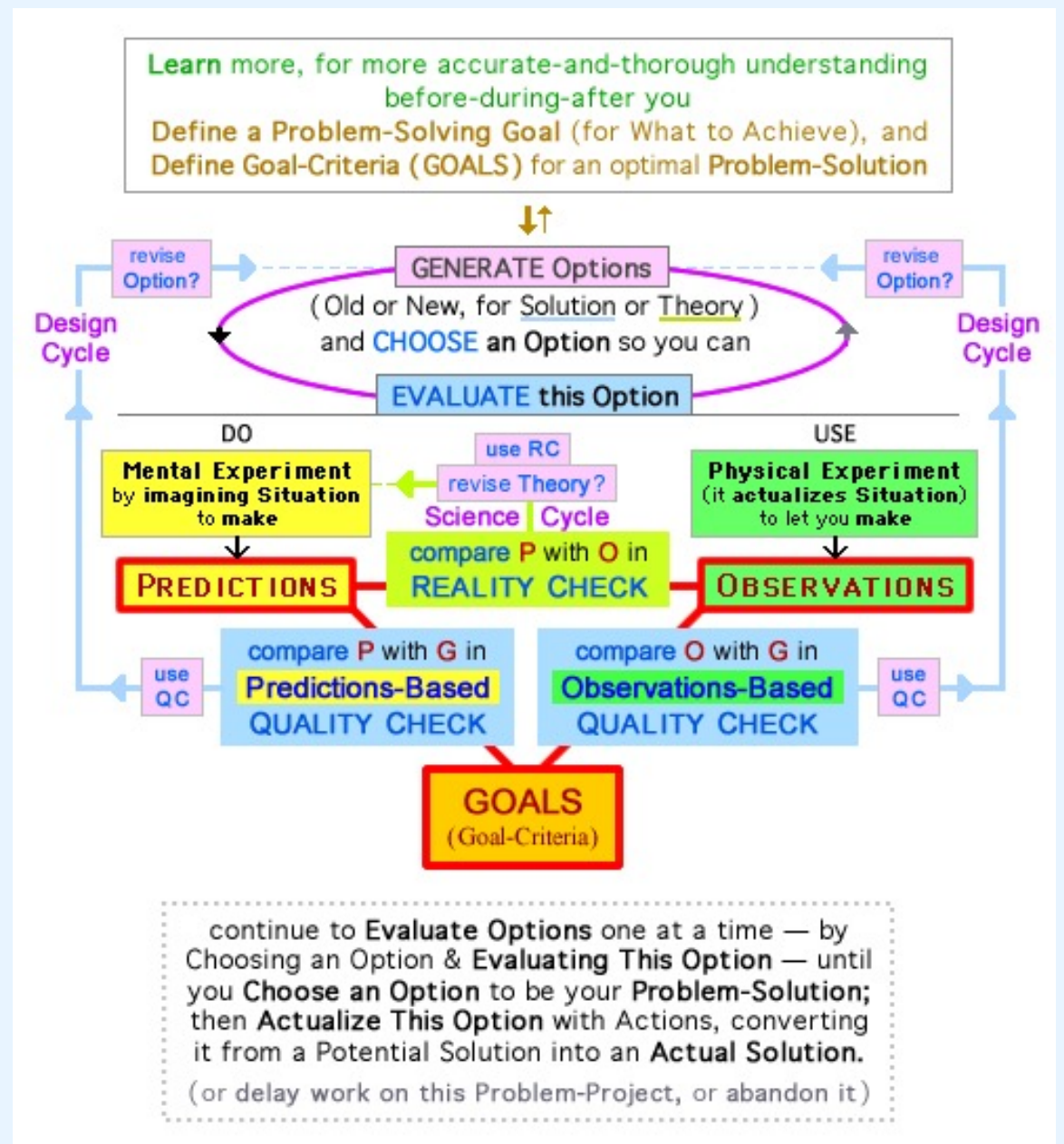
My full diagram for Design Process shows...

three major Problem-Solving Actions:

- 1) **Generate-and-Evaluate** in Design Cycles,
- 2) **Evaluate an Option** with 3 Comparisons,
- 3) use **QC**, ask "revise?" to **Guide Generating**.

- the **Top Box** shows PS-Preparations:
Learn, Define Goal & Define Goal-Criteria.
- the **Bottom Box** is Solving the Problem:
Choose an Option to be a Problem-Solution and Actualize it so it's an Actual Solution.

Well-designed **Teaching Strategies** can help students **Cope with the Complexity**, by **learning in steps** (so simple → complex) and “**Experience + Reflections → Principles**” plus **Discovery Learning** so **Inquiry-Principles** are learned by using an **Inquiry-Process**.



Above, the focus is on the First Slide in the **Talk-PowerPoint** for my talk. Below, the focus shifts to its **two-part Title** that summarizes **two themes** of my talk,
**Integrate Science-Thinking into Design Thinking,
Build Transfer-Bridges (between School and Life) to Motivate Students**

I'll briefly outline each part in the slides below. But explanations that are wider & deeper are in the **Details-PowerPoint** and in web-page sections about [Integrating Design with Science](#) and [Building Transfer-Bridges](#).

iou – during mid-March I will revise my Overview-PowerPoint, and then I'll link to it instead of the section below in [Slides 10-16](#).

Here is a “big picture overview” of 3 main topic-areas in my talk:

why Design Process has **two wide scopes** (for **Activities** & **Process**);
why the wide scopes **promote transfers** **Across Areas** & **Thru Time**;
how these transfers **are educationally beneficial** if we use them to
build bridges [from School into Life] **that increase motivation**
(I want to do) and **confidence** (I can do) with **growth mindset**.

learning my model for **Design Process** (for **Problem-Solving Process**);
metacognition (what it is & why it's useful, how Design Process can
help students develop-and-use **metacognitive Thinking Strategies**).

general principles of education & strategies for effective teaching;
designing C&I that can produce optimal Whole-Person Education.

