A close-up photograph of a person's hand holding a golden key. The hand is positioned on the left side of the frame, with the thumb and index finger gripping the key's head. The key is held horizontally, pointing towards the right. The background is a solid dark blue-grey color.

The Pulse of Knowledge-building

Teaching the 'semantic wave'

Karl Maton
University of Sydney

Plan

- Why bother with ‘Semantics’?
- What is ‘the semantic wave’?
- How can we study and teach the semantic wave?



Why bother?

- Problem of ‘segmentalism’
 - *research*: new knowledge fails to integrate existing knowledge
 - *teaching*: student learn segmented ideas or skills
- Policy focus:
 - need for build knowledge in ‘lifelong learning’ to work in ‘knowledge economies’



Understanding segmentalism

- ‘knowledge’ limited to subjective knowledge
 - focus on learning as generic process
 - focus on ‘whose knowledge?’
 - obscuring of knowledge itself as an object
- accounts of forms of knowledge tend to segmentalism themselves
 - dichotomous types



Typologies of knowledge

- Biglan (1973): hard / soft, pure / applied
- Kolb (1981): abstract / concrete, active / reflective
- Becher (1994) used mixture of above typologies
- Other typologies:
 - effective / ineffective
 - elaborated / restricted
 - context-independent / context-dependent
 - singulars / regions
 - conceptual / contextual
 - generalizing / localizing



More typologies

Bernstein	vertical discourse	horizontal discourse
Bourdieu	theoretical logic	practical logic
Foucault	programmes	technologies
Freud	ego	id
Levi-Strauss	science	bricolage
Levy-Bruhl	modern thinking	primitive thinking
Lotman	rule-governed	exemplary texts
Luria	abstract thinking	situational thinking
Piaget	science/effective thought	technique/sensori- motor
Sohn-rethel	intellectual	manual
Vygotsky	conceptual thinking	complex thinking
Walkerdine	formal reasoning	practical reasoning



Problems

- dichotomous types that describe features of knowledge
- lack analysis of organising principles
- empirical practices do not fit the types perfectly
- no account of processes of change between forms
 - e.g. how to move from one form to another



Bernstein's typology

- Horizontal discourse
 - everyday knowledge: 'local, segmentally organised, context specific and dependent' (1999: 159)
- Vertical discourse
 - 'takes the form of a coherent, explicit, and systematically principled structure' (1999: 159)
- Knowledge structures
 - *hierarchical*: integration and subsumption
 - *horizontal*: accumulation and segmentation



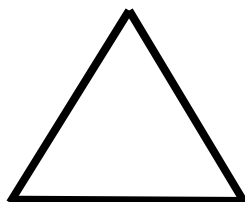
Adding to Bernstein

- *hierarchical curriculum structures*
 - parts of curriculum build on and integrate previous knowledge
- *horizontal curriculum structures*
 - segmented series of skills or knowledge
- *cumulative learning*
 - knowledge transferred across curricular and pedagogic contexts
- *segmented learning*
 - knowledge is locked into its curricular and pedagogic contexts, problematising transfer



Knowledge structures

Hierarchical

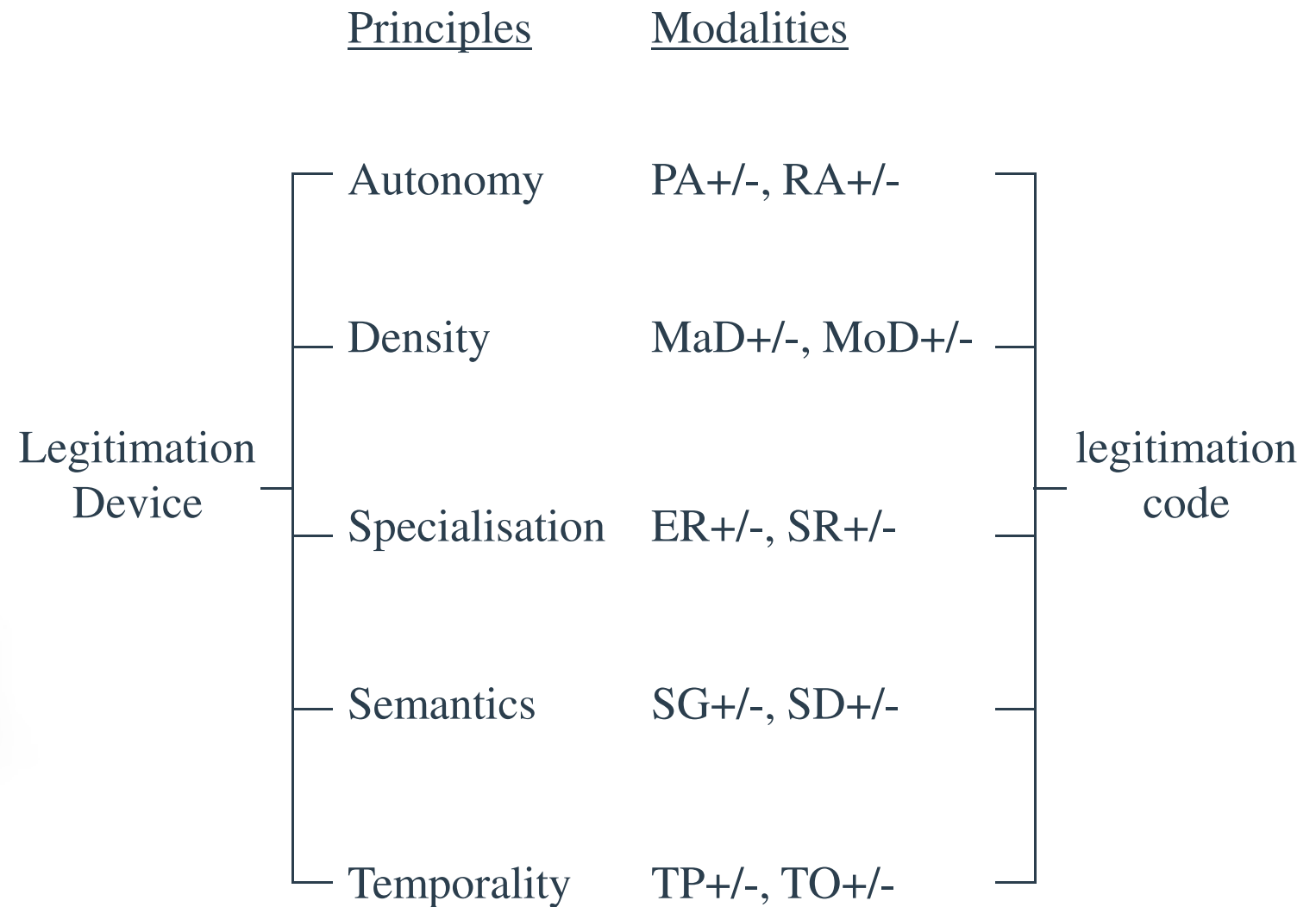
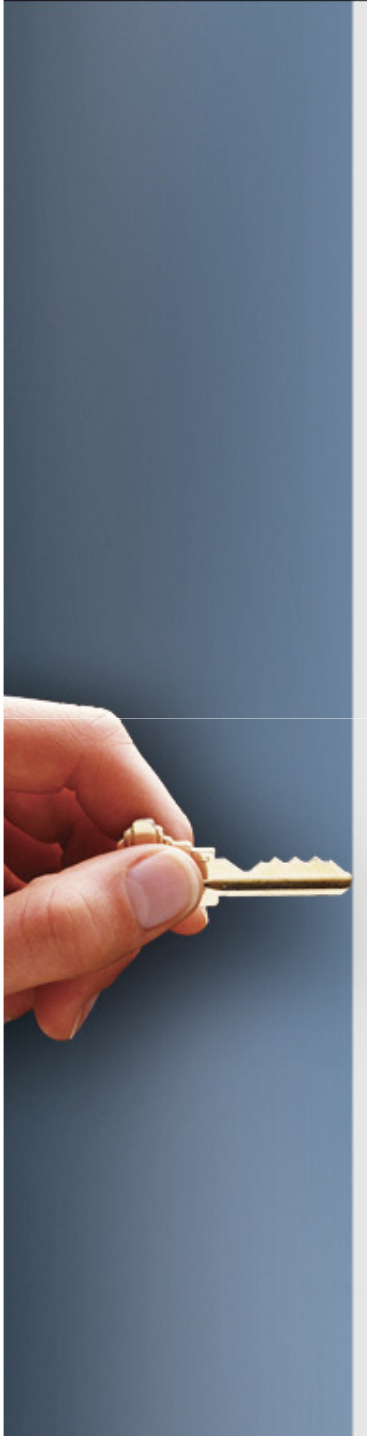


