Catalyst Teaching

High-impact teaching techniques for the Science Classroom

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Introduction

What is Catalyst Teaching

I know what you're probably thinking. You're thinking this is going to be another one of those workbooks saying you have to teach in a "whole new way". But guess again! If you're reading this workbook, you obviously care about your job, and I'll bet you're already pretty good at it. You know how to teach. You've had years of training and probably years in the classroom. You know your kids, your classroom environment and your curriculum. You have lots of good lessons and many that are great. You've been through it all. You need another model of teaching like you need lunch duty.

So to put your mind at ease (and to get you to keep reading!), let's first talk about what Catalyst Teaching is *NOT* It is *not* a tirade telling you that you're doing it all wrong. It does *not* recommend you scrap your lesson plans. It does *not* insult your intelligence by suggesting that it's the salvation of science education. Quite frankly, as a good teacher, you're probably already using most of the techniques described in this workbook, and will hopefully view them as common sense.

The only problem with common sense is that it isn't common!

So why should you keep reading? Similar to the quote above, the problem for many teachers is identifying *WHY* what they're doing works. In other words, what makes your technique effective? If we can make explicit what makes lessons work well, then we can apply those techniques more consistently and effectively. This would make every lesson much more powerful and, as a result, would make our students more successful. In essence, <u>by verbalising *why* our current bag of tricks works we are giving ourselves an even bigger bag we can more easily fill!</u> And that's why you should keep reading.

Catalysts spark and accelerate reactions, and reduce the amount of energy required for them to occur. This is exactly what Catalyst Teaching techniques do for learning. They *help* you make your lessons 1) more *engaging* and 2) more *memorable* to your students, thus making real learning occur faster and easier. What could be more fundamental?

To help you implement these techniques, this workbook has two sections:

1) An introduction of Catalyst Teaching concepts and their application

2) Sample lesson plans that exemplify the techniques discussed.

Remember, Catalyst Teaching is *not* about rewriting curricula *nor* implying teachers aren't doing a good job. It's all about providing a common understanding and terminology for learning so you and your students can be more successful. So let's get at it!

How Did We Get Here?

Science - Boring?!

Believe it or not, some people think *science* is boring, and this perception is often an obstacle to learning. How could someone thing of science as boring?! To answer this, let's go back and look at a typical progression of a student's exposure to science. Early in primary school, science lessons are often purely enrichment rather than content-focused. Kids generally LOVE science at this age because the focus is on discovery and wonder. Even in the late primary years, students usually show an open enthusiasm for science because science is still seen as something intriguing, adventurous and accessible. Science is *cool*!

Then it begins – the disenfranchisement of students from the discovery process. *Some* middle-years and secondary-school teachers, who usually have high levels of science training and an increasing pressure of standardised tests, start focusing on content-knowledge. To much of the general public, science proficiency at these levels is often equated with knowledge of science trivia, so fact-learning seems perfectly normal. Certainly, basic facts are needed. Too often, however, this comes at the expense of learning how to process and *apply* the information. With these valuable learning tools goes discovery, and with discovery goes student interest. The association of science with "boring" is born.

Science Teachers Are Deviants

There's another teaching obstacle that science educators must often overcome because, let's face it, we are a different breed. Science teachers tend to be left-brained with linear logic, we generally performed well as students with lecture format, and we have little problem with maths. As a result, we often find it difficult to understand why others cannot clearly see cause and effect, or why students don't see the importance of the topics we cover. However, if we teach the way *we* (think we!) learn best, which is often lecture, we will have lost nearly 90% of our students on Day One. Why? Because few people share our learning style. In essence, we are deviants - from the norm, that is! Many students taught in these styles quickly become frustrated and express that frustration as apathy, boredom or open rebellion. The "science is boring" mantra continues.

Don't Entertain - Engage!

One approach tossed around by the public (and unfortunately some teachers) to address these obstacles is, "Science should be *fun*". The term "fun" often troubles me because it is very often misused. *Fun* can mean anything from enjoyment to engagement to entertainment and, in education, far too many people view it as the latter. At the risk of being quoted out of context, let me be clear: *The goal of a teacher is not to entertain students but rather to engage them.* Entertainment *alone* is passive, but *engagement* is when a student *wants* to find the answer, *wants* to complete the assignment, and *wants* to learn more about the topic.

As long as entertainment is the tool and not the objective it should be embraced in the classroom.

"Fun" activities serve well as mental breaks, to enhance social interactions, or to *assist* in engaging a student, and teachers should implement for "engaging fun" where appropriate. All too often, however, teachers conduct labs or activities only because "the kids love it," while the content is lacking or non-existent. Sometimes teachers are made to feel that learning *must* be entertaining or they are a failure. Nonsense!! Your time with your students is too brief and too valuable to entertain – ENGAGE!

Section 1:
The Brain Game

Catalyst Teaching Concepts and Application

What Is Effective Instruction?

Walk into any classroom and it usually doesn't take long to determine if great teaching is taking lace. But what elevates *good* teaching to great? The answer: truly *effective teaching*.

Effective teaching accomplishes or provides three things:

1) **Framing** the material so it is relevant to the student
2) **Engaging** the student (and keeping them there!)
3) **Memory strategies** to help the student comprehend and recall information.

More simply put, in effective teaching the *students* know *why* they're learning the material, they're paying *attention* and they *remember* the information. All these are the responsibility of the teacher, yet they rarely happen with just a textbook and a worksheet. *But effective teaching doesn't have to be difficult*. All most teachers need are some basic concepts of learning and a few strategies to apply them *AND* the most difficult part, they must also be willing to try something new! So let's analyse each of these components so we can get to the good stuff: techniques for applying them in the classroom (i.e. tricks!).

