

# EXPLORING SCIENCE THROUGH DRAMA

## WORKSHOP

**DRAMA AND SCIENCE: HOW  
DRAMA CAN ENGAGE SCIENCE  
STUDENTS IN THE HUMAN  
DIMENSIONS OF SCIENCE  
FROM TIDDALIK THE GIANT  
FROG TO BRECHT'S GALILEO**



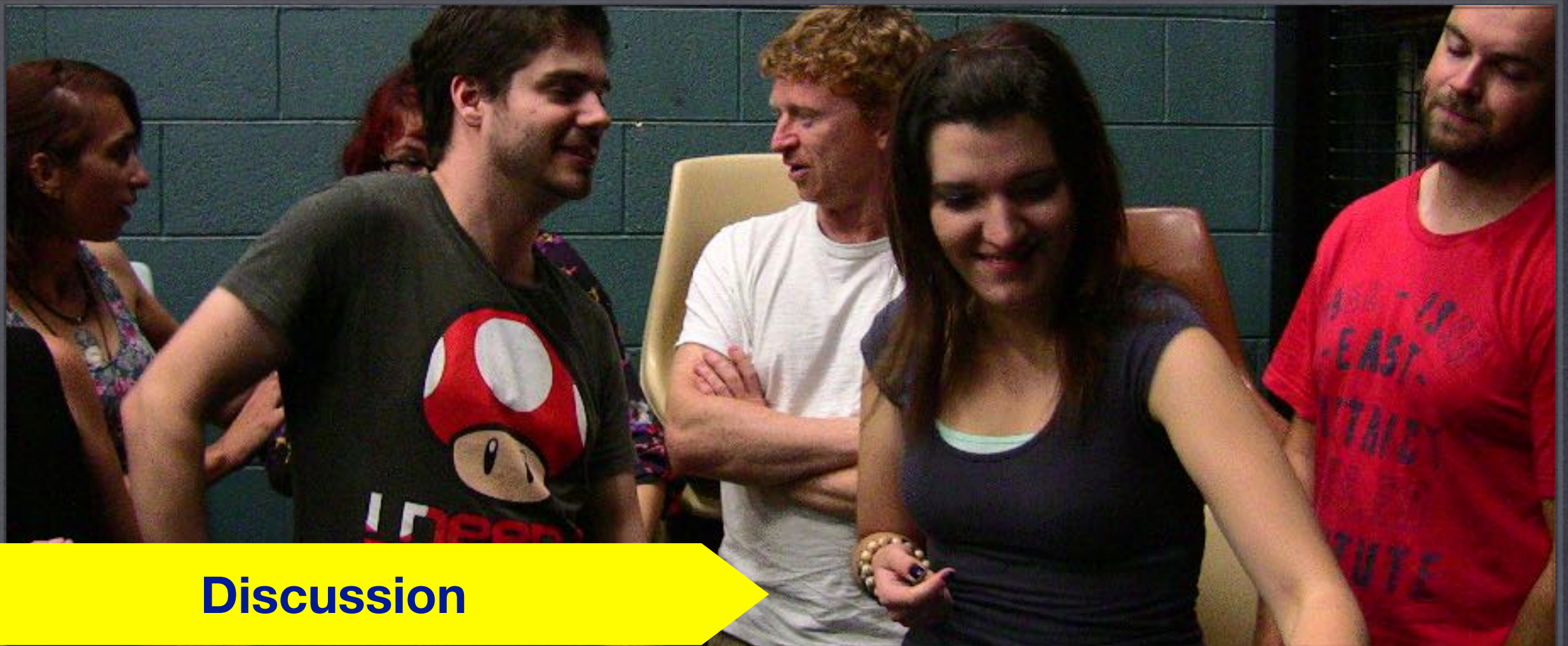
**SDEA Theatre Arts Conference  
2015**

**Standing Still:Still Standing  
26 June – 28 June 2015,  
Singapore**

**ROBIN PASCOE  
MURDOCH UNIVERSITY**



# WHAT IS SCIENCE?



**Discussion**



# Warming up

- \* **Stretching**
- \* **Humming**
  - \* **Resonance scan**
- \* **Leading with different parts of body**
- \* **Circle**
  - \* **Passing claps**
  - \* **Passing movements**
  - \* **Passing sounds**
  - \* **The rain storm**