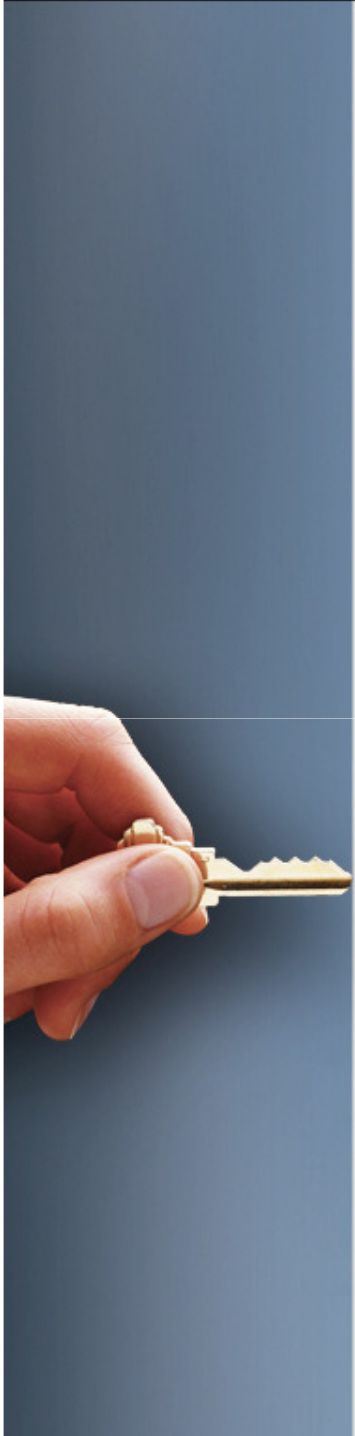
‘an explicit, coherent, systematically principled and hierarchical organisation of knowledge’ which develops through integrating ‘knowledge at lower levels, and across an expanding range of phenomena’

Horizontal



‘a series of specialised languages, each with its own specialised modes of interrogation and specialised criteria ... with non-comparable principles of description based on different, often opposed, assumptions’





<u>Principle</u>	<u>Referent relations</u>	<u>Concepts</u>
Autonomy	external	positional autonomy, relational autonomy
Density	internal	material density, moral density
Specialisation	social- symbolic	epistemic relation, social relation
Semantics	meaning	semantic gravity, semantic density
Temporality	temporal	temporal positioning, temporal orientation

Semantic gravity

- degree of context-dependence of meaning
- can be stronger (+) or weaker (-) along a range of strengths
 - weaker = less context-dependent
 - stronger = more context-dependent

weaker SG

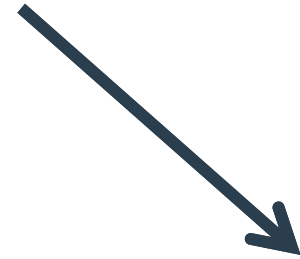


stronger SG



Semantic gravity

- *strengthening* semantic gravity
 - e.g. moving down from abstract concept to concrete examples
- *weakening* semantic gravity
 - e.g. moving up from concrete examples to more abstract ideas