The **background colors** of slides (**yellow, white, blue**) tell you the
topic-area, and **you can study the topics in any order you want.**

This slide summarizes most main ideas from the “yellow slides” topic-area:

my verbal-and-visual model for Design Process (for **Problem-Solving Process**) accurately-and-usefully describes the creative-and-critical **Process** that most people use for most of the **Activities** we do in most areas of life.

evidence-based logic (from *How People Learn*, NRC 2001) supports my claims that **these wide scopes** (for **Process** & **Activities**) increase **Transfers-of-Learning**, both **Across Areas** (between School-Areas, and **between School-Life & Whole-Life**) and **Through Time** (from Past to Present, and **from Present into the Future of students**); **these Transfers** (for Learning & Performing) are **educationally beneficial** by producing **Direct Benefits with Transfers-of-Learning** (Across Areas & Through Time) and also **Indirect Benefits with Transitions-of-Attitudes** (better **Motivations** & **Confidences**).

A student increases their **Motivations** when we help them build **Transfer-Bridges** from School into **their Life**, and from Now into **their Future**, so they are predicting that “if I improve my School-Life Now, it will (due to Transfers) improve my **Whole-Life Later**, and I want a better Life.” This helps them **develop a Growth Mindset**, so they **expect to improve their Learning** (Now) and **Performing** (Now & Later). They **WANT to improve** (with **Motivation**) and they **EXPECT to improve** (with **growth-mindset Confidence**).

results of **expectations**: When students **think** they will get
TRANSFERS of Knowledge-and-Skills
THROUGH TIME and **ACROSS AREAS**,
this can produce **TRANSITIONS** in **Attitudes**:

Past

PRESENT

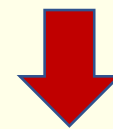


FUTURE

SCHOOL



my LIFE



MOTIVATIONS:

IF I improve **PRESENT** PS-Skills in SCHOOL,
these will be **FUTURE** PS-Skills in LIFE.

student expectations for two other kinds of Transfer
(for Past-to-Present, and Life-into-School)
can produce a Transition in an **ATTITUDE,**



CONFIDENCE

I've done PS-Process BEFORE in LIFE,
so I can do it NOW in SCHOOL.

Performing Goal = want best performing NOW.

Learning Goal = want best learning NOW

so you can improve best performing LATER.

Past

Present

Future

Learning
NOW



Performing
LATER

For example, a basketball team has a
LEARNING Goal in early-season practice,
PERFORMING Goal in late-season tournament game.

Why do I claim that **my model for problem-solving Design Process** has **two wide scopes**?

First, I broadly define a **Problem** as any opportunity to make things better in any area of life, so people do **Problem Solving** (verb) whenever **we are trying to** make something better, and we are **Problem Solvers** (noun) whenever **we actually do** make something better, so most of our Activities (in most areas of life) are **Problem-Solving Activities**.

Second, I'm confident that we **use a similar Problem-Solving Process for most things we do**, **AND that Design Process accurately describes this similar (but not identical) Process** **AND its description is useful** for helping students improve their Problem-Solving Skills.

These two wide scopes (for PS-Activities & PS-Process) let teachers design instruction that **increases two kinds of Transfers** (Across Areas, Through Time) and **helps us motivate students by building Transfer Bridges** (between School & Life, and from Past to Present into the Future), to produce **direct benefits** (with increased Transfers: **School ↔ Life** and **Past → Present → Future**) plus **indirect benefits** (with improved **Attitudes** in **Motivations & growth-mindset Confidences**).

Reflection & Recognition: Think about **your PS-Actions**. Do you typically **use Design Cycles of Generation-and-Evaluation?** (it's #1 in Slide 8) Do you (#2) **Evaluate an Option by comparing your Predictions** (of its Actual Characteristics) **with your Goal-Criteria** (for Desired Characteristics)? Is your **Option-Revising** (#3) sometimes **guided by mismatches between Predictions & Goal-Criteria?** { but sometimes these **Basic PS-Actions** should be supplemented { **why & how?** } by **Extra PS-Actions** }

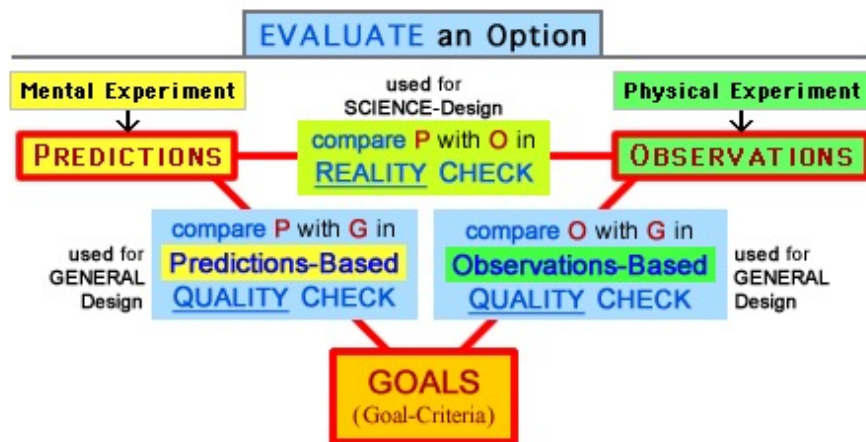
It can be useful to think about your **Problem-Solving Goal**
(it's **the thing you want to make better**, it's **what you want to achieve**)
in categories with “kinds of things” — for example, you can decide to **design** a better
product or **activity** or **relationship** or **STRATEGY** (in **General Design**)
or
a **theory** (in **Science-Design**).