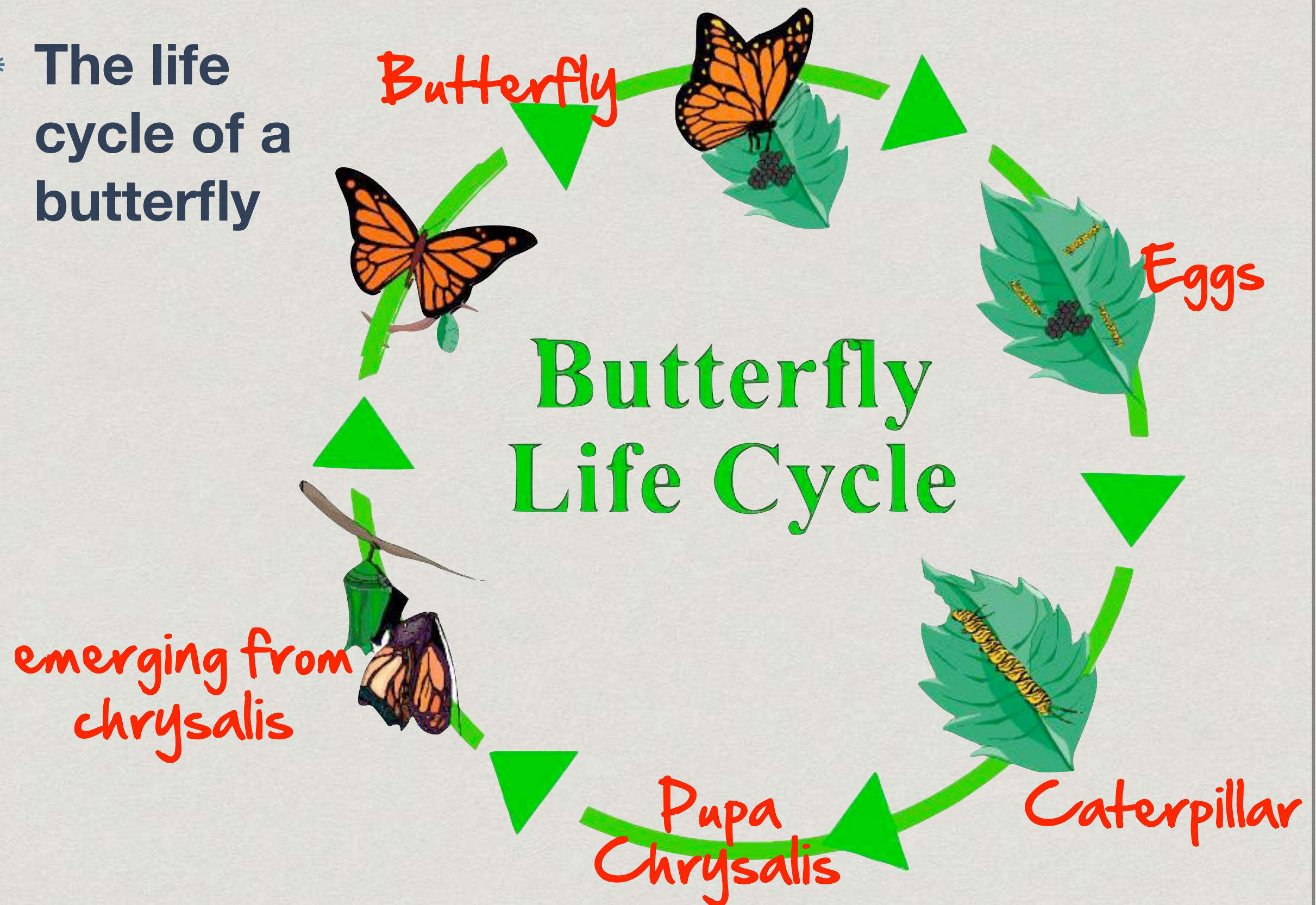


**What is the Science in these warm ups?**



# Embodied learning in science

- \* The life cycle of a butterfly





# Embodied learning in science

- \* The life cycle of a butterfly

- \* using your hands
- \* working as a group



**Embodiment**

**Individually**

**As a group of 4**

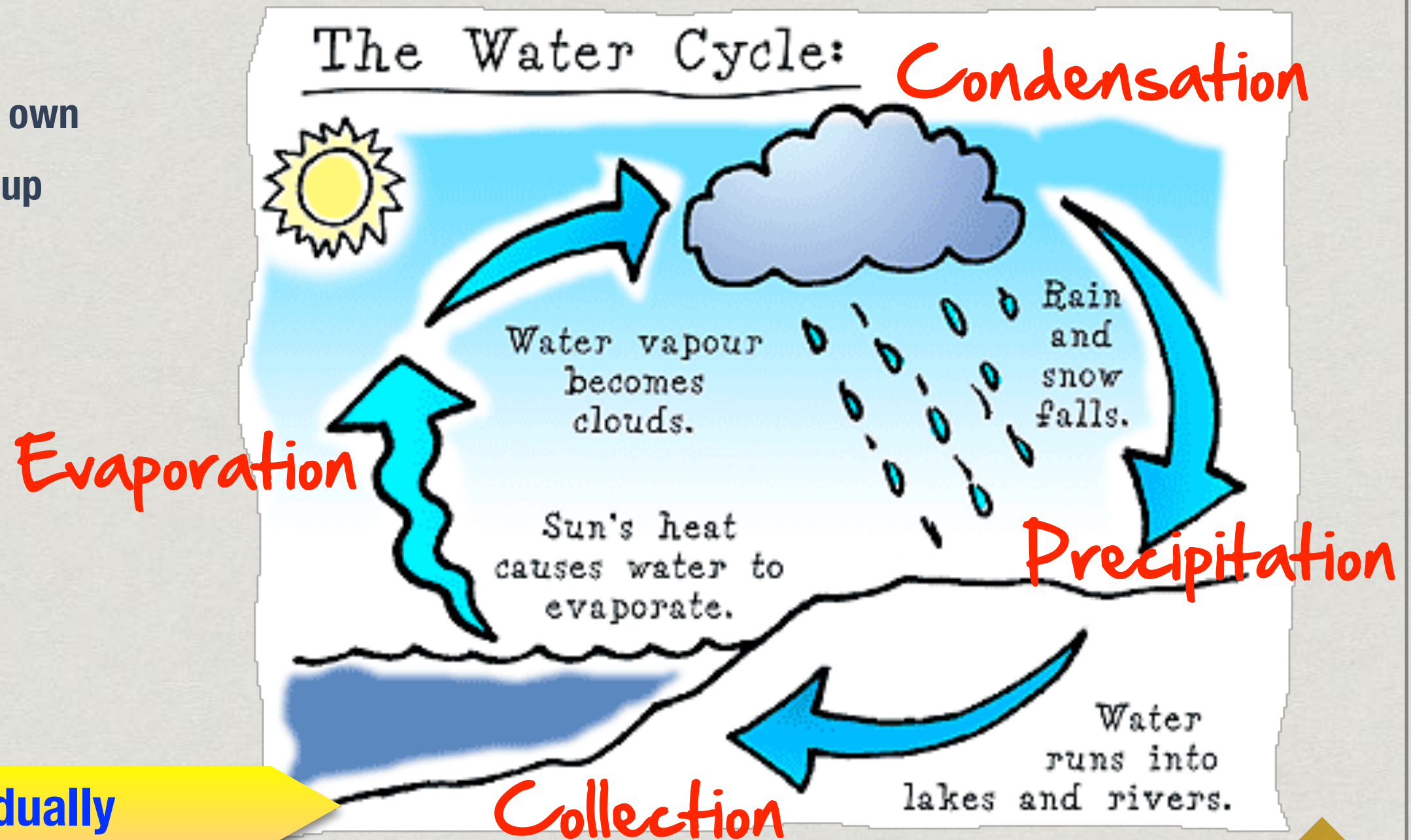


# Embodied learning in science

- \* The water cycle

- \* on your own

- \* In a group



Individually

Whole group Movement

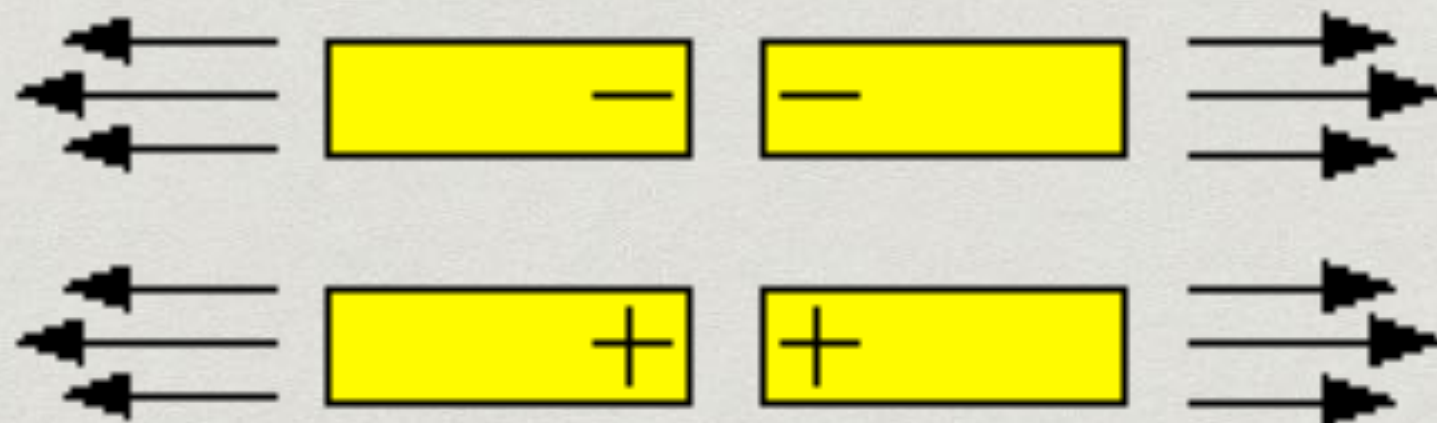
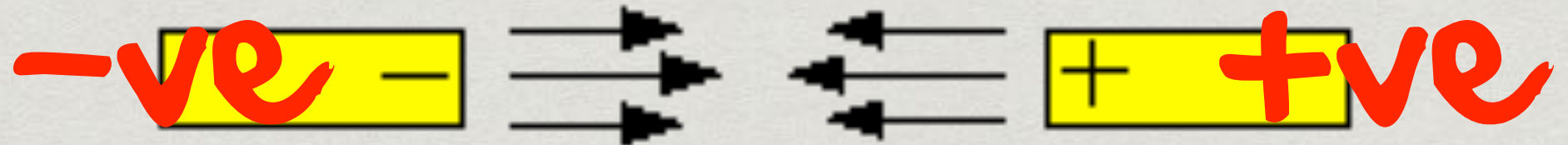


# Embodied learning in science

- ✱ **Opposites attract**

- ✱ **whole class activity**

opposite charges attract

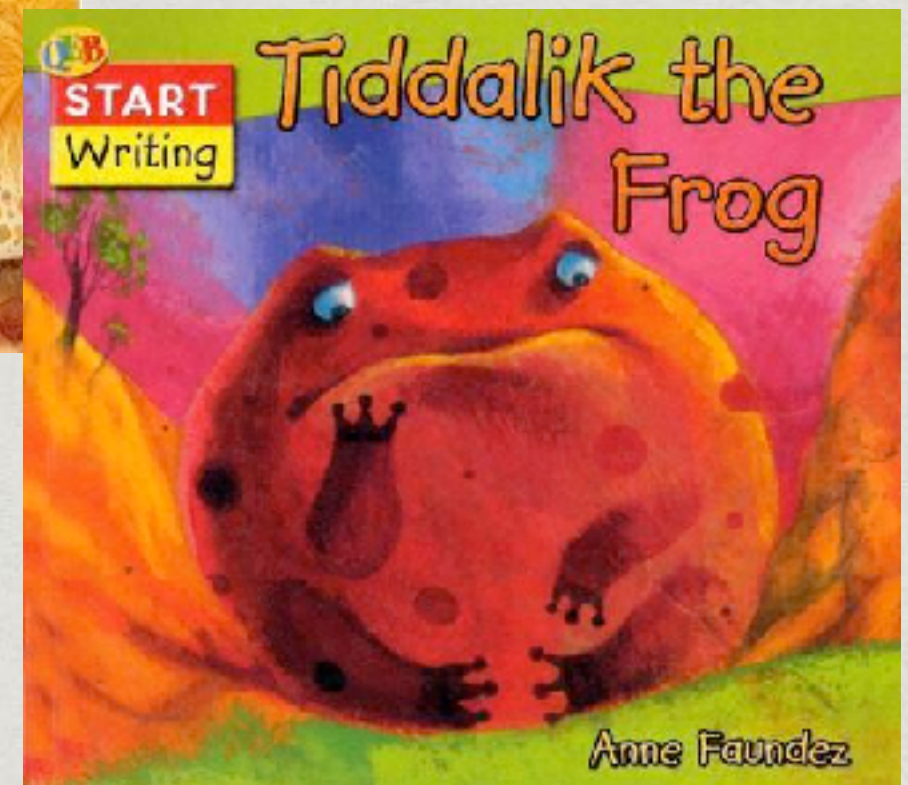
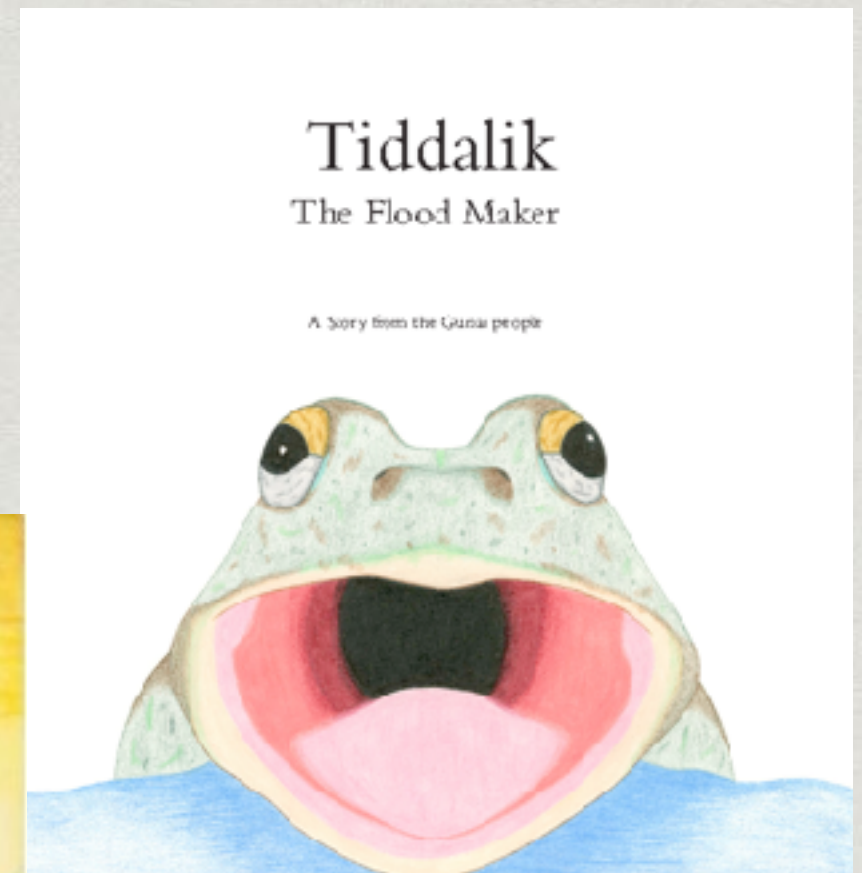
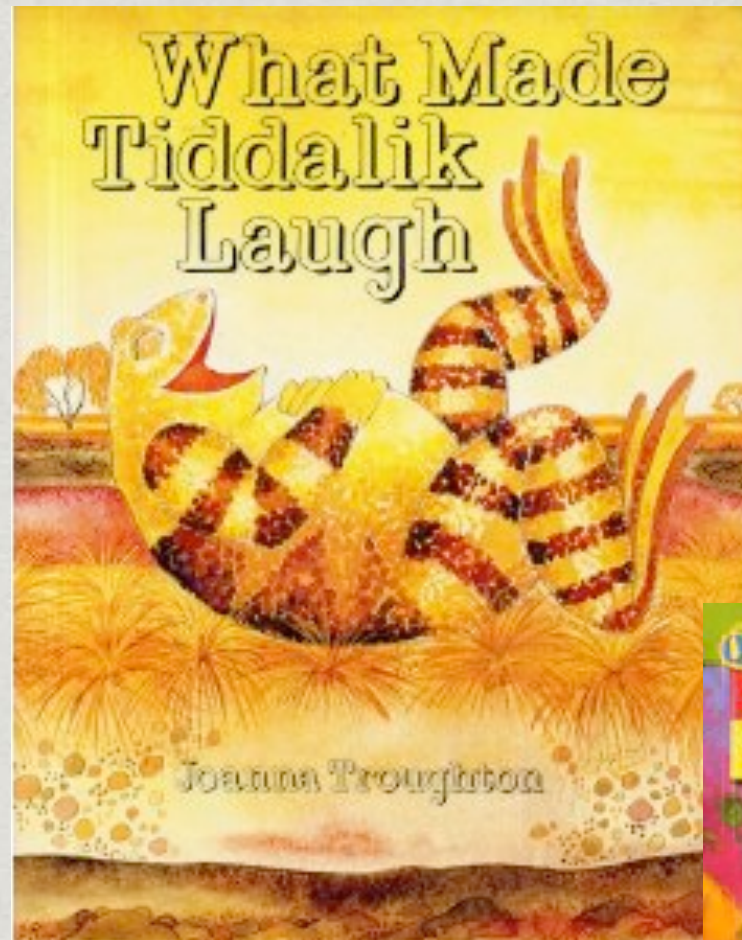


like charges repel

**Embodiment for conceptual understanding**



Moving from  
simple  
concept to  
more  
complex  
scientific  
explorations  
through  
story





# Tiddalik the giant frog

In the Aboriginal dreamtime there lived a giant frog.

Some called him Tiddalik.

Each day he hopped to the billabong to drink the water.



[http://ilbijerri.com.au/static/files/assets/17fb0597/Tiddalik\\_810x540\\_show.jpg?1363223523](http://ilbijerri.com.au/static/files/assets/17fb0597/Tiddalik_810x540_show.jpg?1363223523)

**Narration**

**Questions**

**Who are aboriginal people?**

**What is the dream time?**

**Why tell stories about animals?**



# Tiddalik the giant frog

And Tiddalik  
would drink  
side by side  
with the  
other  
animals.



<http://www2.alphabestreet.com.au/wp-content/uploads/2011/12/Fullscreen-capture-12122011-92735-PM-1.jpg>

Shall we  
move to the  
water like a  
giant frog?

Let's make  
sounds like a  
frog

Let's imagine  
we are  
drinking the  
water

**Narration**

**Movement/enactment**



# Tiddalik the giant frog

But one day  
Tiddalik  
decided to  
drink all the  
water.  
ALL the water.  
And Tiddalik  
was so full of  
water that he  
went to sleep



[http://sphotos-a.xx.fbcdn.net/hphotos-prn1/p206x206/21292\\_10152749838815338\\_1807694788\\_n.jpg](http://sphotos-a.xx.fbcdn.net/hphotos-prn1/p206x206/21292_10152749838815338_1807694788_n.jpg)

Should  
Tiddalik drink  
all the water?

What would  
happen to the  
other animals  
if Tiddalik  
drinks it all

How could we  
stop Tiddalik  
drinking all  
the water?

Narration

Questioning



# Tiddalik the giant frog

**When the other animals came to drink, they found that there was no water for them.**



# Where has the water gone?

**They saw that  
Tiddalik was  
asleep and  
grown huge  
with water**

<http://www.rainboweducational.com.au/86-192-large/what-made-tiddalik-laugh-a-dreamtime-story.jpg>

# Meeting

## Who are the animals?



# Tiddalik the giant frog

When the other animals came to drink, they found that there was no water for them.



<http://1.bp.blogspot.com/-mH5bTGBgVFQ/Tyi2uz3AuUI/AAAAAAAAADn0/o9Vq7papw8I/s1600/DSCF2784.JPG>

Where has the water gone?

Is it fair that Tiddalik has drunk all the water?

What should we do about Tiddalik?