Semantic density

- degree of condensation of meaning
- can be stronger (+) or weaker (-) along a range of strengths
 - weaker = fewer meanings are condensed
 - stronger = more meanings are condensed

stronger SD

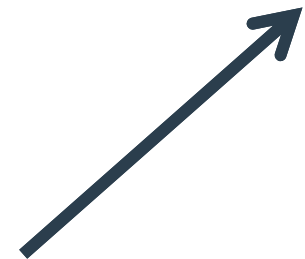
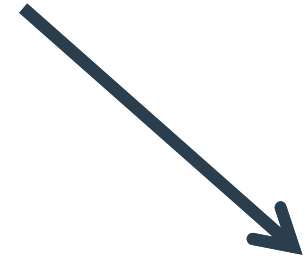


weaker SD



Semantic density

- *weakening* semantic density
 - e.g. ‘unpacking’ a dense concept by putting it into everyday language
- *strengthening* semantic density
 - e.g. taking a lengthy description and ‘packing it up’ into a symbol or technical term



Semantics

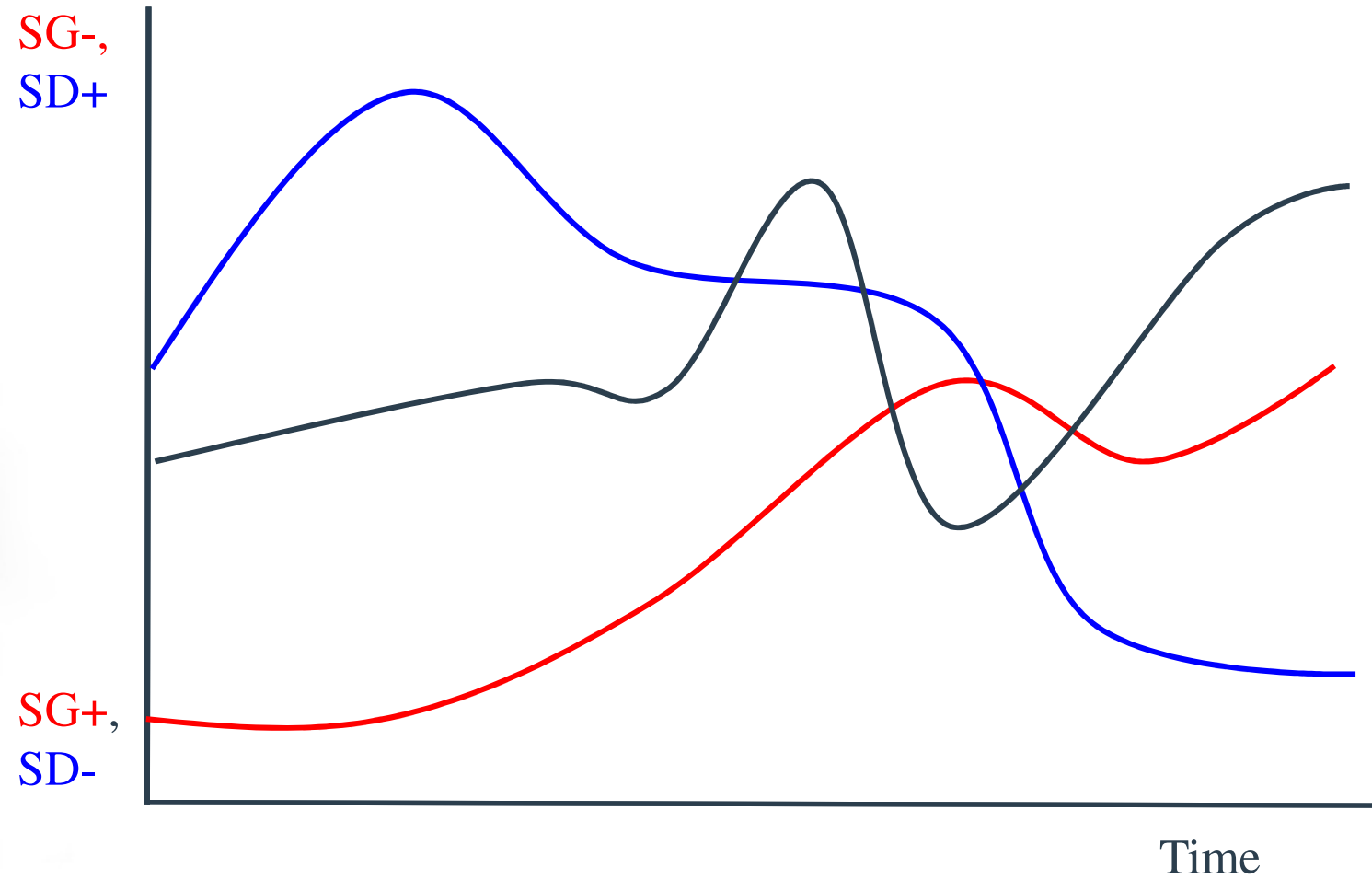
- Semantic codes: SG+/-, SD+/-
 - organising principles rather than dichotomous types
- Chart change over time: SG↑↓, SD↑↓
 - semantic profiles
 - semantic wave
 - semantic flatline