With overlaps, your **Goal(s)** can be **activity-and-relationship-and-STRATEGY**, or
other combinations; many combos include a **STRATEGY**, for reasons explained in the next slide.

other ways to categorize: You may want to define another set of categories,
customized by you so it's a better fit for the students in your educational situation.
You want the PS-Goals to closely match the life-experiences of your students, so they
will recognize the personal relevance of school activities, and **will be motivated** by thinking
that “**my learning in School-Life will improve my Whole-Life** (= School-Life + NonSchool-Life)
and **I want a better Whole-Life, so I want to proactively pursue my own Personal Education.**”

The diagram below is an important part of my model for Design Process; it shows **3 Comparisons of 3 Elements**; this is the **WHAT** of the 3 Comparisons.

The right side explains two **WHY**'s.
 For a Quality Check, the Goal-Purpose (with answers for “why am I doing this? how does it help? what does it achieve?”) is “to ask The Design Question”.
 For a Reality Check, the Goal-Purpose is “to ask The Science Question”.



use **Quality Check** to ask **Design Question**,
 use **Reality Check** to ask **Science Question**:

With a **Quality Check** you are asking The Design Question,
 “how close is the match?”

when you compare

This Option's **Actual Characteristics** (Predicted or Observed) with the **Desired Characteristics** that you have defined as your GOALS.

It's a **Quality Check** because in this comparison you also are asking
 “how high is the Quality?”

with **Quality** defined by your **GOALS** (i.e. by your **Goal-Criteria**).

With a **Reality Check** you are asking The Science Question,
 “am I surprised?”

and you're answering “**yes**” if there is a mis-match when you compare **Predictions** with **Observations** but you answer “**no**” if there is a close match.

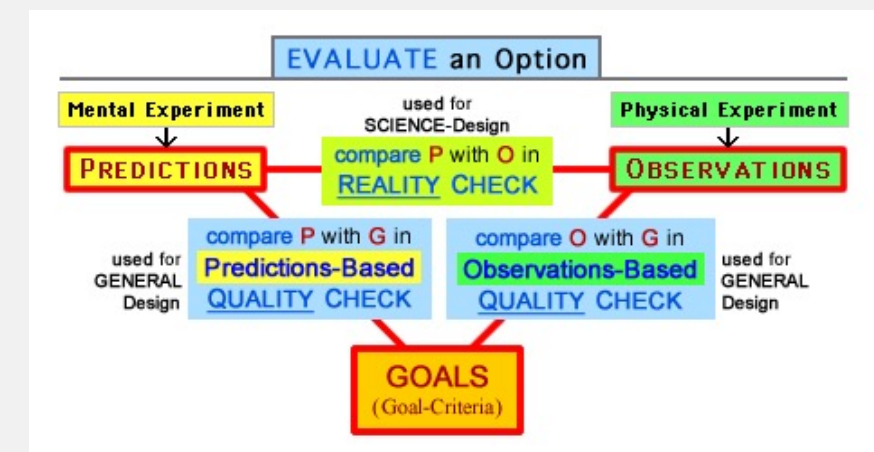
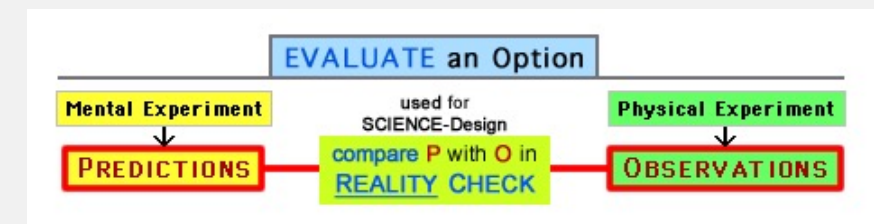
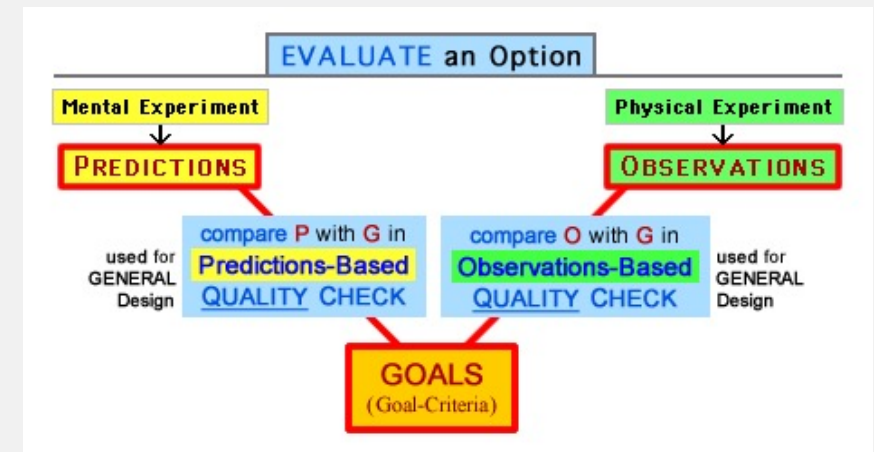
It's a **Reality Check** because it shows you how closely Your Theory about “how the world works” matches The Reality of “how the world really works.”

These diagrams show how we "Evaluate an Option" for
1a) Design-Only when we use two kinds of Quality Check,
1b) Science-Only by using a Reality Check,
2) Design-and-Science using Quality Checks + Reality Checks.

Most **other models-for-process** describe either **Design** (as in 1a) or **Science** (1b) but **my model for Design Process** has a logical integrating of Design-AND-Science, because **the core of its evaluation-logic (using 3 Elements in 3 Comparisons)** leads naturally to it being used for both **General Design** and for **Science-Design**. This is beneficial because when students understand the logical integrating of design-with-science in **my model** (and they internalize it) this helps them develop a logical integrating of design-with-science in **their thinking** while they're solving problems.