Tiddalik give us back our water

But Tiddalik was too full to reply

Improvisation



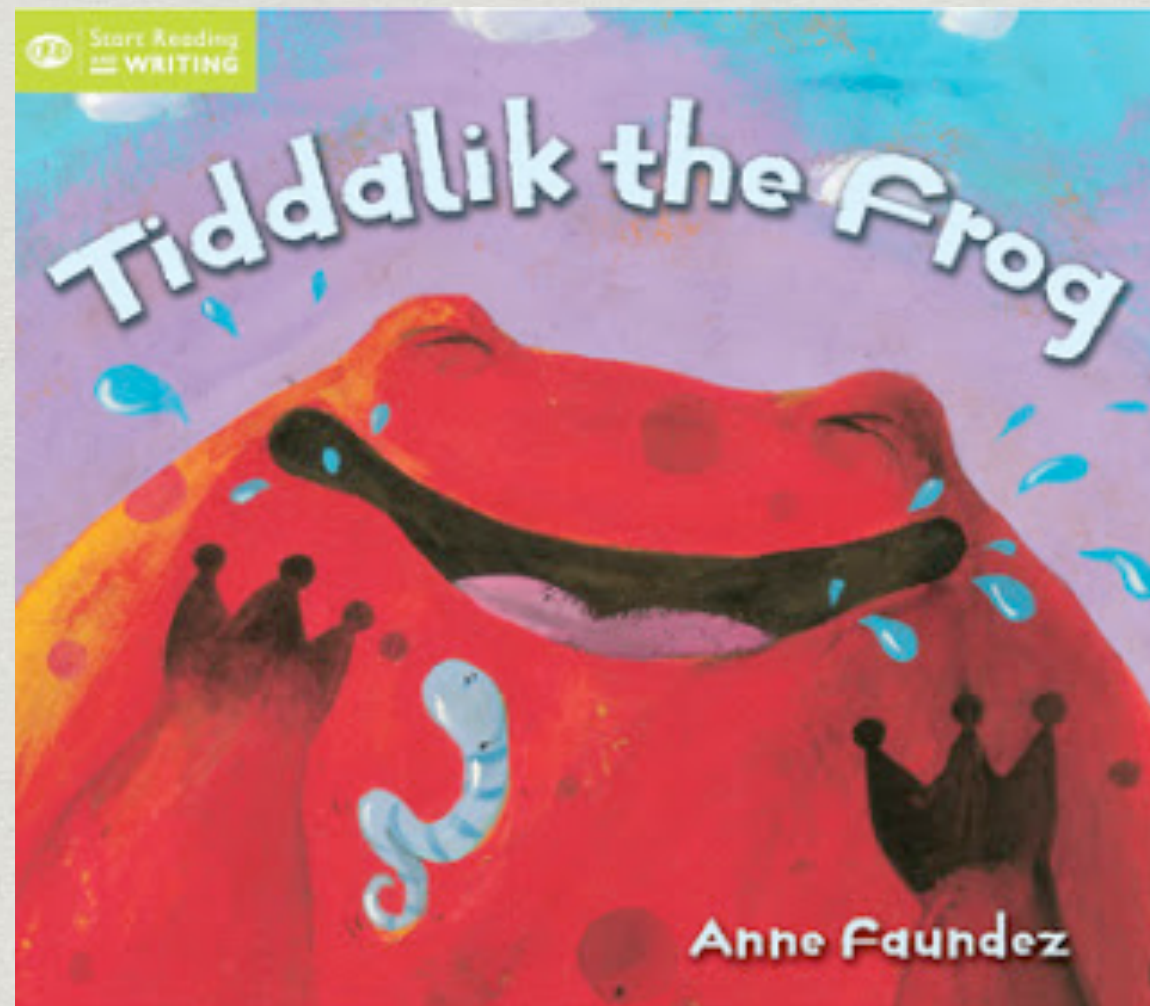
# Tiddalik the giant frog

“I know,” said one of them.

“We shall tell jokes and make Tiddalik laugh.”

The others asked why.

“If we make Tiddalik laugh then he cannot keep all that water and it will flow back into the billabong.”



Tell a joke to make some one laugh

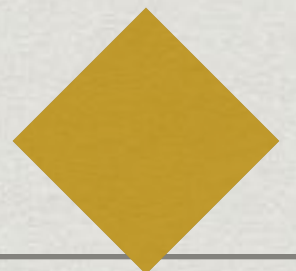
Why do jokes make us laugh?

Should we play tricks on people?

[http://3.bp.blogspot.com/-1QTmGSS6S3Q/Tagodk75lzl/AAAAAAAAAxQ/3\\_E08CAHAYA/s320/tiddalikthefrog.jpg](http://3.bp.blogspot.com/-1QTmGSS6S3Q/Tagodk75lzl/AAAAAAAAAxQ/3_E08CAHAYA/s320/tiddalikthefrog.jpg)

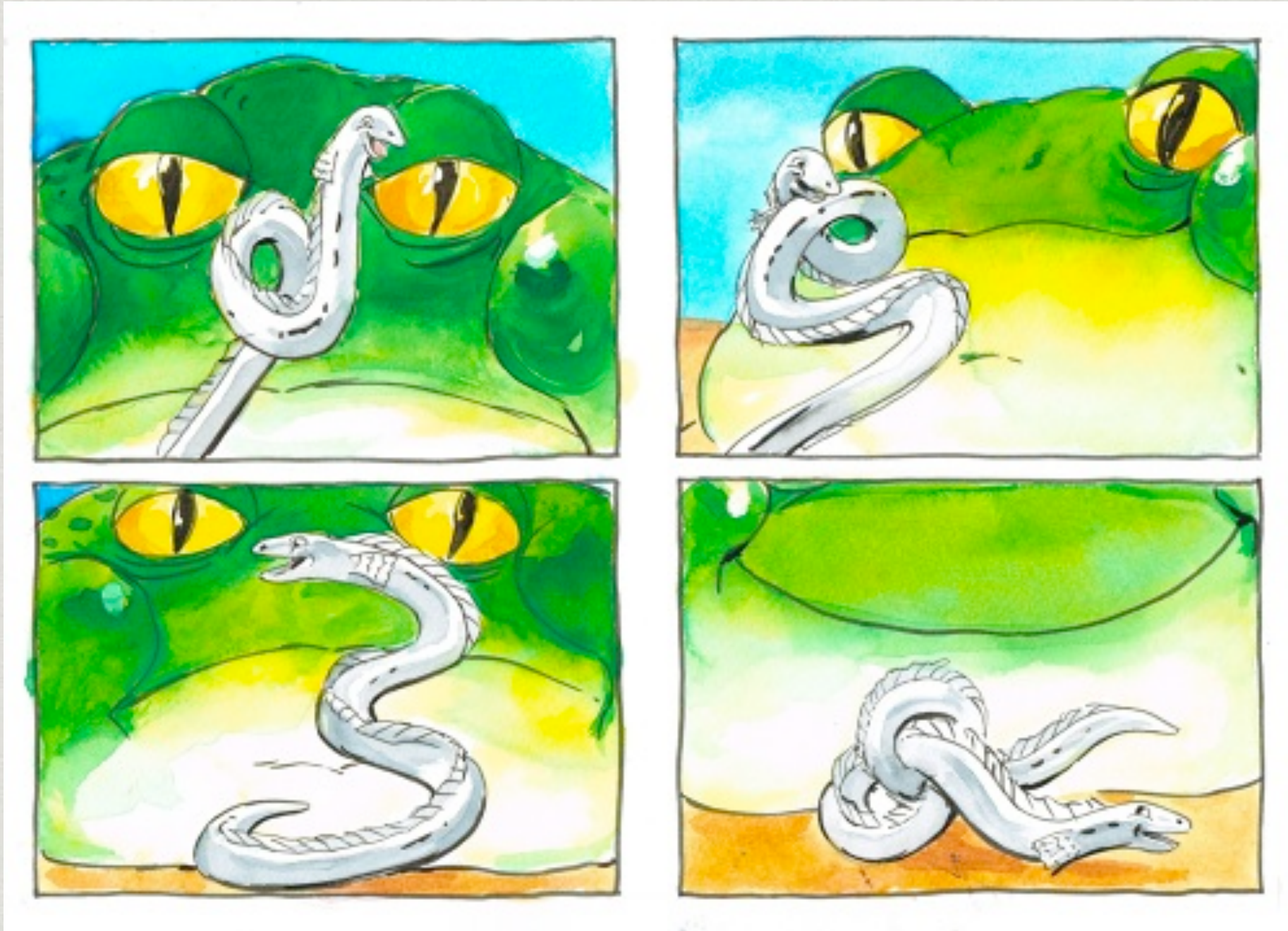
Narration

Joke telling





# Tiddalik the giant frog



[http://media.virbcdn.com/cdn\\_images/resize\\_500x500/c0/078a1f6800a86fd5-tiddalick5b.jpg](http://media.virbcdn.com/cdn_images/resize_500x500/c0/078a1f6800a86fd5-tiddalick5b.jpg)

**Narration**



# Tiddalik the giant frog



<http://i1.ytimg.com/vi/tWvoTZxvEs8/maxresdefault.jpg>

**Narration**



He started with slow, graceful movements, but as the dance became faster he wriggled and twisted himself into the most grotesque and comical shapes, until suddenly Tiddalik's eyes lit up and he burst out laughing.

And as he laughed, the water gushed from his mouth and flowed away to replenish the lakes, the swamps, and the rivers.



**Narration**





[http://  
morethanreadingblog.files.wordpr  
ess.com/2011/04/tiddalik-pe-288-  
x-208.jpg](http://morethanreadingblog.files.wordpress.com/2011/04/tiddalik-pe-288-x-208.jpg)

**Improvisation**

**The water gushing from Tiddalik**

**Using fabric to symbolise water**





[http://  
morethanreadingblog.files.wordpr  
ess.com/2011/04/tiddalik-pe-288-  
x-208.jpg](http://morethanreadingblog.files.wordpress.com/2011/04/tiddalik-pe-288-x-208.jpg)

**Discussion: what's the science here?**



# What's the science learning?

**About water  
and its  
importance  
for life**

**About how if one person/  
company takes all the  
resource, then others face  
consequences**

**There is a need to share  
scarce resources for  
sustainability of life**

**It is important to work  
together in a crisis.**

**Knowledge of  
science in  
ancient story  
and life**



<http://judelyon.com/frog.jpg>



# Science in the Australian Curriculum

Australian Curriculum: Science Scope and Sequence			
Thread		Year 1	Year 2
Biological sciences		Living things live in different places where their needs are met	
Earth and space sciences		Observable changes occur in the sky and landscape	Earth's resources, including water, are used in a variety of ways
Nature and development of science	Science involves exploring and observing the world using the senses	Science involves asking questions about, and describing changes in, objects and events	
Use and influence of science		People use science in their daily lives, including when caring for their environment and living things	
Questioning and predicting	Respond to questions about familiar objects and events	Respond to and pose questions, and make predictions	
Communicating	Share observations and ideas	Represent and communicate observations and ideas in a variety of ways such as oral and written language, drawing and role play	



# Drama in the Australian Curriculum

## Australian Curriculum: The Arts Scope and Sequence Drama

Thread	The Arts: Foundation to Year 2	The Arts: Years 3 and 4
Exploring ideas and improvising with ways to represent ideas	Explore role and dramatic action in dramatic play, improvisation and process drama	Explore ideas and narrative structures through roles and situations and use empathy in their own improvisations and devised drama
Developing understanding of practices	Use voice, facial expression, movement and space to imagine and establish role and situation	Use voice, body, movement and language to sustain role and relationships and create dramatic action with a sense of time and place
Sharing artworks through performance, presentation or display	Present drama that communicates ideas, including stories from their community, to an audience	Shape and perform dramatic action using narrative structures and tension in devised and scripted drama, including exploration of Aboriginal and Torres Strait Islander drama
Responding to and interpreting artworks	Respond to drama and consider where and why people make drama, starting with Australian drama, including drama of Aboriginal and Torres Strait Islander Peoples	Identify intended purposes and meaning of drama, starting with Australian drama, including drama of Aboriginal and Torres Strait Islander Peoples, using the elements of drama to make comparisons



# PART 2





# WHAT IS SCIENCE?

**Scientists tell stories by creating theories that use current information to provide an explanation of a natural phenomenon.**



**Discussion**



# SCIENCE IS...

- "knowledge attained through study or practice,"
- "knowledge covering general truths of the operation of general laws, esp. as obtained and tested through scientific method [and] concerned with the physical world."
- Science refers to a system of acquiring knowledge using observation and experimentation to describe and explain natural phenomena.
- The term science also refers to the organised body of knowledge people have gained using that system.
- The word science often describes any systematic field of study or the knowledge gained from it.