Plan

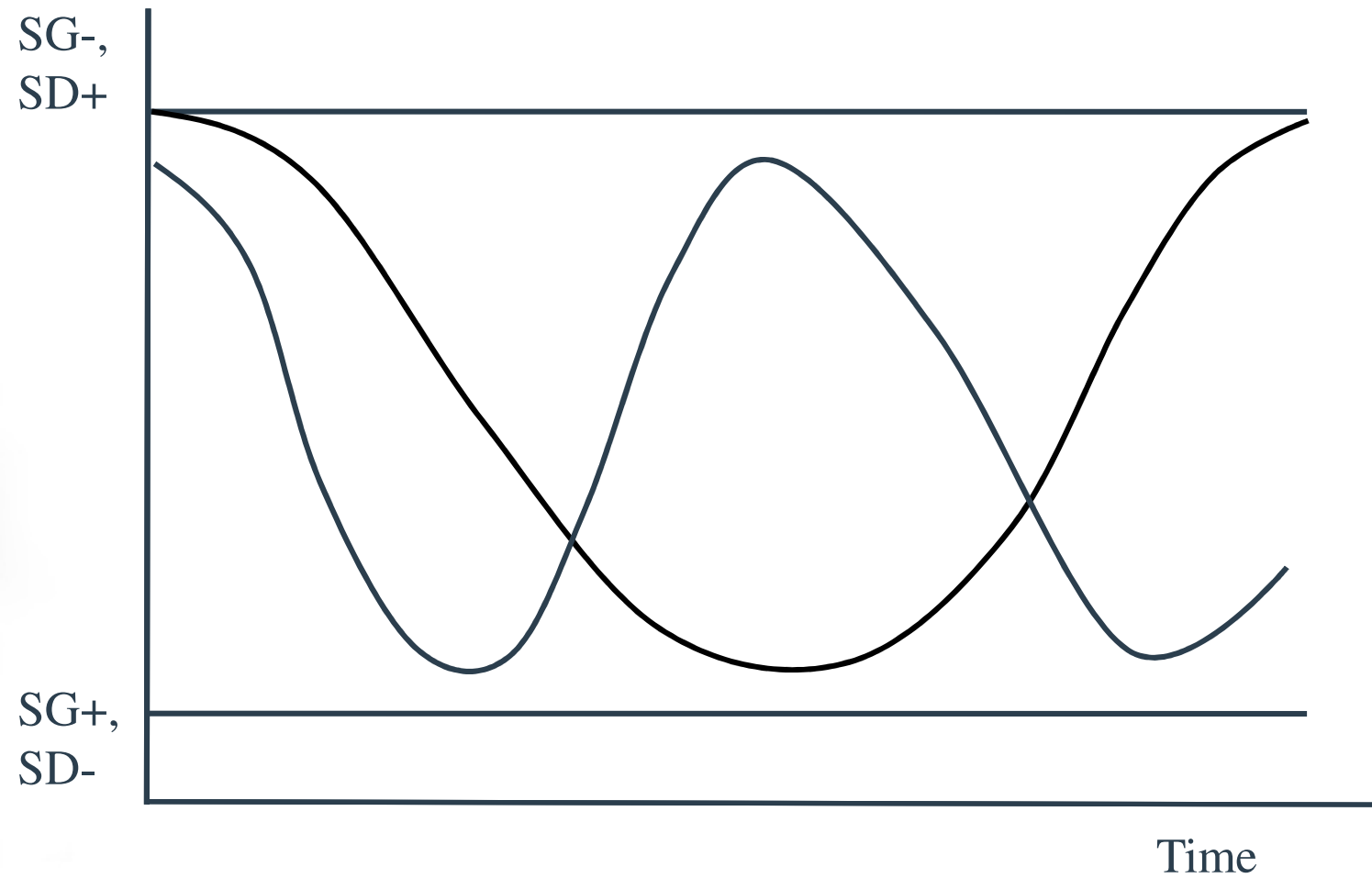
- Why bother with ‘Semantics’?
- **What is ‘the semantic wave’?**
- How can we study and teach the semantic wave?



Semantic profiles



Semantic profiles



School English

- School English: ‘The Journey’
 - secondary school in New South Wales (Australia)
 - HSC qualification
 - compulsory for all students
 - physical, imaginative or inner journeys
- ‘Imaginative Journeys’: texts which ‘take us into worlds of imagination, speculation and inspiration

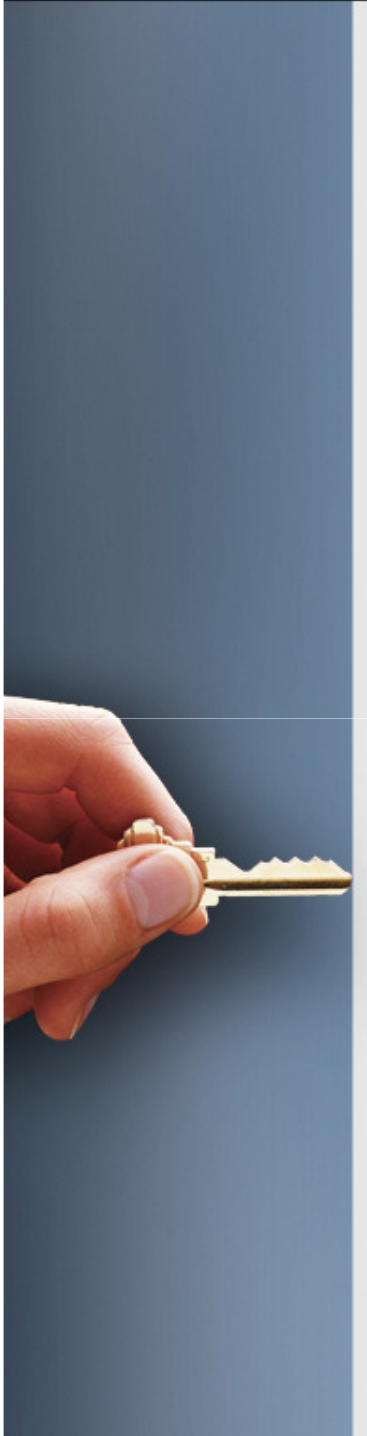


Question, 2008

“To what extent has studying the concept of imaginative journeys expanded your understanding of yourself, of individuals and of the world?”

Answer must refer to the course textbook, one text from list below, and at least one other text of their own choosing.

Ender's Game by Orson Scott Card; *The Tempest* by Shakespeare; a selection of Coleridge's poems; *On Giant's Shoulders* by Melvyn Bragg; the movie *Contact*.