1a & 1b are "public domain" but 2 is (afaik) my invention.

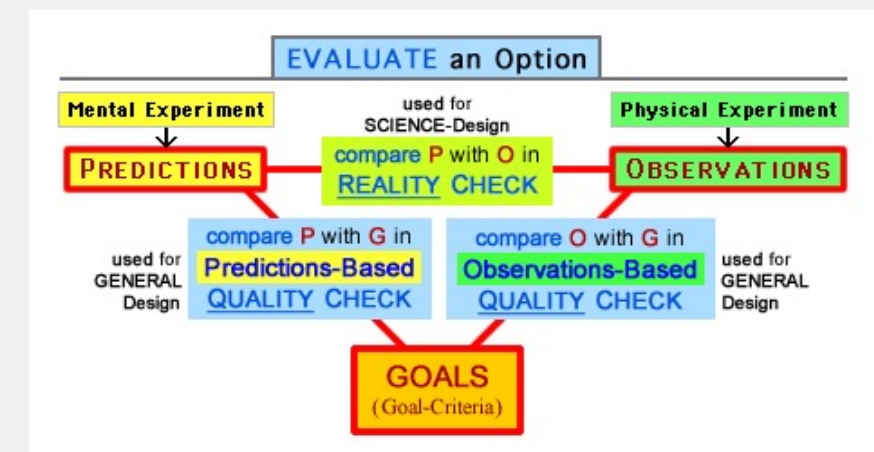
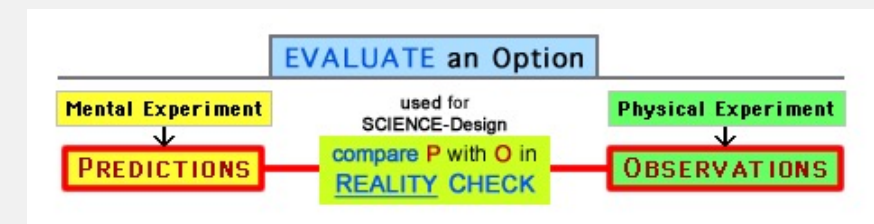
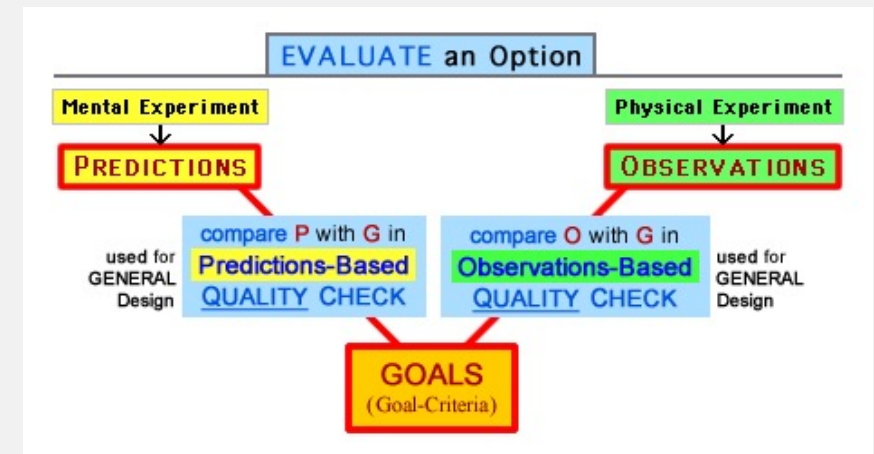
Teachers can design *activity progressions* (with 1a-and-1b, then 2) moving from easy-and-familiar to difficult-and-novel, to help more students – with wider diversity – do STEM.



The bottom diagram shows “3 Comparisons of 3 Elements” that people use while we Design Solutions for a Problem. Students can see the two comparisons that use Predictions, for a Quality Check (it's the focus of their Design Thinking) AND for a Reality Check (in their Science Thinking). When a teacher often reminds them to “use BOTH” this helps them develop a disciplined habit of **integrating Science-Thinking into their Design Thinking** with Science-during-Design that improves the effectiveness of the Design Process they can use to do most things in life. {we use Science Thinking in Science-during-Design, Everyday Science, Research Science}

This habit – of regularly testing their Theories with logical Reality Checks – is a practical benefit, helping students *make accurate Predictions* (so their Quality Checks can be accurate indicators of Quality) and *Design better Problem-Solutions*.

Research shows the effectiveness of activities when students make Predictions and get Feedback on their predictive accuracy; it also shows the instinctive pleasure (with increase of attention) we get when we make predictions and anticipate being correct.



It's useful to persuade students that “**active high-quality thinking**” will produce **INDIRECT Benefits** that will happen when students **are motivated with “active thinking” by imagining** that **what they are learning in School will Transfer Across Areas** (from **School-Life** into their **Whole-Life**) and it will **Transfer Through Time** (from their **Present** into their **Future**), so their **present School-Learning** will improve the overall quality of their **future Life-Living in ways they want**.

These **expectations** can **motivate a student** to pursue **Personal Education** that is **Problem-Solving Education** because its goal is “**making things better**” in **Their Life**. They see **Their Education** as a **Problem-Solving Project** (with a **PS-Goal** of “**making things better**” **later**) so they will proactively invest extra effort in **Their Education now** because **they are motivated by expecting that improving Their School-Life will improve Their Whole-Life in Their Future**.



This is an “extra section” that isn't part of the Proposal-PowerPoint.