Science is an unfolding response to explorations of the natural world in which we live

Science is a human story unfolding

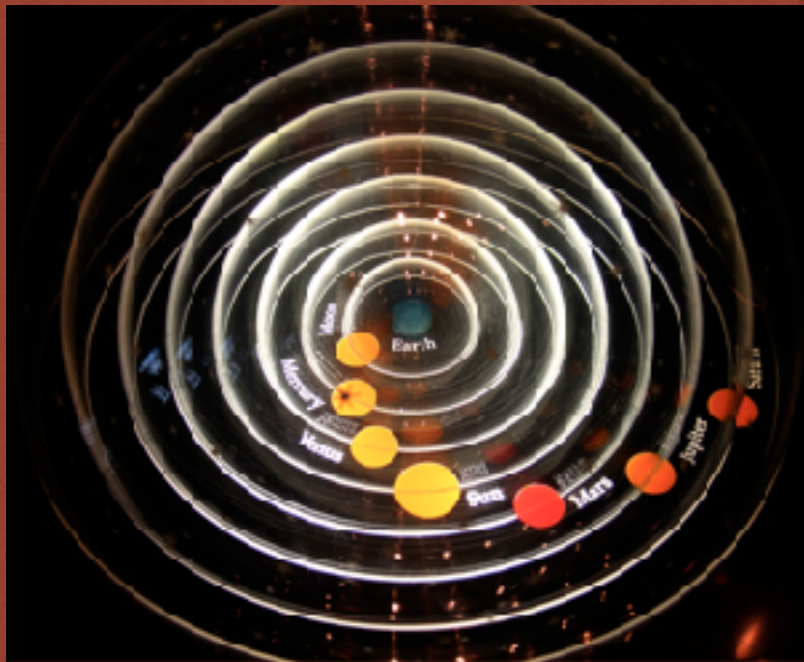
As a human story it can be explored by drama

## HOW DO WE LEARN SCIENCE THROUGH DRAMA?

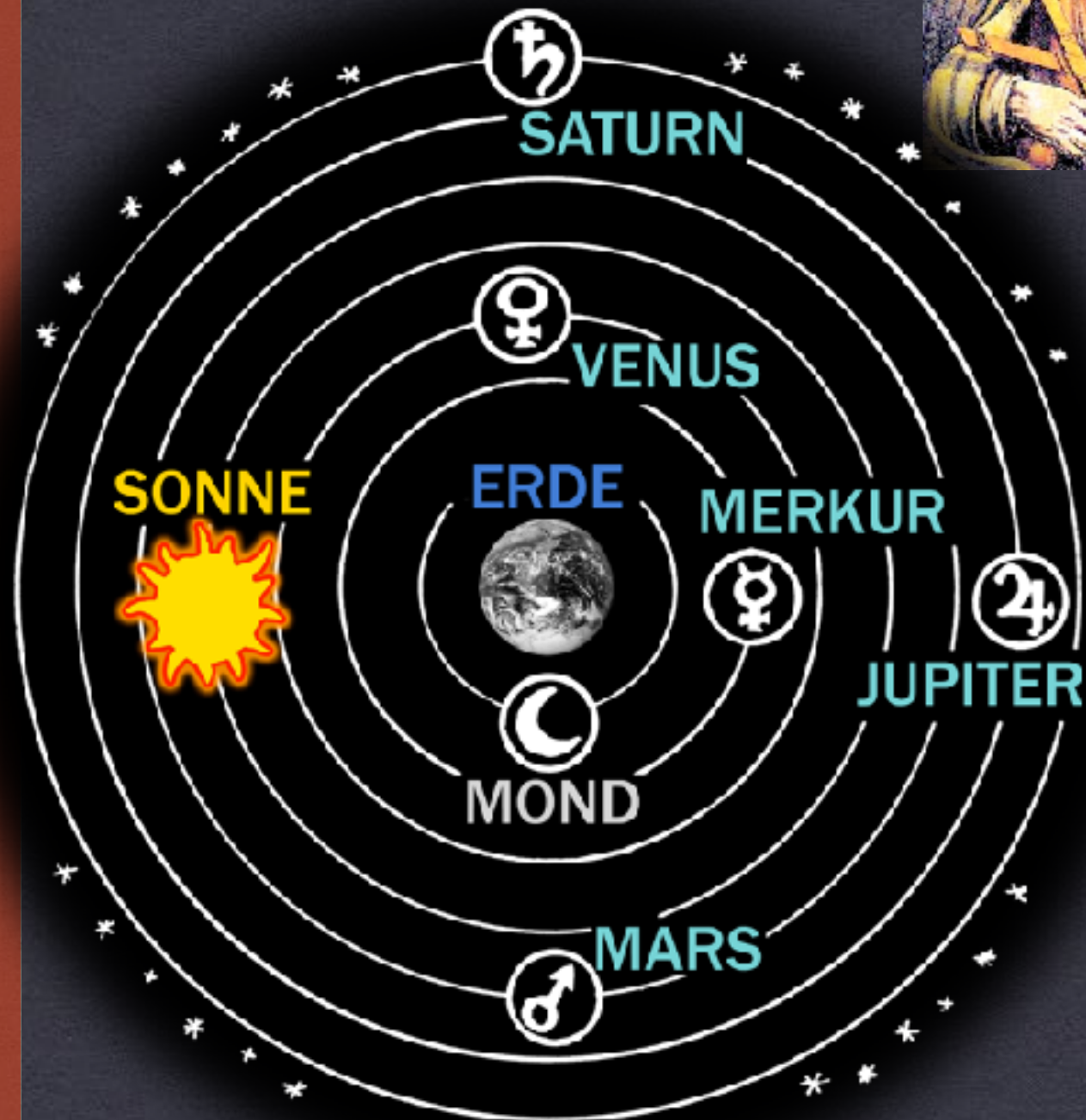


# GALILEO'S DILEMMA

The traditional way of understanding the world placed the earth at the centre of the universe around which all other planets and the sun orbited.



<http://images.cdn.fotopedia.com/flickr-4115860027-hd.jpg>

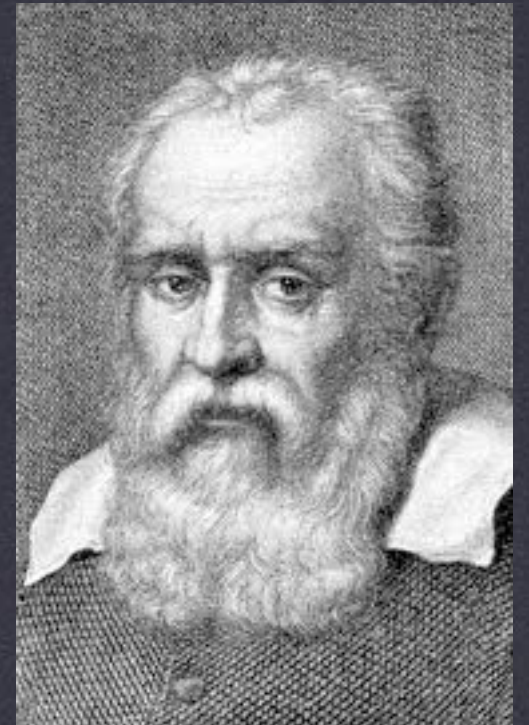


[http://upload.wikimedia.org/wikipedia/commons/f/f6/Ptolemaic\\_system\\_\(PSF\)2.png](http://upload.wikimedia.org/wikipedia/commons/f/f6/Ptolemaic_system_(PSF)2.png)



# GALILEO'S DILEMMA

Galileo's discoveries through telescopes, observation and mathematics challenged the conventional view of the world.



**“I have made  
discoveries  
we can no longer  
withhold  
from the world.”  
Brecht's *Galileo***



**DIALOGO**  
D I  
**GALILEO GALILEI LINCEO**  
MATEMATICO SOPRAORDINARIO  
DELLO STUDIO DI PISA.  
*E Filosofo, e Matematico primario del*  
SERENISSIMO  
**GR.DVCA DI TOSCANA.**  
Doue ne i congressi di quattro giornate si discorre  
sopra i due  
MASSIMI SISTEMI DEL MONDO  
TOLEMAICO, E COPERNICANO;  
*Proponendo indeterminatamente le ragioni Filosofiche, e Naturali  
tanto per l'una, quanto per l'altra parte.*  
CON PRI  VILEGI.  
IN FIRENZA, Per Gio:Batista Landini MDCXXXII.  
CON LICENZA DE' SUPERIORI.

**Narration**



# BACKGROUND

In astronomy, the geocentric model (also known as geocentrism, or the Ptolemaic system) is a description of the cosmos where Earth is at the orbital centre of all celestial bodies. This model served as the predominant cosmological system in many ancient civilisations such as ancient Greece including the noteworthy systems of Aristotle (see Aristotelian physics) and Ptolemy. As such, they assumed that the Sun, Moon, stars, and naked eye planets circled Earth

It was not until the 16th century that a fully predictive mathematical model of a heliocentric system was presented, by the Renaissance mathematician, astronomer, and Catholic cleric Nicolaus Copernicus, leading to the Copernican Revolution.

Galileo's championing of heliocentrism was controversial within his lifetime, when most subscribed to geocentrism. He met with opposition from astronomers, who doubted heliocentrism.

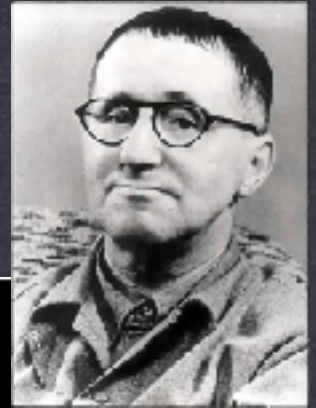
Heliocentrism was investigated by the Roman Inquisition in 1615, which concluded that heliocentrism was false and contrary to scripture, placing works advocating the Copernican system on the index of banned books and forbidding Galileo from advocating heliocentrism.

Galileo was tried by the Holy Office, then found "vehemently suspect of heresy", was forced to recant, and spent the rest of his life under house arrest.

Discussion/background



# BRECHT *The Life of Galileo*



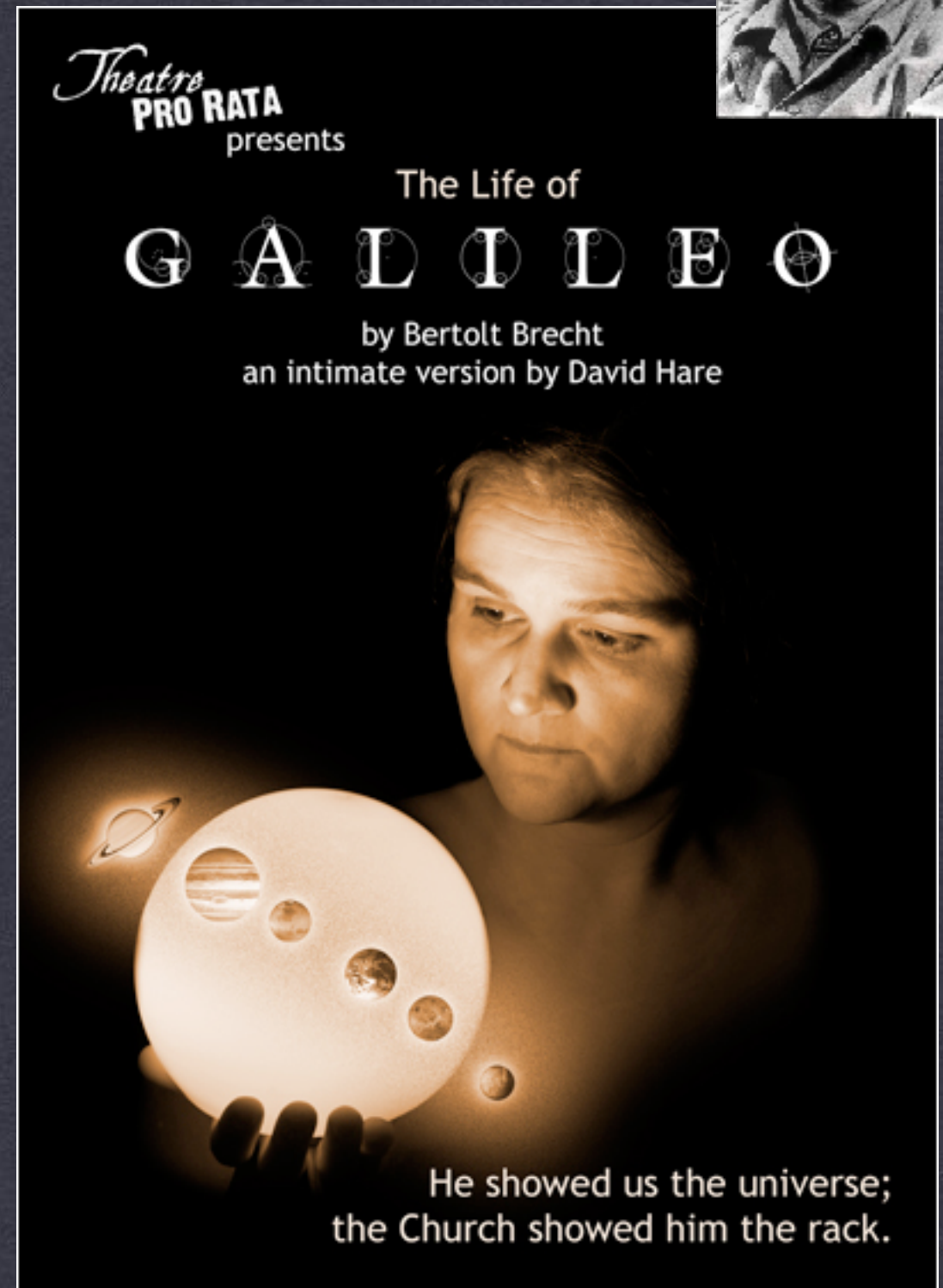
Working in pairs

How dare you challenge  
the Divine Aristotle

Improvise an imagined  
a conversation between  
a scientist who believed  
in helocentrism and one  
who did not.