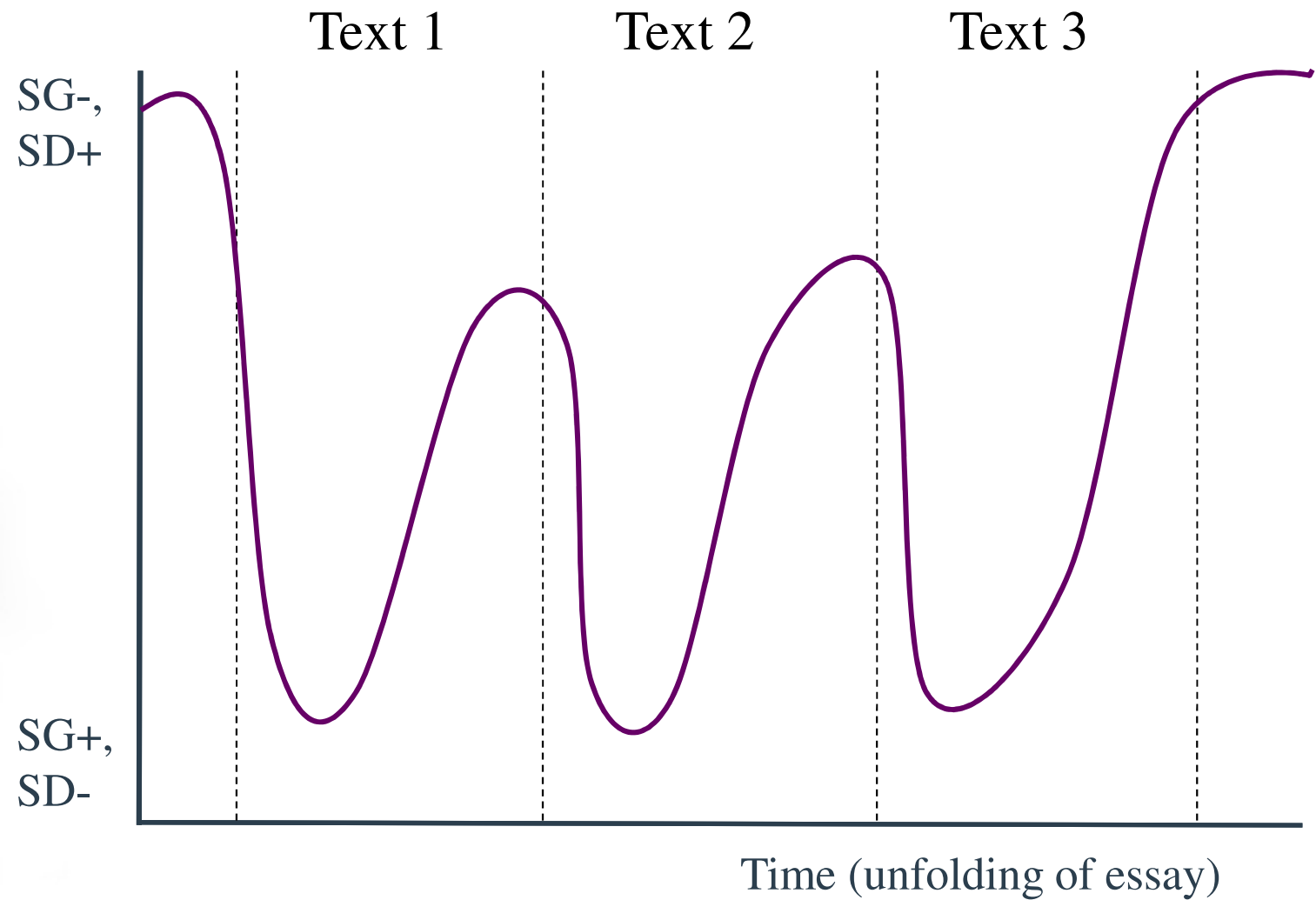


High grade essay

- begins from high on semantic range
 - ‘The journey, especially in the imaginative sense, is a process by which the traveller encounters a series of challenges, tangents and serendipitous discoveries to arrive finally, at a destination and/or transformation.’
- down to example of text, then straight up again; e.g.:
 - *On Giants’ Shoulders* depicts the individual lives and achievements of 12 scientists as a collective imaginative journey over the last 2500 years. In portraying their separate profiles as one story in a chronological line up, Bragg delineates the concept of a cumulative and ongoing journey, reflected in his thesis that science is “an extended kind of continuous investigation”.