My talk (and its **Talk-PowerPoint**) will begin with one slide for “**Discovery + Mystery**” but my **Overview-PowerPoint** will have — near its beginning, after an introduction to provide a “big picture” overview — **the longer set of slides (23-29)** you see below, **to guide your longer journey with Discovery Learning, and it will link to sections** (later in the Details-PowerPoint, and in my web-pages) **with my Explanations,** for people who want to learn more time-efficiently, to understand ASAP.
But a better “guide for Discovery Learning” is **[Part 1 of the HomePage](#)**.

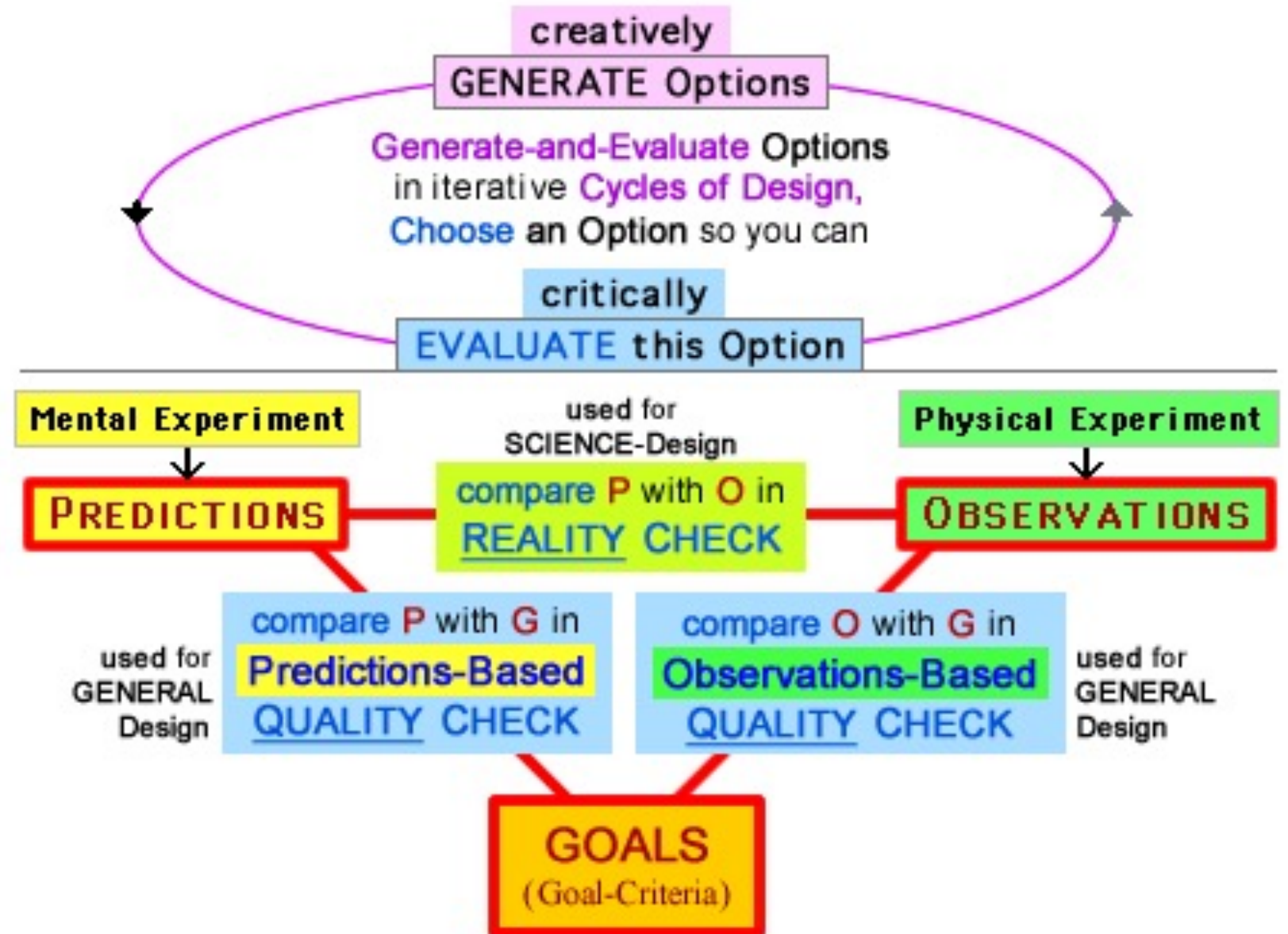
Discovery Learning:

observe (and think about) the words & colors, and spatial relationships.

Recognition Learning:

think about Your Actions when you “make something better” to solve a problem, and you will recognize that The Diagram-Actions are Your Actions.