**Improvisation**

**Replay with voices in the head**





# BRECHT *The Life of Galileo*



Working in groups of six

How dare you  
challenge the  
Church

Galileo was brought  
before a Church court  
over his championing of  
the this new science



<http://www.abbeytheatre.ie/images/sized/images/uploads/user/resources/AbbeyTheatre-500x400.jpg>

**Trial - 2 groups**

**Thoughts in the Head**

**Who is in the trial?**

**How are trials run?**

**We will watch two trials**



# BRECHT *The Life of Galileo*



Whole class

"You have set yourself up against the authorities and they have already warned you once ... you show signs of sense and tell me that you know you must control yourself because it's dangerous.

Before the court Galileo was forced to withdraw his championing of heliocentrism.



<http://www.mnsu.edu/theatre/season/past/archive/g/images/Galileo%20web%203.jpg>

**Symbol (tearing the astronomical charts)**





# BRECHT *The Life of Galileo*



## Individual

"You have set yourself up against the authorities and they have already warned you once ... you show signs of sense and tell me that you know you must control yourself because it's dangerous."

As an old man Galileo reflects on his choices.



Writing in role





# BRECHT *The Life of Galileo*

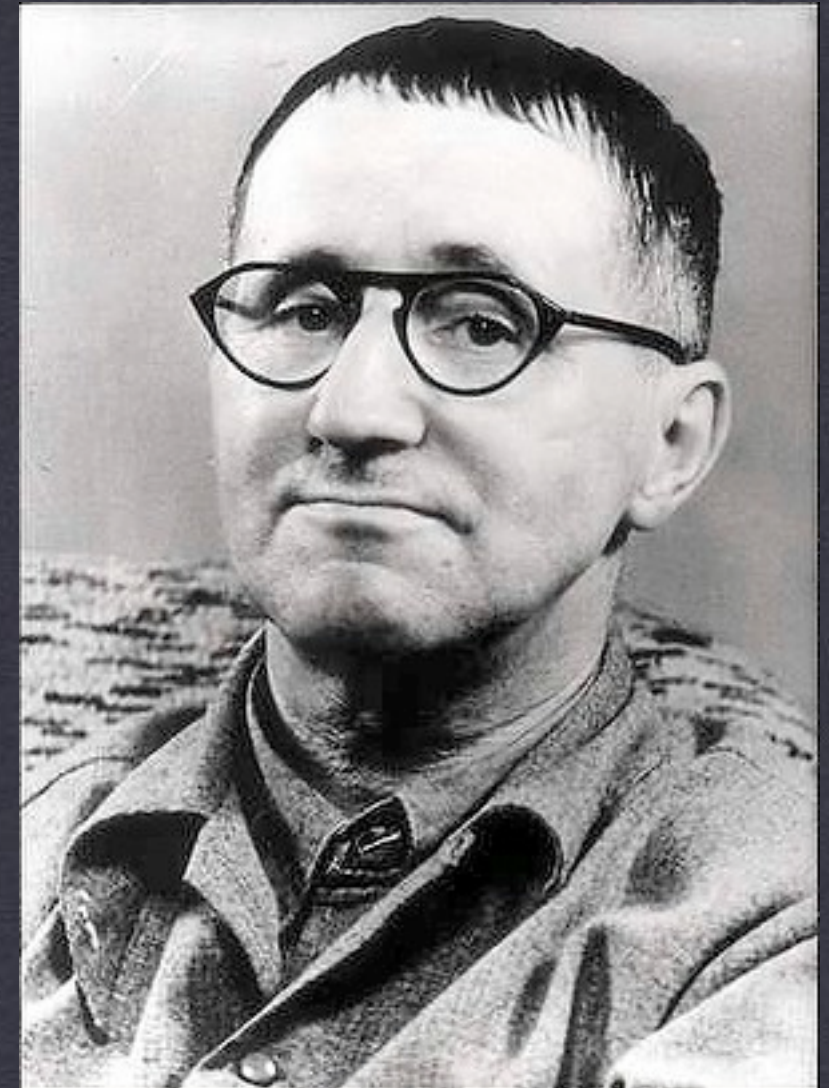
"Belief ... is one thing; facts,  
tangible facts, are another ...  
Gentlemen, I beseech you in all  
humanity to trust your eyes."

Brecht was writing a play.  
He argued from a point of  
view.

A play is not necessarily  
science.

Discussion: what is objectivity?

Is science objective



READ MORE: [HTTP://  
WWW.SMH.COM.AU/NATIONAL/  
EDUCATION/CONFLICT-OF-  
QUESTIONS-20130322-2GJNY.HT  
ML#IXZZ2Z83YDLYQ](http://www.smh.com.au/national/education/conflict-of-questions-20130322-2GJNY.HTML#IXZZ2Z83YDLYQ)



# DILEMMA

YOU ARE A TEAM OF  
SCIENTISTS WHO HAVE  
DISCOVERED A CURE FOR  
CANCER.  
IT IS WORLD BEATING  
SCIENCE.  
BUT AS A RESEARCHER YOU  
CHEATED AND CUT CORNERS



**Discussion: ethics and science**

**Improvisations**

**Publish and manufacture the drug even though it is not proven**

**Tell the world the truth knowing that it  
might save someone**

**Keep a dirty secret**



# Identify the Science learning?



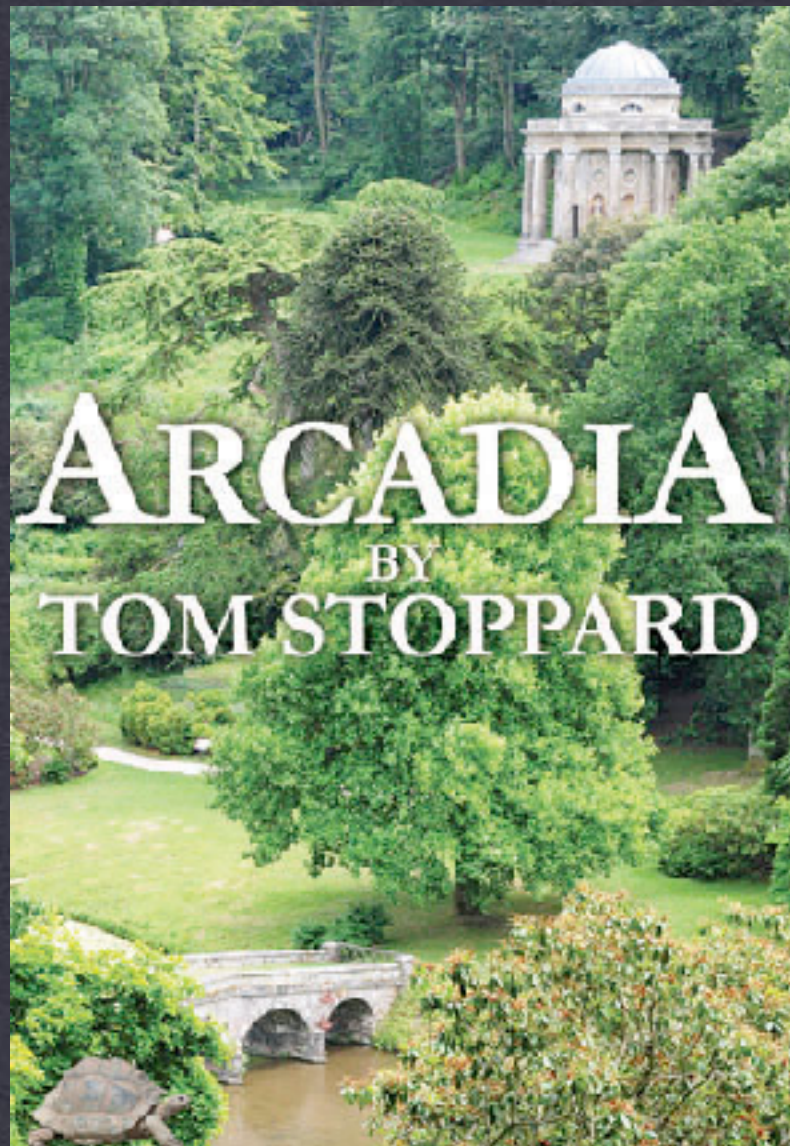
# Identify the Drama learning?

**Reflection**



# Other Plays focused on Science

Arcadia by Tom Stoppard



[https://www.sedos.co.uk/2011/images/Arcadia-Front\\_A6\\_Final\\_360\\_000.jpg](https://www.sedos.co.uk/2011/images/Arcadia-Front_A6_Final_360_000.jpg)

Copenhagen by Michael Frayn

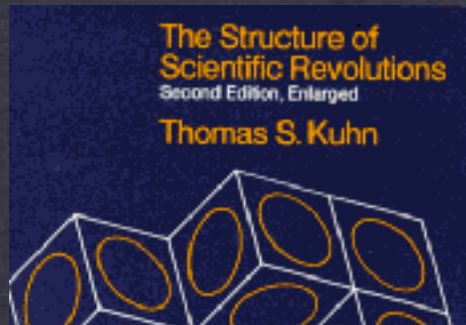


[http://images.iop.org/objects/ccr/cern/39/4/16/theatre1\\_5-99.jpg](http://images.iop.org/objects/ccr/cern/39/4/16/theatre1_5-99.jpg)

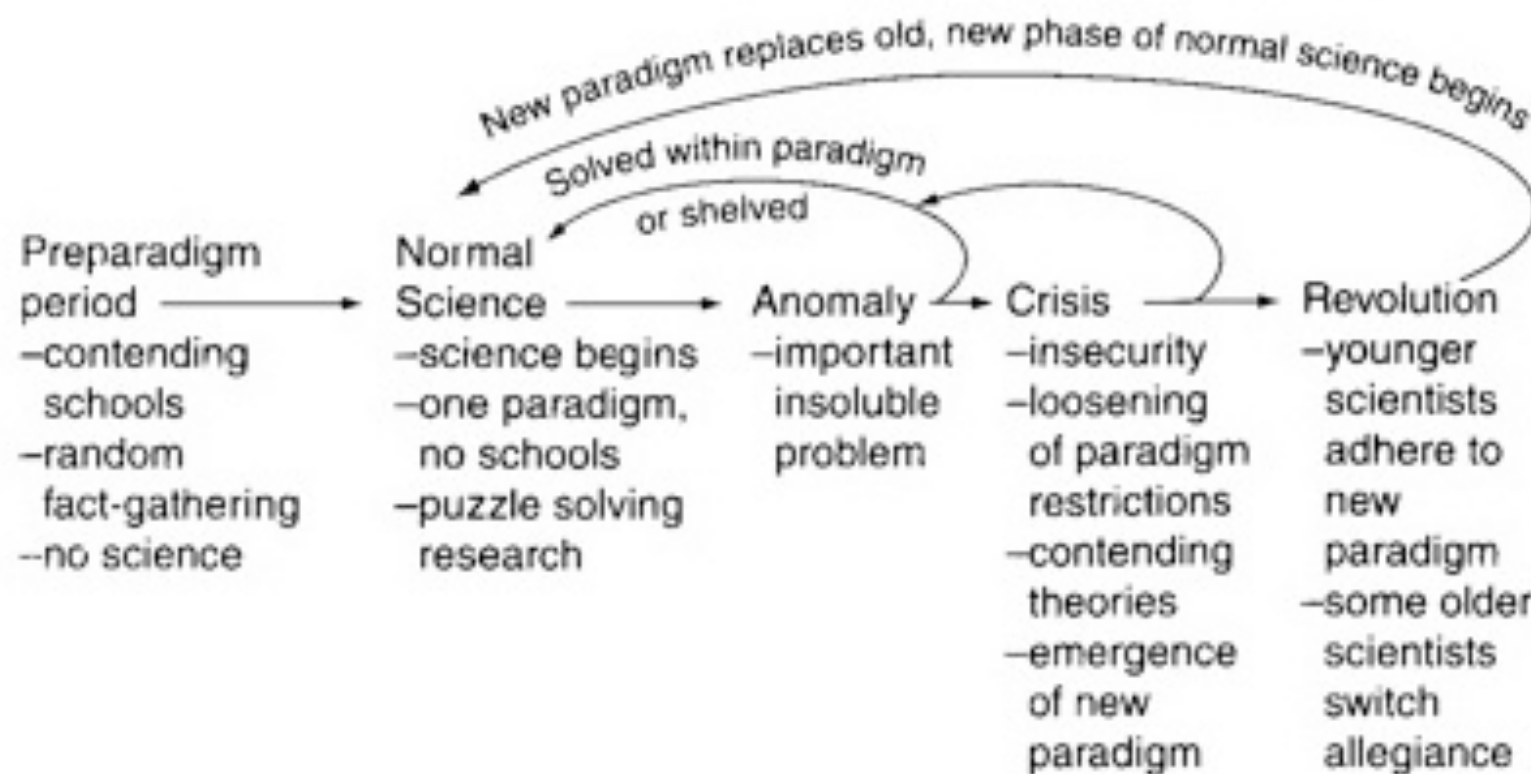
<http://www.curtainup.com/scienceplays.html>



# The Structure of Scientific Revolutions



**FIGURE 1-1** The revolutionary character of paradigm shifts and the cyclical nature of science (a schematization of Kuhn, 1970).