Semantic profiles

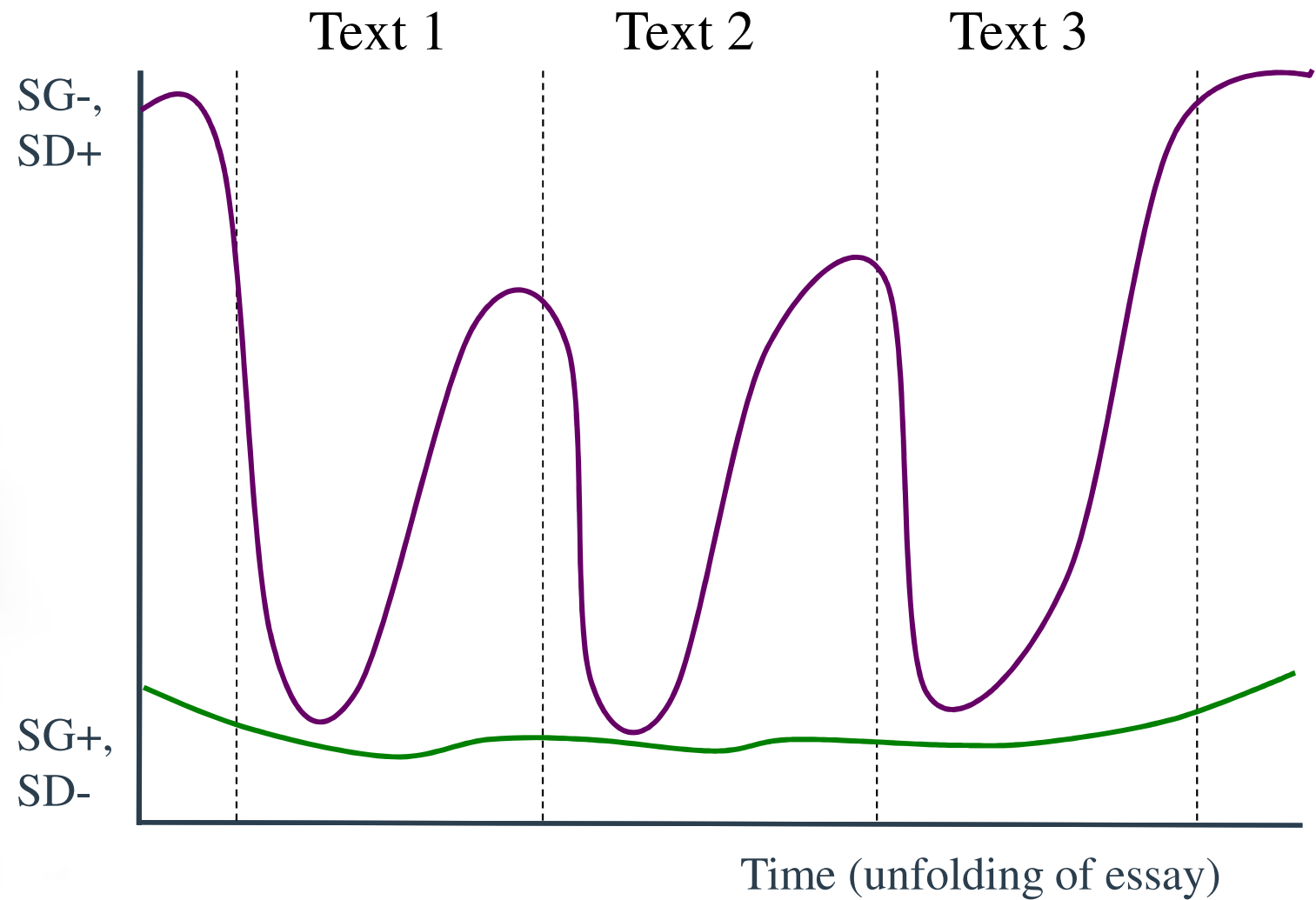


Low grade essay

- segmented form
 - ‘I took on three wonderful journeys’
- observations are concrete
 - ‘I could relate to Ender in many ways and I didn’t stop to think this story wasn’t actually real ... I was so involved that I truly thought what was happening around Ender and I was reality.’
- personal response
 - ‘I felt very empathetic towards the character Ender. I found myself involved in the novel, travelling my Imaginative Journey alongside Ender. I felt that Ender was a friend of my own.’



Semantic profiles



Semantic ranges and profiles

- wave as basis of cumulative learning
- wave as profile of cumulative research
- relations between students' semantic ranges and those required for success
- Semantic concepts:
 - move beyond dichotomous types
 - can trace change over time
 - not locked into an object: can be used to analyse learning, curriculum, research, etc



Plan

- Why bother with ‘Semantics’?
- What is ‘the semantic wave’?
- **How can we study and teach the semantic wave?**



DISKS Project

- ‘Disciplinarity, Knowledge and Schooling’
- funded by Australian Research Council
 - Chief Investigators: Peter Freebody, J. Martin and K. Maton
- Discussion today:
 - Karl Maton, J.R. Martin, Erika Matruglio and Lucy MacNaught



Project

- Questions
 - How is cumulative learning enabled in classrooms?
 - How does this differ across subjects?
 - How can we help teachers improve cumulative learning?
- Approaches
 - Legitimation Code Theory (Specialization, Semantics and Temporality)
 - Systemic functional linguistics
 - Ethnomethodology



Timeline

1. Investigation

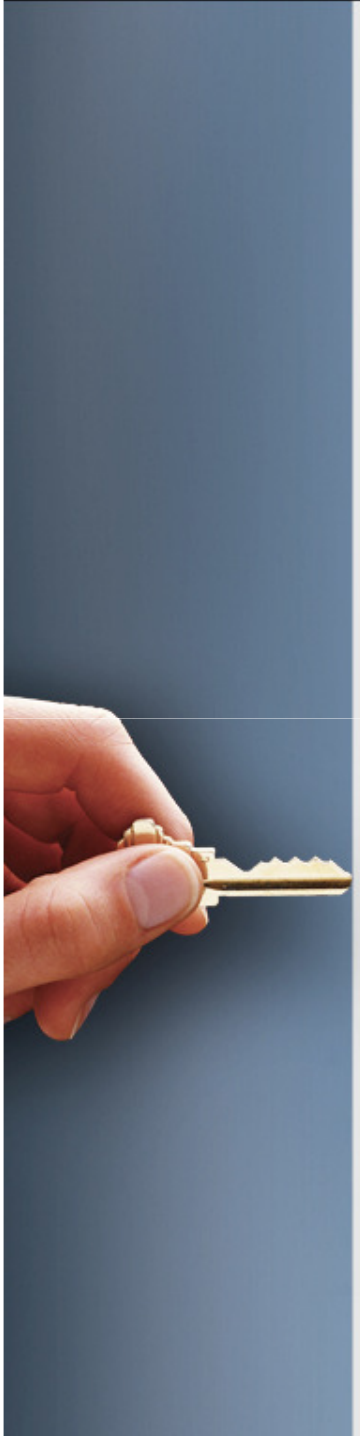
- ethics and recruitment
- classroom observation
- student work samples

2. Analysis

- shifts in gravity and density
- shifts in temporality

3. Intervention

- collaboration with teachers
- data collection and analysis
- teacher symposium



Phase 1: data collection

- New South Wales, Australia
 - secondary schooling
 - Year 8 (ages 13-14) and Year 11 (ages 16-17)
 - 100 lessons in Science/Biology (55) and History (45) of 1 hour each
 - 6 urban schools and 2 rural schools
- ... a lot of videorecording and samples of student work