Section 2: Why You Really Bought This Book!

Sample Lesson Plans

If you're like most teachers, this is likely to be the first page in this book to which you turned, so welcome! This section may provide you with a few lesson ideas, but please do go back and take a look at the rest of the book when you get a chance to see the concepts behind what's being done. That way you can apply the ideas to *your* lessons!

My intent here is not to simply provide you with a few new lesson plans, but rather to illustrate ways that lessons can be made to be more engaging *and* memorable. As you read through them, look for state changes, memory cues, use of music and student movement. Some may appear intimidating by their length, but I've largely scripted them out and that takes space. All but the labs take less than 20 minutes, and most of these are under 10. Enjoy!

Lessons by Format

Lectures:	
Mitosis Dance	Mitosis
Climate Control	Latitudinal effects on climate
Analogies:	
Blue Skies	Why the sky is blue
Labs:	
Parallax Lab	Parallax in stars
A Juicy Lab!	Experimental design/enzymes
Kiddie Catch and Release	Population estimation
Show-Stopping Demonstrations:	
Genie in a Bottle	Scientific method
Potato Candle	Observation vs inference

Vacuum-Packed Kid

Seal a Kid in a Garbage Bag?!

This is a slam-dunk attention-getter that kids will definitely try at home and my favourite air-pressure demonstration. The wonderful thing about it is that it actually teaches kids something: 1) There is no such thing as suction in science, and 2) small changes in air pressure can have huge effects when spread over a large area, like a continent. This is a great "week-ender" (one used on Friday to send them home on a high!), so plan ahead!

WARNING

Many students will try this at home, which is great! Just tell them that they shouldn't do it on smaller siblings (say, less than 40 kilograms to be safe) because the pressure on their chests may be too much. Also, it's not a nice thing to do to the cat! I've had limited success vacuum-packing the lower-half of large adults, but make sure someone is there to hold them up because they won't be able to move their legs!

Abstract: A student sits in a garbage bag and is "vacuum-packed," using a hose attachment from a vacuum cleaner.

Class Time Required: 15 minutes or more, depending on how many kids you want to vacuum pack!

Materials: Vacuum cleaner with hose, plastic lawn bags.

Teacher Preparation Time: None (don't forget the vacuum cleaner from home!)

Student Prior Knowledge: None

Frame Suggestion: [If combining with the previous demo, *The Baffling Balloon*, check out the suggested segue to this demo at the bottom of that demonstration's description.]

Activity: Write "1.034 kg/cm^2 = 76 cm = 1013.25 hPa" on the board (average atmospheric pressure at sea level in kg/cm^2, centimetres of mercury and hectopascals, respectively!) Explain that, because air has mass, these are measures of the amount of air pressure at sea level. (No more detail is needed at this point.) "As we'll learn later, large pressure changes cause large changes in the

Sample Lesson Plans

weather. What do you think might be a number that is possible but is also a large change in atmospheric pressure." Take responses and write them down on the board.

Demonstration:

- PICK A VOLUNTEER (a small person, preferably). Have them takeoff their shoes, stand on a table, and get into the bag. ("Put both feet into *one* corner of the bag and your butt in the *other* by sitting down.") Make sure they don't fall over!
- "Okay, we know from the last demo that AIR HAS MASS and that air flows FROM an area of high pressure TO an area of low pressure. What we're going to do here is to *vacuum pack* this person!'
- "To vacuum pack something what do we have to do? *'Suck' all the air out of the bag*. How could we do this easily? *Yeah! Use a vacuum cleaner*" (Pull out vacuum cleaner.)
- "What a vacuum cleaner really does is create a LOW pressure INSIDE the vacuum. So if the air pressure inside is LOW, this means that the air pressure OUTSIDE the vacuum is ... HIGH. We know that air flows FROM areas of high pressure TO areas of low pressure, so air is actually being PUSHED INTO the vacuum! It's true! Actually, in science, there is no such thing as "suction". Therefore, science never sucks! (You might think it blows, but it can never suck!)"
- Place the hose-end of the vacuum into bag with the volunteer. Have the person hold the hose while covering its end with spread-apart fingers to prevent bag from getting "sucked" into the vacuum. Pull the bag opening snug around the person's neck.
- Inform the volunteer that if they at any time feel uncomfortable when you turn on the vacuum, that all they have to do is say "Stop" and you'll turn off the vacuum.
- Dramatically count-down and finally turn on the vacuum. Ask them to move their arms ... They can't! [If it doesn't vacuum-pack them well, gather the plastic at the bag opening near their neck to make the seal tighter.] Turn off the vacuum cleaner.
- "If she can't even move, there must be a HUGE difference in air pressure between the inside and outside of the bag. How many think the pressure difference is about 700 hPa? 800? 1000? Actually, the difference in air

pressure is only about 100 hPa! You couldn't handle 100 hPa?! But remember, that's equal to 0.1 kg per square centimetre. How many square centimetres are on her arm – a lot! How many kilograms is that? A lot!"

- "It's only one-tenth of a kilogram per square centimetre BUT IT'S OVER A LARGE AREA. Well, the same thing is true with *atmospheric pressure* – it's very small changes, but it's over a huge area ... like all of western Victoria! So what does this demonstrate? *That very <u>small</u> changes in air pressure cause <u>huge</u> changes overlarge areas.*
- Write a common, local high-pressure reading on the board alongside a cyclone pressure reading (e.g. 2 kg/cm^2 [2000 hPa] and 1.9 kg/cm^2 [1873 hPa] are cut-offs for Category 1 and 5 cyclones, respectively!) and compare it to their guesses. It's not much difference in pressure over a small area but there's an ENORMOUS difference in the result!
- Vacuum-pack more kids!