Paradigms

Paradigm shifts

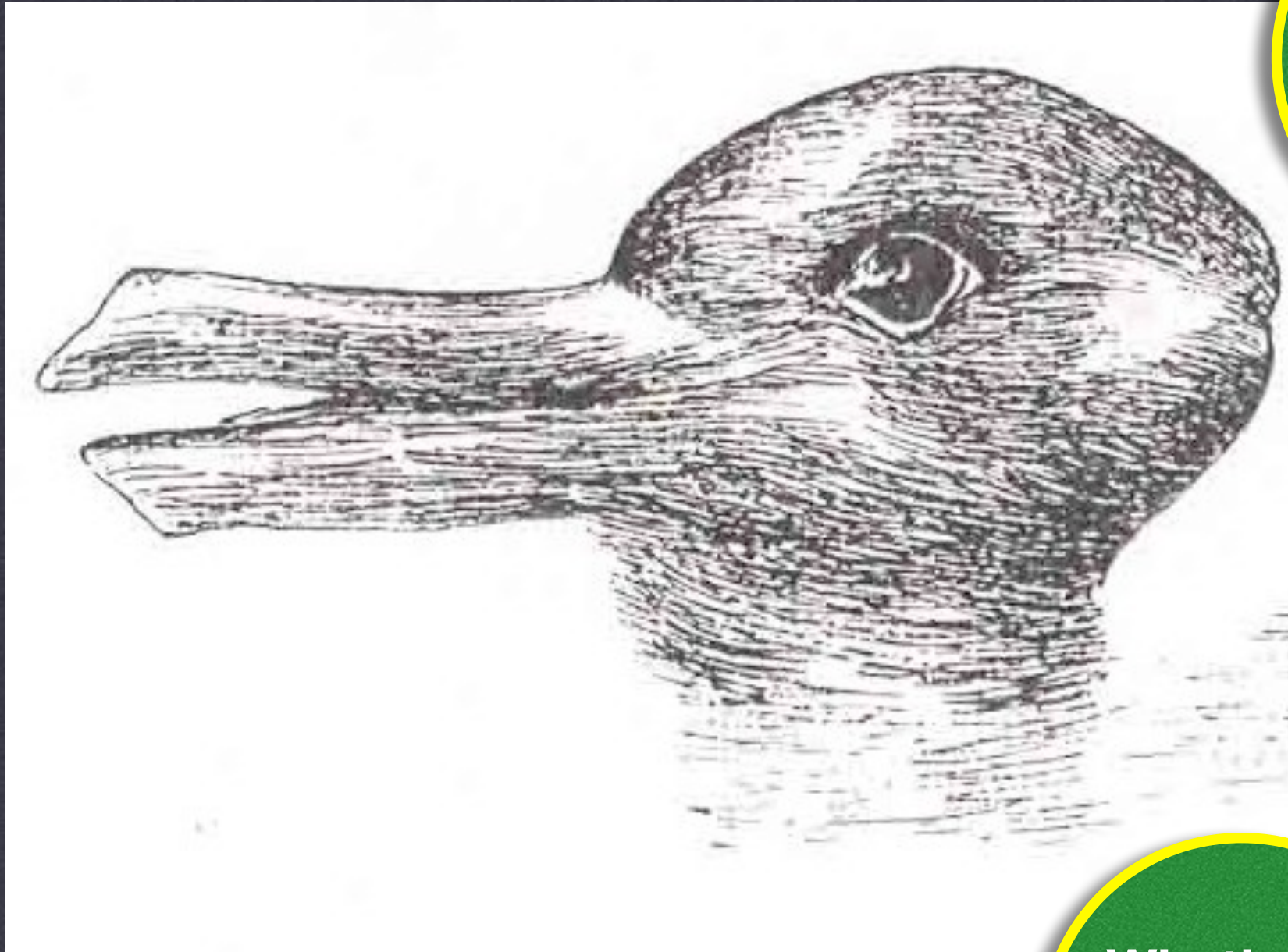
What happens when our paradigms shift?

<http://johnwhawthorne.files.wordpress.com/2014/01/kuhns-revolutions.jpg>

Drama enables to see the nature of knowledge



**What do you see?**



**Why?**

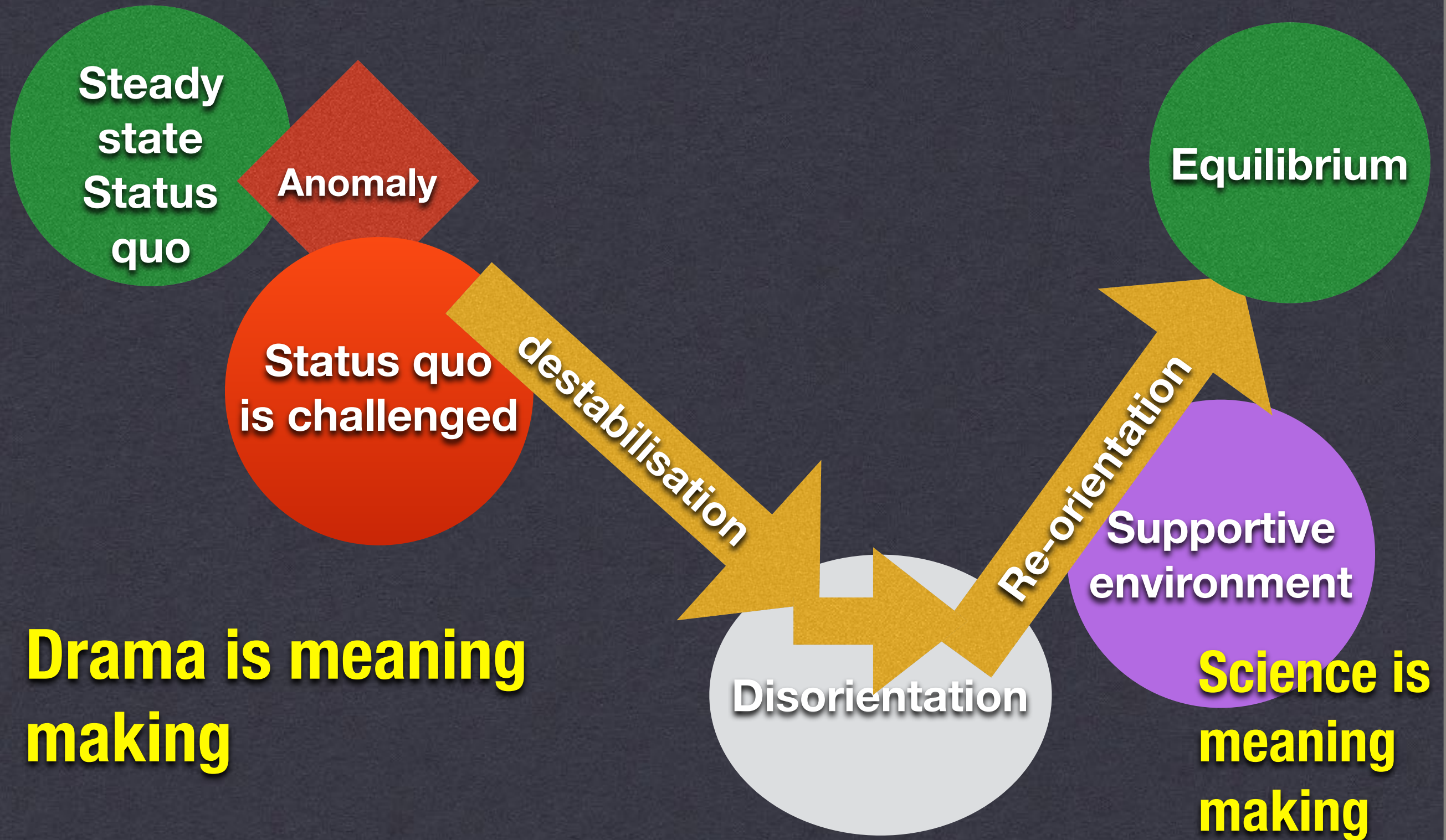
**Can you  
shift  
between  
images?**

**What's the  
science  
lesson  
here?**

**What's the  
drama lesson  
here?**



# Drama enables us to enact shifts in paradigms





# YOUR IDEAS ON USING DRAMA IN SCIENCE





# REFLECTION ON WORKSHOP

- What drama strategies were used?
- Could you use?
- Why would you teach science in this way?



"Belief ... is one thing; facts, tangible facts, are another ...  
Gentlemen, I beseech you in all  
humanity to trust your eyes."

Brecht

**What is the Science in the warm ups?  
How did they prefigure the workshop?**



**THESE NOTES HAVE BEEN PREPARED  
BY ROBIN PASCOE FOR THE SINGAPORE  
DRAMA EDUCATORS CONFERENCE IN  
SINGAPORE, JUNE 2015.**