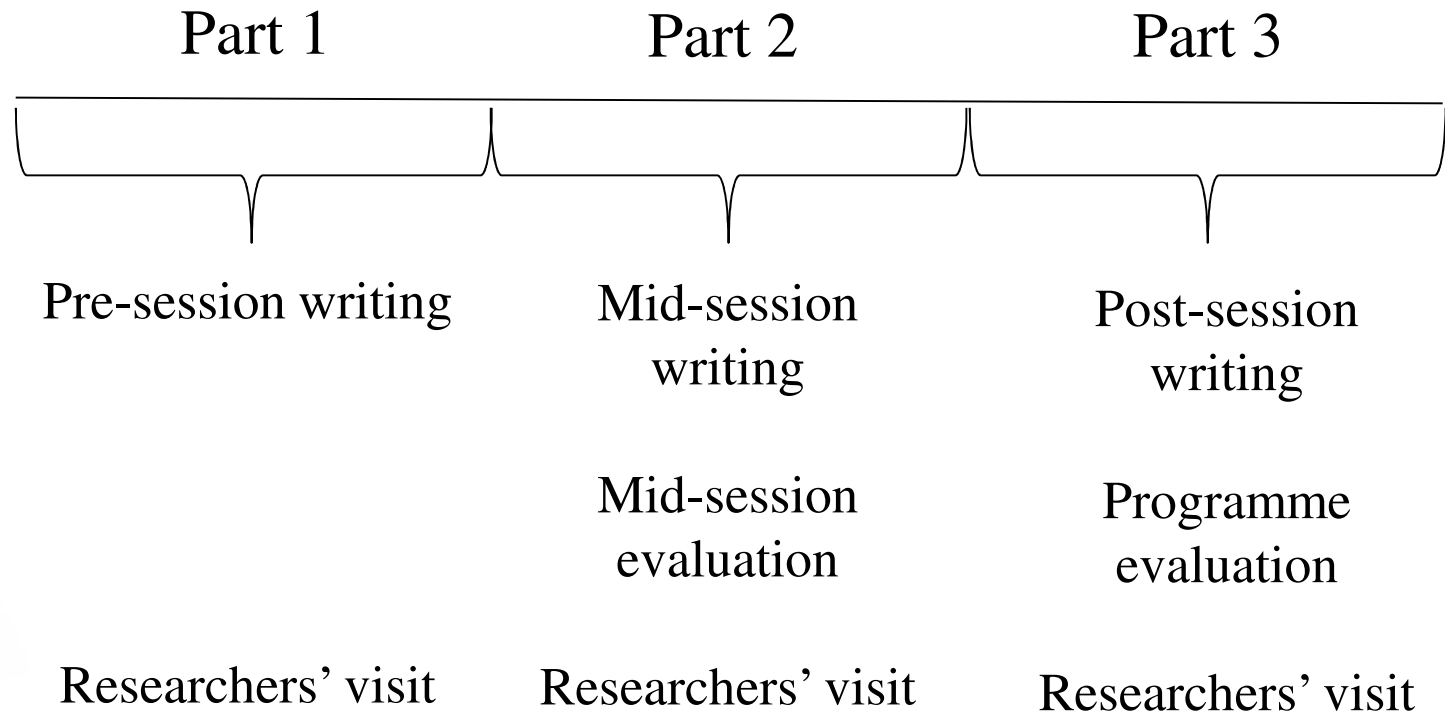




Phase 3: collaborative intervention

- Intensive training with teachers from 4 schools (2 urban & 2 rural)
- Sessions on our analysis
 - semantic wave (LCT)
 - how appears in language (SFL)
- Workshops
 - using ‘Joint Construction’ to achieve wave
 - planning teaching and learning activities appropriate to their discipline and classes

Collaborative interventions



Teaching people to wave

1. semantic wave modelled in teaching
 - why bother with waves?
 - incomplete waves
2. waving in language of teaching
 1. how to model waving to students
 - ‘Joint Construction’ of waves



T Okay B [student's name] what are the 'cilia'. What was it? No? A [student's name] do you know what cilia is? No? Someone must know what they are...

S Hairs

S The little hairs?

T The little hairs. And basically, they beat in an upward motion from inside your body out through to your nose. ((Teacher is waving arms up)). So, they beat up and they take the pathogens away with them. And, guys, I don't know if I've ever told you this but when you smoke cigarettes, the tar actually causes your cilia to, because its so heavy, to drop, and so your cilia don't work probably after that because they're too heavy they've dropped, so they can't beat the pathogens out of your body! So that's one reason that smoking's bad as well. Okay! Alright, write this down under description!





((Teacher writes on the board))