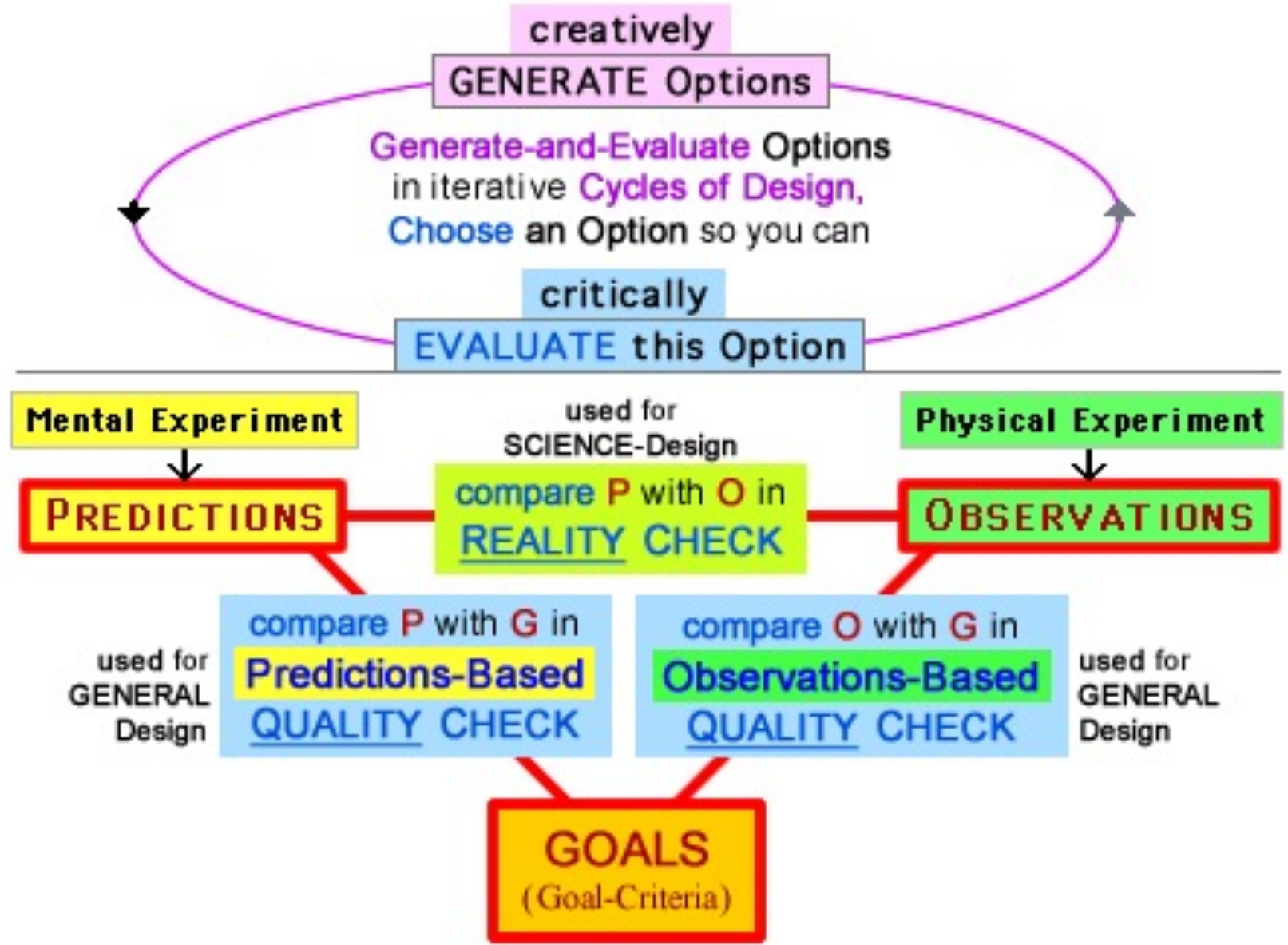
a mystery: In this model for **Problem-Solving Process**, why does the Cycle have a right-side arrow, pointing from Evaluate to Generate?



In **TOP Part** of diagram,
 what is the strategy
 for problem solving?
 In the **BOTTOM Part**,
 what is the goal-purpose
 for each comparison?

What action has an essential
 function (and what/why is it?)
 in Top Part & Bottom Part?

Why does the Cycle have
 an arrow on its right side,
 from Evaluate to Generate?
 hint: What is the functional
 connecting-of-actions between
 Top and Bottom? How does
 it explain what happens in **the
 arrow-action** on the right side?



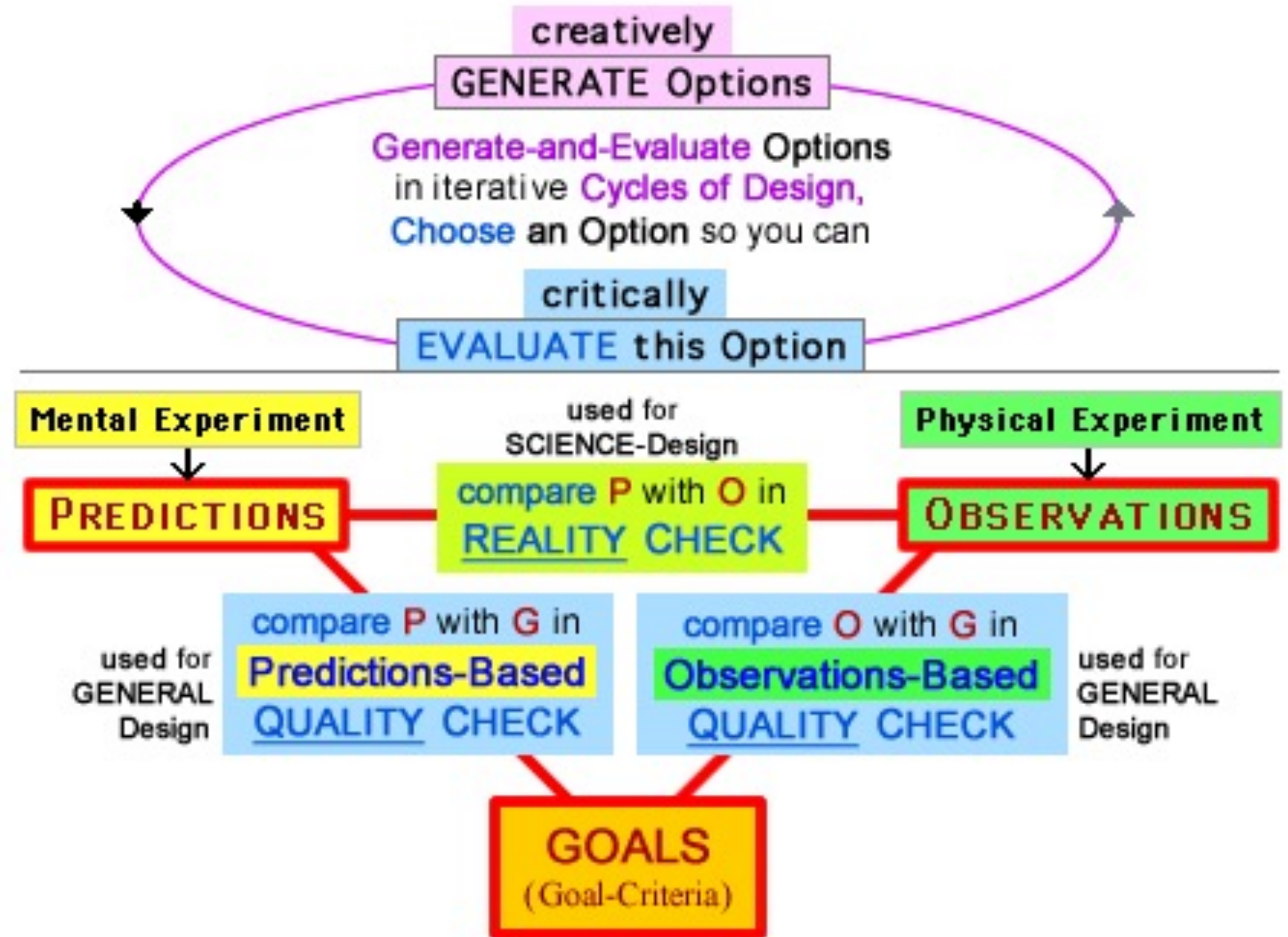
In **TOP Part**, main strategy is Generate-and-Evaluate Cycles.