**[R.PASCOE@MURDOCH.EDU.AU](mailto:R.PASCOE@MURDOCH.EDU.AU)**

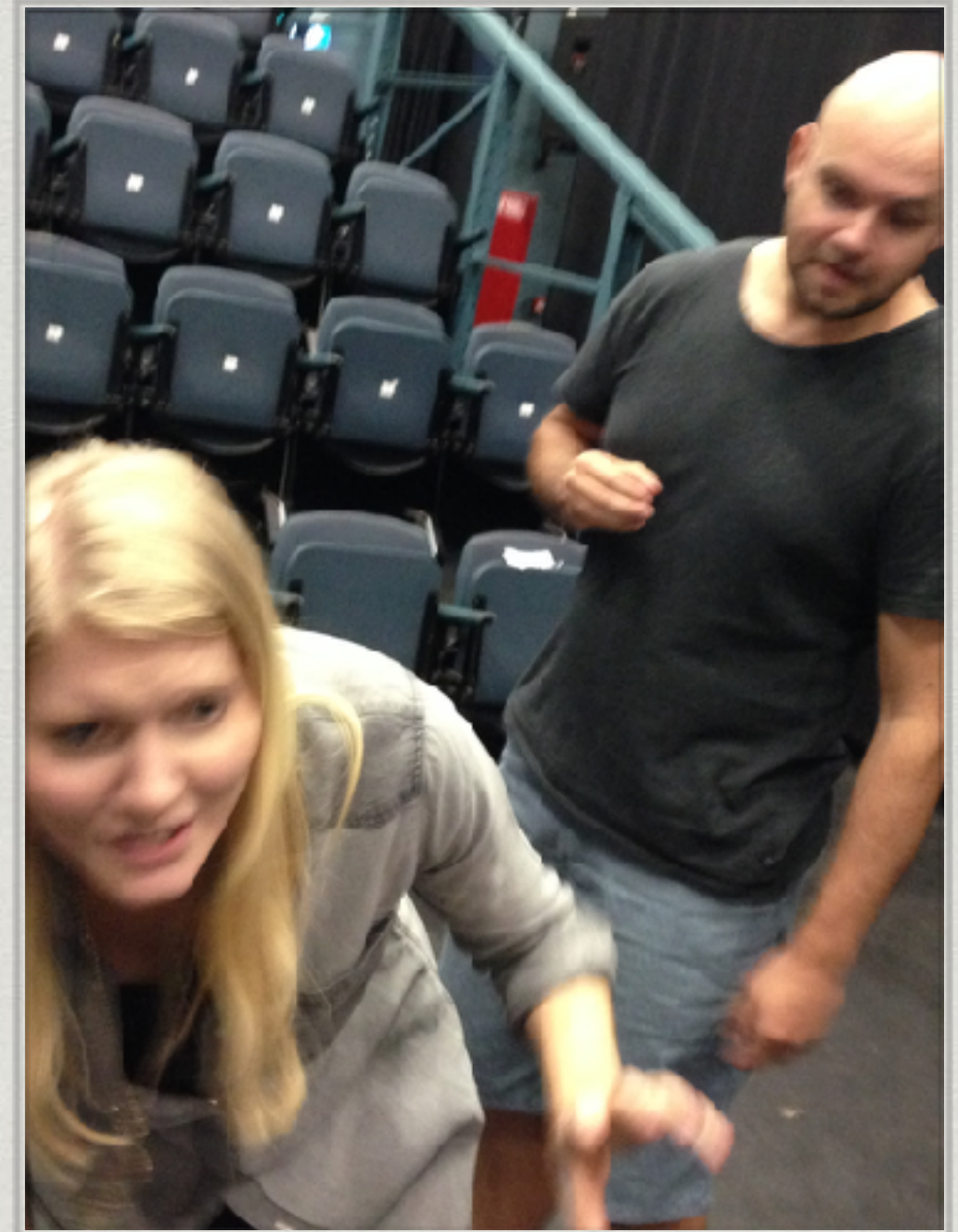
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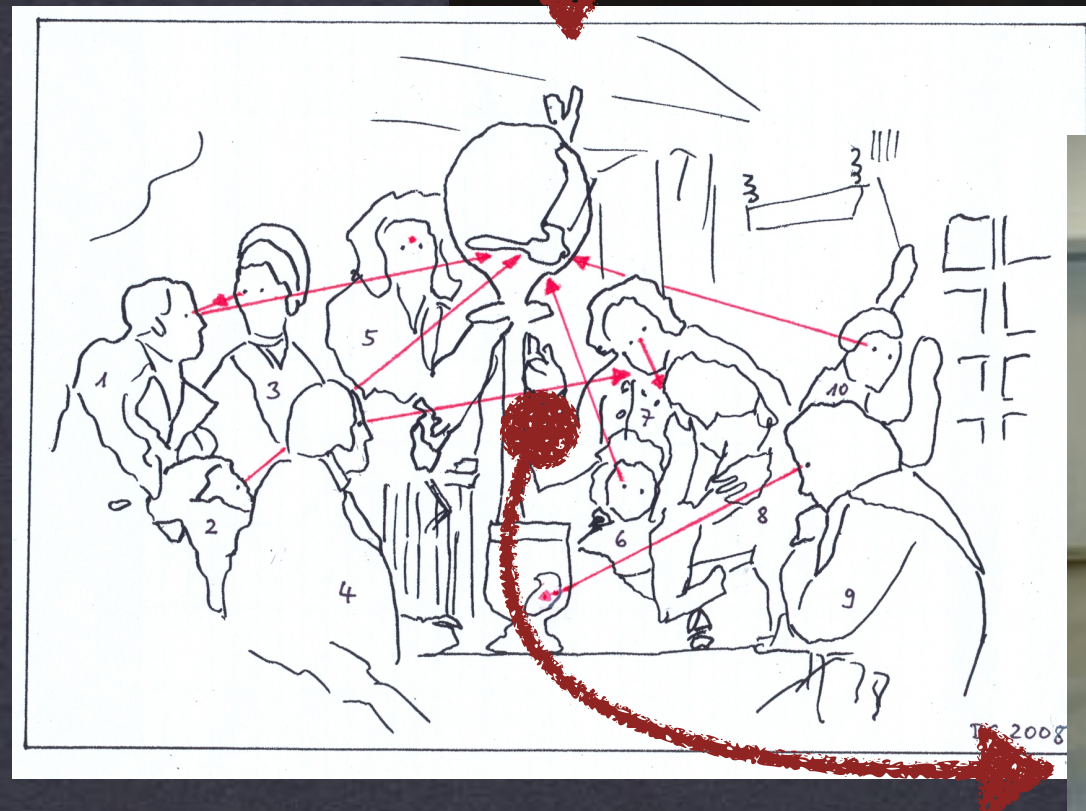


# Additional Workshop





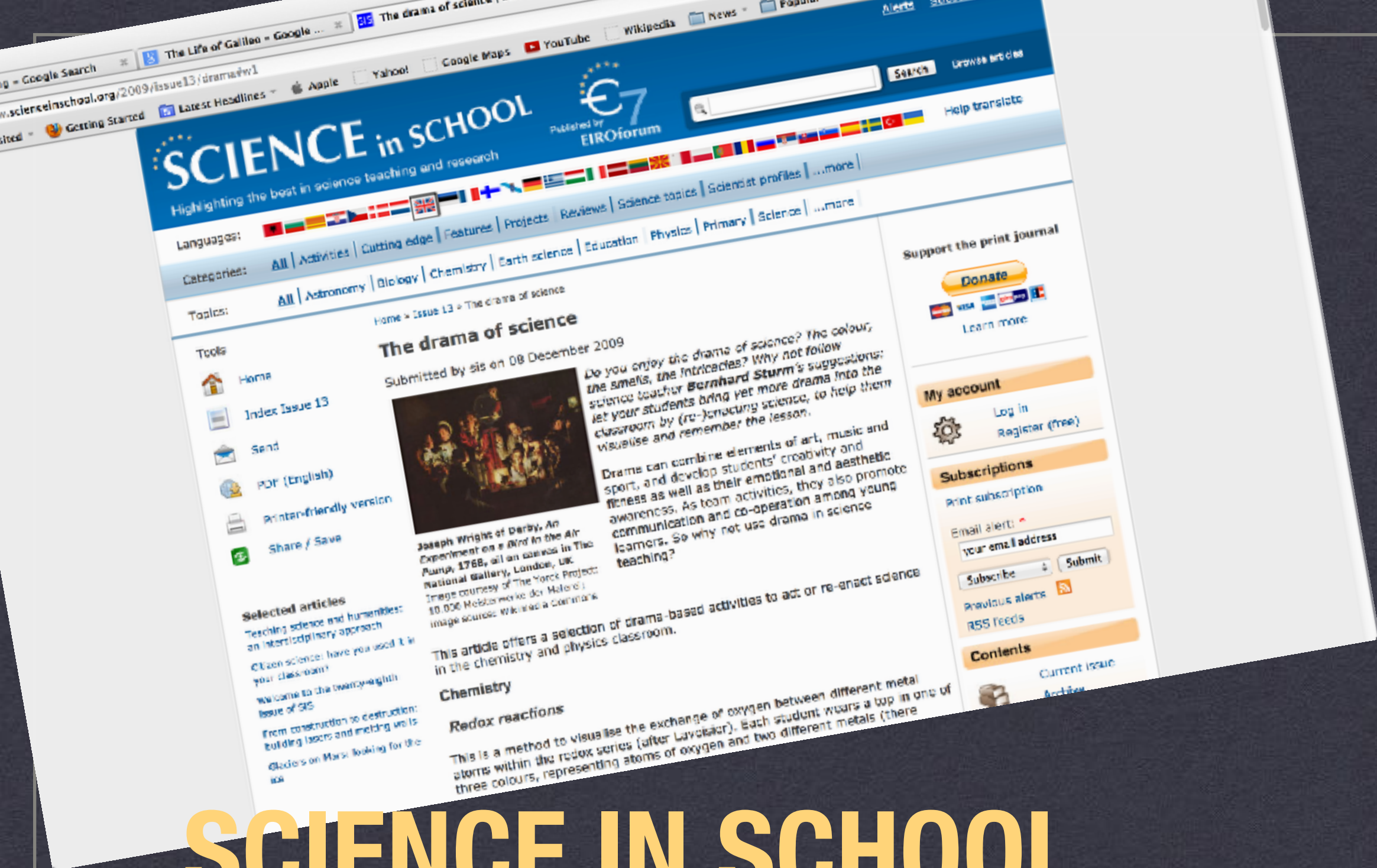
# The Drama of Science



Joseph Wright of  
Derby, *An Experiment on  
a Bird in the Air Pump*,  
1768, oil on canvas in The  
National Gallery, London, UK







# SCIENCE IN SCHOOL

[HTTP://WWW.SCIENCEINSCHOOL.ORG/2009/ISSUE13/](http://www.scienceinschool.org/2009/issue13/drama)  
[DRAMA](#)

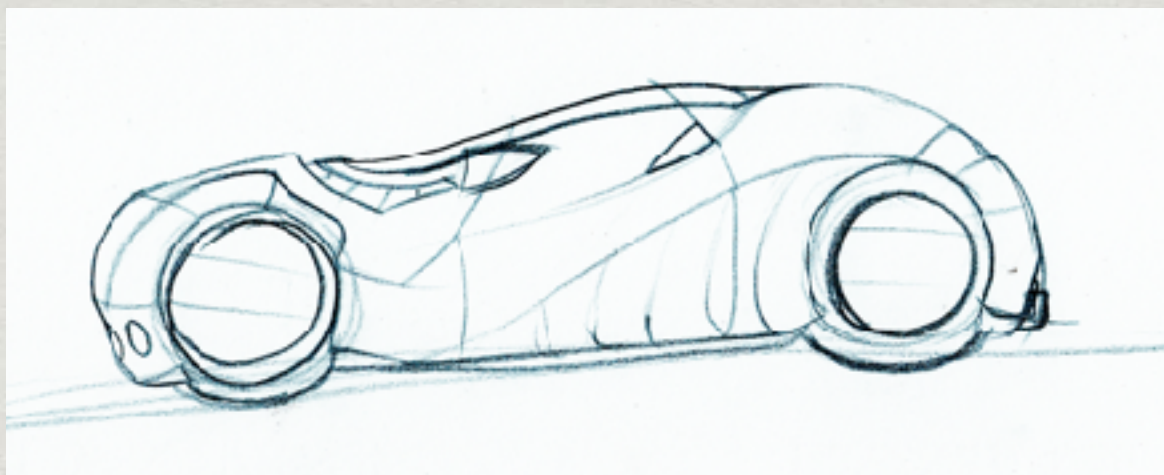


# Challenging science

## Project

You are working on a team developing a new hybrid electrical car

- \* The Head of Research has called a meeting of team working on the project
- \* The project is behind schedule
- \* The research funds are drying up
- \* Team members have been arguing – are not working together well



[http://fc02.deviantart.net/fs70/i/2010/024/1/6/Futuristic\\_Car\\_Design\\_by\\_hao\\_li.png](http://fc02.deviantart.net/fs70/i/2010/024/1/6/Futuristic_Car_Design_by_hao_li.png)

Who are you  
in the team

What are the  
relationships?

What's the  
problem?

Team meeting

Mantle of the expert



# Challenging science

**The dilemma**  
You receive news from the testing field

- \* In tests the new batteries your team has developed keep bursting into flames

Some of you argue that the project must be stopped

Some believe the project must go ahead

Why?

Some are unsure what to do

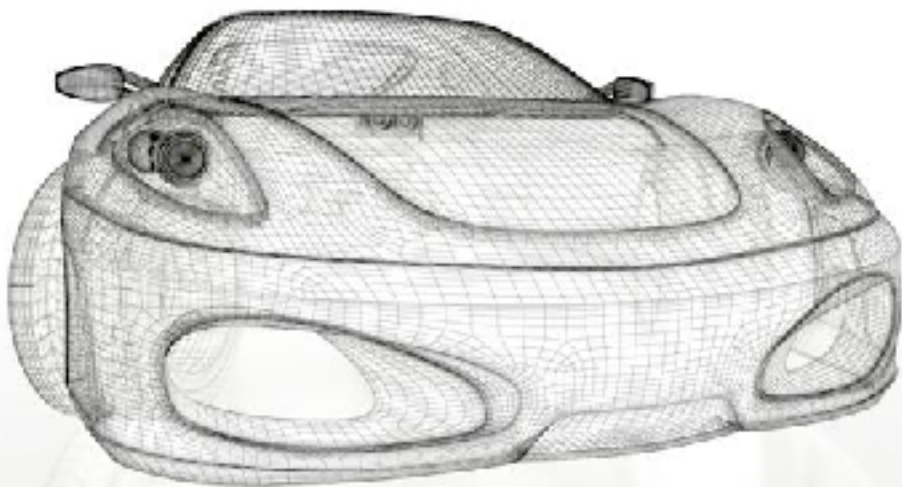
**Improvisation**

**Decision line**

**Stop**

**Maybe**

**Go**



[http://www.slate.com/content/dam/slate/articles/health\\_and\\_science/new\\_scientist/2012/08/120824\\_NS\\_conceptCar.jpg.CROP.rectangle3-large.jpg](http://www.slate.com/content/dam/slate/articles/health_and_science/new_scientist/2012/08/120824_NS_conceptCar.jpg.CROP.rectangle3-large.jpg)



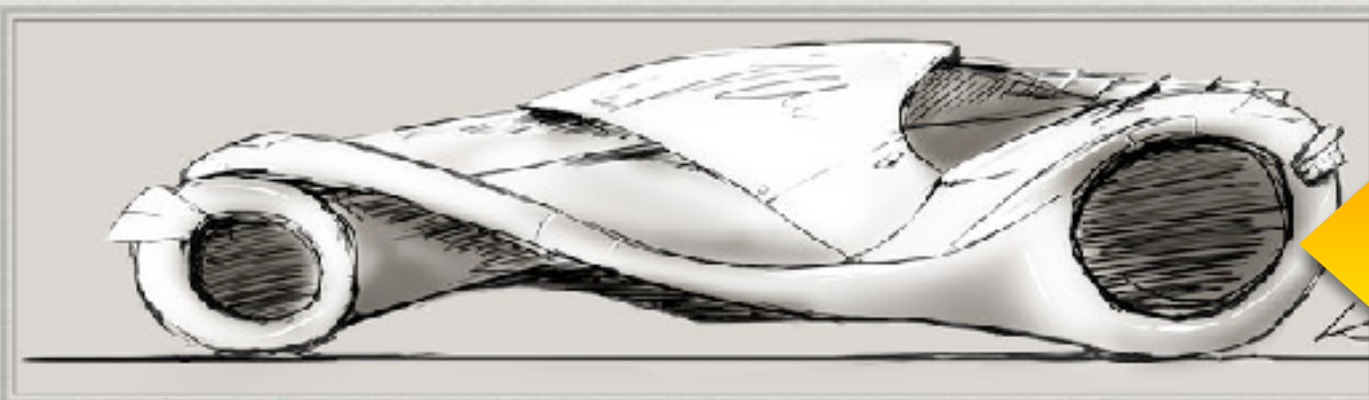
# Challenging science

**In another part of the company...**  
**A meeting of advertising executives**

- \* Your task is to dream up new slogans and advertising campaigns for this new car



[http://bluetoothcar.typepad.com/main/WindowsLiveWriter/AcuraconceptcarsAcuraFutureVehicles\\_78DA/image%7B0%7D%5B3%5D.png](http://bluetoothcar.typepad.com/main/WindowsLiveWriter/AcuraconceptcarsAcuraFutureVehicles_78DA/image%7B0%7D%5B3%5D.png)



[http://fc08.deviantart.net/fs70/i/2012/090/3/0/futuristic\\_car\\_by\\_digital\\_kebap-d4uhn17.jpg](http://fc08.deviantart.net/fs70/i/2012/090/3/0/futuristic_car_by_digital_kebap-d4uhn17.jpg)

Sexy

Identity

Style

Status

Jingle

Sounds

Words

Images

**Improvisation**

**Advertisement**



# Challenging science

**While out testing the car  
on the freeway  
an accident  
the burning batteries in  
car explode,  
bus of children killed**

- \* You are a television news reporter reporting with eyewitnesses from the scene



**News report**

Accuracy

Sense of  
horror

Immediacy



# Challenging science

**Doubt and conscience**



[http://myfreedomfoundation.com/imgLib/20130612\\_Whistleblower.jpg](http://myfreedomfoundation.com/imgLib/20130612_Whistleblower.jpg)

- \* You are a member of the research team who has been troubled that the project team did not listen to your concerns

Truthfulness

Immediacy

Sense of  
horror

Your  
decision



# Challenging science

**The news has broken that  
there is a whistleblower**

\* **The head of the research  
team calls a meeting**



[http://www.insure.com/imagesvr\\_ce/7082/accusing-man.jpg](http://www.insure.com/imagesvr_ce/7082/accusing-man.jpg)

**Accusing all in  
the team**

**Angry**

**Vindictive**

**Trying  
to find out  
who betrayed  
the project**

**Team meeting**

**Teacher in Role**



# Challenging science

**One member of the team  
has admitted**

\* Out of role, the  
participants ask  
questions

Why?

???

What  
are the  
consequences?

Have you  
lost your  
job?

Trying to  
understand what  
has driven this  
whistleblower to  
speak



<http://newsroom.unl.edu/releases/downloadables/newsblog/whistleblower.jpg>

**Hot seating**



# Challenging science

**All the members of the research team after the Head of Research has admitted his mistakes**

- \* As the Manager of the Research team walks between the lines of the researchers we hear what they think of him/her

Should you have stopped the project?

Unsure?

Should it continue?

What are the consequences of scientific decisions?

**Conscience Alley**

**Decision line**



Why might  
this matter?

All science  
faces ethical  
questions and  
choices

Sometimes  
those choices have  
life and death  
consequences



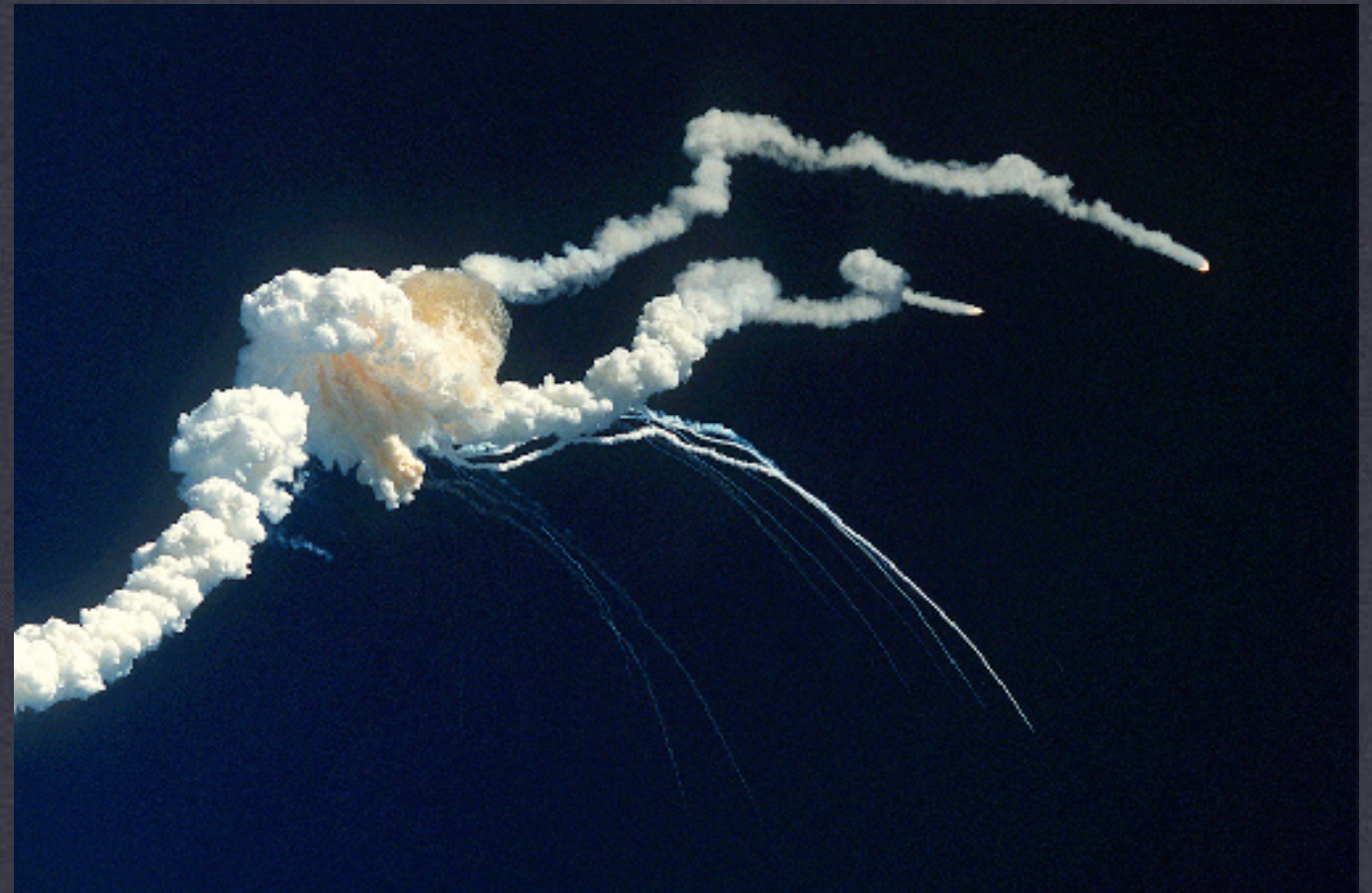
[HTTP://EN.WIKIPEDIA.ORG/WIKI/  
SPACE SHUTTLE CHALLENGER DISASTER](http://en.wikipedia.org/wiki/Space_Shuttle_Challenger_Disaster)





# THE CHALLENGE OF SCIENCE

- The Space Shuttle Challenger disaster occurred on January 28, 1986
- Disintegration of the vehicle began after an O-ring seal in its right solid rocket booster (SRB) failed at liftoff
- NASA managers had known contractor Morton Thiokol's design of the SRBs contained a potentially catastrophic flaw in the O-rings since 1977, but failed to address it properly.
- They also disregarded warnings (an example of "go fever") from engineers about the dangers of launching posed by the low temperatures of that morning and had failed in adequately reporting these technical concerns to their superiors
- The Challenger accident has frequently been used as a case study in the study of subjects such as engineering safety, the ethics of whistle-blowing, communications, group decision-making, and the dangers of groupthink.



[http://www.google.com.au/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&docid=dLyAbEHkpgYSMM&tbnid=40mHF-HzN6ezCM:&ved=0CAUQjRw&url=http%3A%2F%2Fwww.theatlantic.com%2Finfocus%2F2011%2F07%2Fthe-history-of-the-space-shuttle%2F100097%2F&ei=\\_TJTU-iw0ca5lQX5tIGgCw&bvm=bv.65058239,d.dGI&psig=AFQjCNGhn0wJLhp7a5Wcl50aeKlhyxejrA&ust=1398047848279896](http://www.google.com.au/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&docid=dLyAbEHkpgYSMM&tbnid=40mHF-HzN6ezCM:&ved=0CAUQjRw&url=http%3A%2F%2Fwww.theatlantic.com%2Finfocus%2F2011%2F07%2Fthe-history-of-the-space-shuttle%2F100097%2F&ei=_TJTU-iw0ca5lQX5tIGgCw&bvm=bv.65058239,d.dGI&psig=AFQjCNGhn0wJLhp7a5Wcl50aeKlhyxejrA&ust=1398047848279896)

**Discussion: Ethics and responsibility**



# Challenging science

We will replay  
this scene as  
forum theatre

**The dilemma**  
You receive news from the  
testing field

- \* In tests the new batteries  
your team has developed  
keep bursting into flames

Some of  
you argue that  
the project must  
be stopped

Some  
believe the  
project must go  
ahead

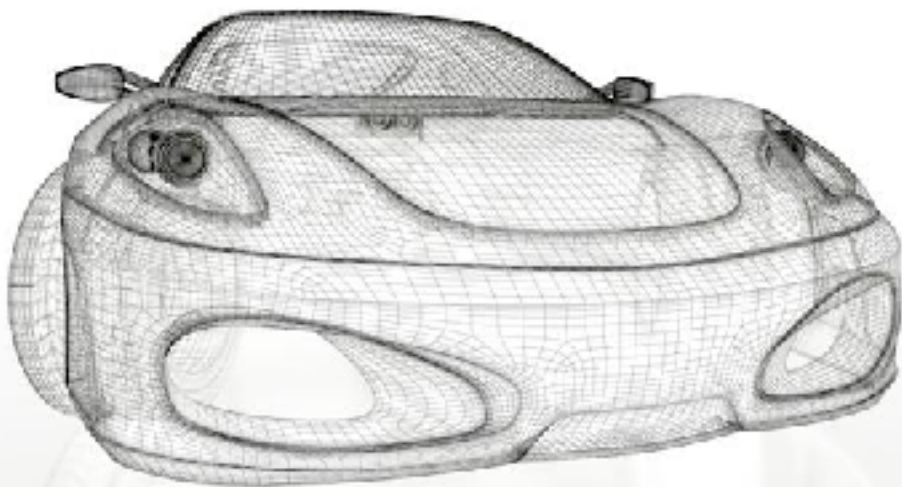
Why?

Some are unsure  
what to do

Stop

Maybe

Go



[http://www.slate.com/content/dam/slate/articles/health\\_and\\_science/new\\_scientist/2012/08/120824\\_NS\\_conceptCar.jpg.CROP.rectangle3-large.jpg](http://www.slate.com/content/dam/slate/articles/health_and_science/new_scientist/2012/08/120824_NS_conceptCar.jpg.CROP.rectangle3-large.jpg)

**Forum Theatre**