In **BOTTOM Part**, goal-purpose for Quality Checks (in General Design) your purpose is to **EVALUATE the Quality** of an Option, with Quality defined by Goal-Criteria.

"**EVALUATE this Option**" is essential in TOP & BOTTOM, connecting the two Parts.

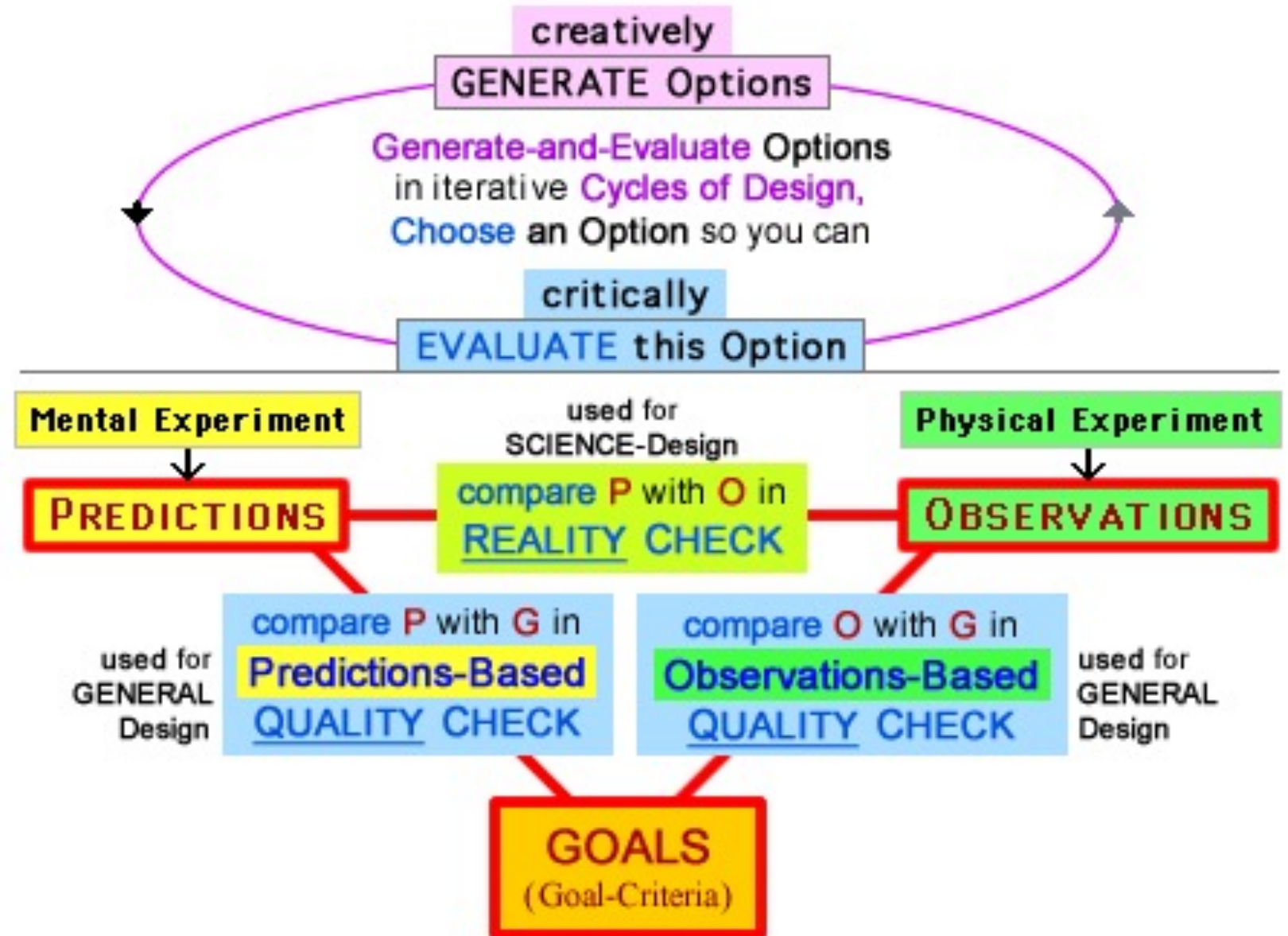
Why does **Design Cycle** have an arrow on its right side?

spoiler alert – This is a strong hint: After a comparative Quality Check, how do you respond if there is not a close match between Predictions and Goals?



The right-side arrow shows the Action of **Guided Generating** that completes a **Design Cycle**.

In the Problem-Solving Action of **Guided Generating** your Generation of A New Option is Motivated-and-Guided by the mismatch between Goals (for Desired Characteristics) and Predictions (of Actual Characteristics), by asking “how can I get a closer match so The New Option will have higher Quality?” In this way **your creative Generating** (by revising The Old Option) is **Motivated** (because you want higher Quality) and is **Guided** (in designing a better match) **by your critical Evaluating**.



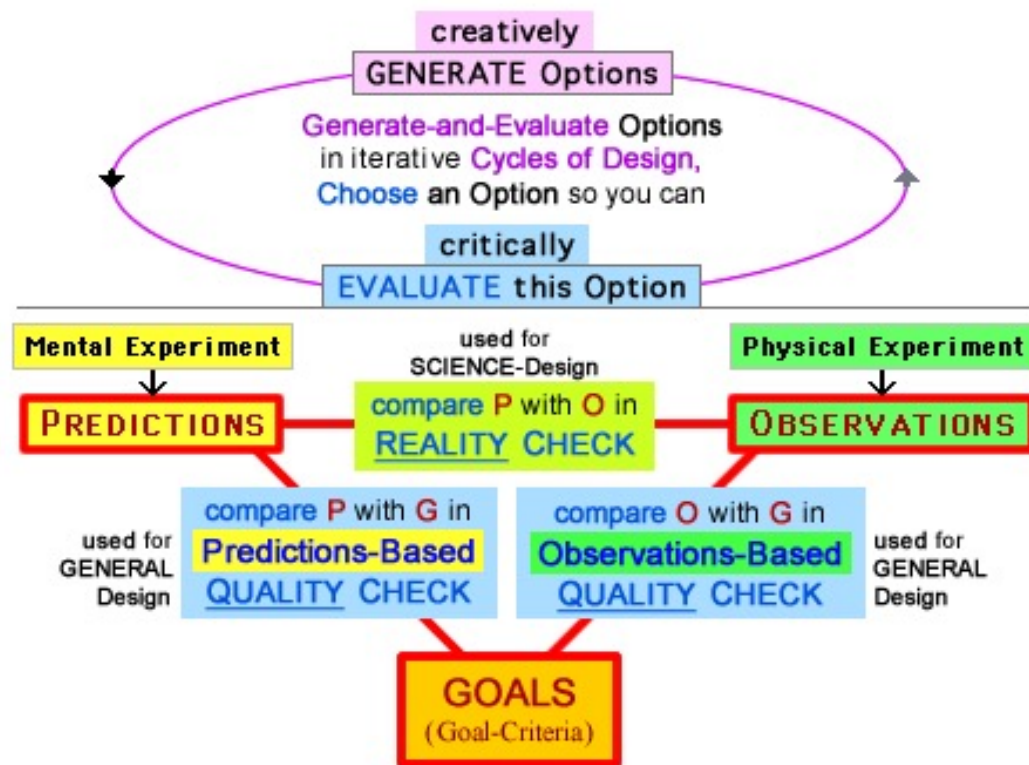


Do you see (in 2 slides above) how "Guided Generating that completes a **Design Cycle**" is The Mystery Answer?

To stimulate your Discovery Learning, **compare the diagrams (Left & Right) and ask questions**, including these:

- on the Right, what is added? or subtracted? [is each trivial (like changing a term to a synonym) or major?]
- what Problem-Solving Strategies – major and minor – are represented at the Left (Top & Bottom) and Right?
- what is the meaning and functional importance for each term-pair in "Old or New, for Solution or Theory"?
- on Right, how/why do my descriptions of Mental Experiments & Physical Experiments differ in three ways?

{ My responses – with answers & comments – are in the next slide. }



my terms: In the Left-Side Diagram, I call the Top Part "**Diagram 1**" and the Bottom Part "**Diagram 2**". On the Left Side these are combined to form "**Diagram 1+2**"; and on the Right Side is "**Diagram 3**".

When we **compare Diagram 1+2 with Diagram 3**, here are the main similarities and differences: Basically, **1+2 ≈ 3** (they're approximately equal with many similarities) but there are differences.

- no major Action (or concept) is “subtracted” **in Diagram 3**, but there are some **minor removals** {gone are "Generate-and-Evaluate Options in iterative Design Cycles", "creatively" & "critically", "used for GENERAL Design" & "used for SCIENCE-Design"} because I think you already know these (from studying Diagram 1+2) and you will “assume their continuing existence” in the new Diagram 3.
- a **semi-major addition** is "**Old or New**" because instead of “re-inventing the wheel” sometimes a good Solution-Option is just “using a wheel [as-is or modified]” that's an Old Option you remember, or you can invent a New Option; both Actions (use Old, invent New) are “creative” ways to Generate.
- a **semi-major addition** is "**Solution or Theory**" because we can Generate Options for a **Solution** (in General Design) and/or (in Science-Design) Generate Options for a **Theory** about “how things work.”
- a **MAJOR addition** (it's the third major PS-Strategy in Design Process, the Guided Generating that is described in Slide 11) is the "Design Cycle" (on Left Side & Right Side) that occur when you "use QC" to ask "revise Option?" so Evaluation motivates-and-guides you to Generate a New Option.

more: You can learn from **Your Discoveries** and **My Explanations**. This set of slides (22-29) uses both, and if you want **Less Discoveries & More Explanations** so you will understand more in less time, ASAP, you can use sections (later in the Details-PowerPoint and in my web-pages) that help you learn quickly.