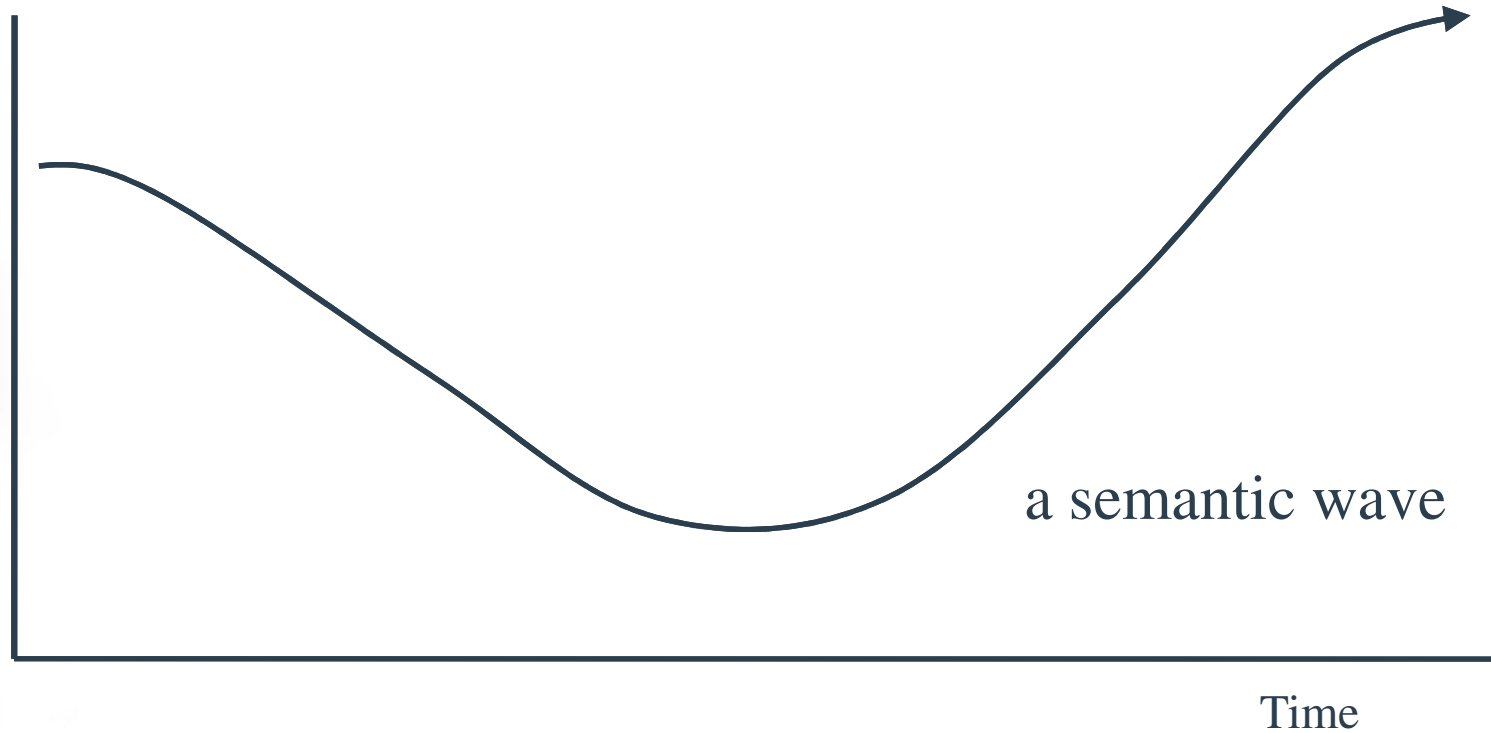
cilia	Hair-like projections from cells lining the air passages	Move with a wavelike motion to move pathogens from the lungs until it can be swallowed into the acid of the stomach
-------	--	---

*conceptual
term*

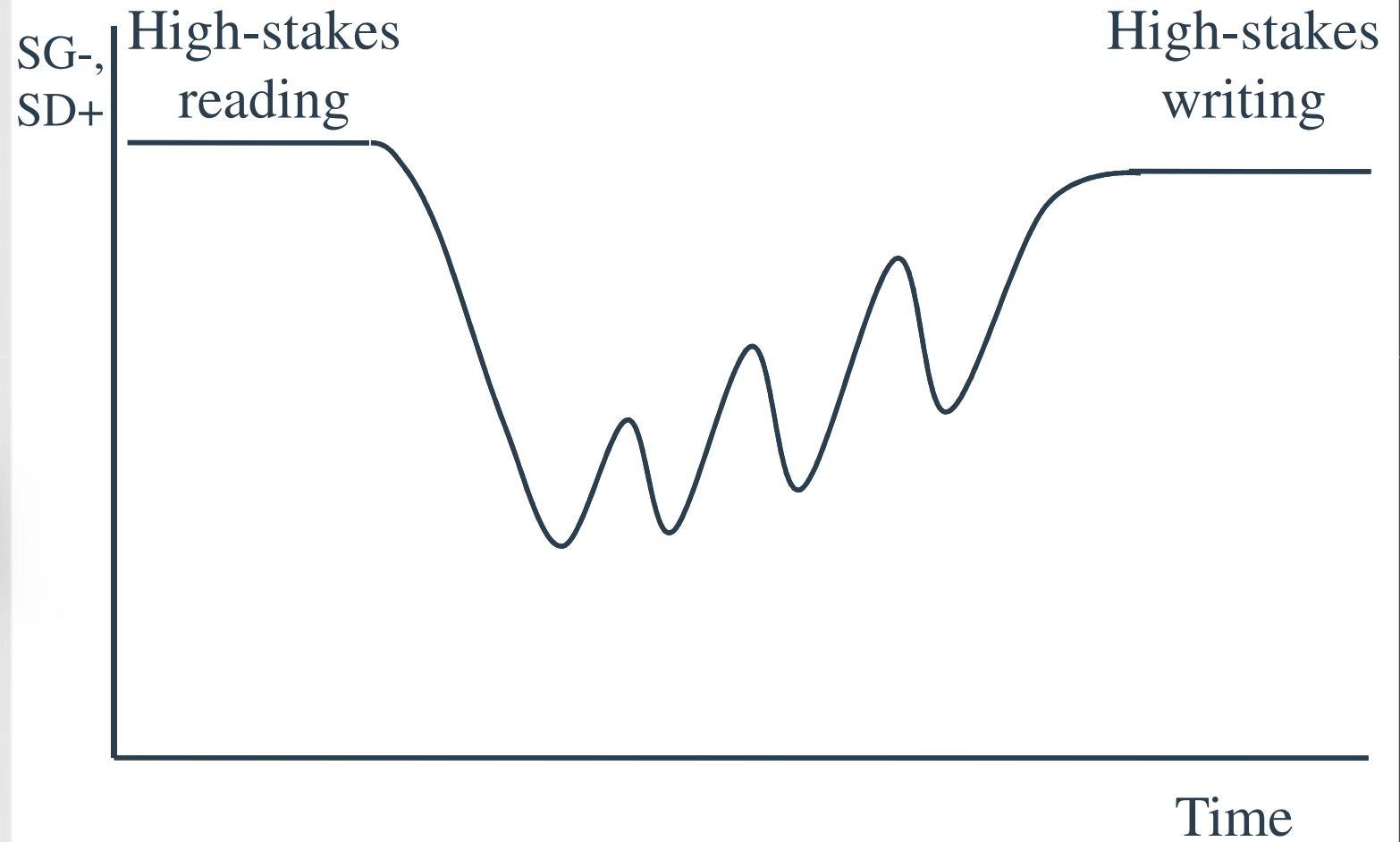
*unpacking of term using
previously learnt terms,
everyday language and body
language, including an
example from everyday life*

*repacking of
descriptions into
table*

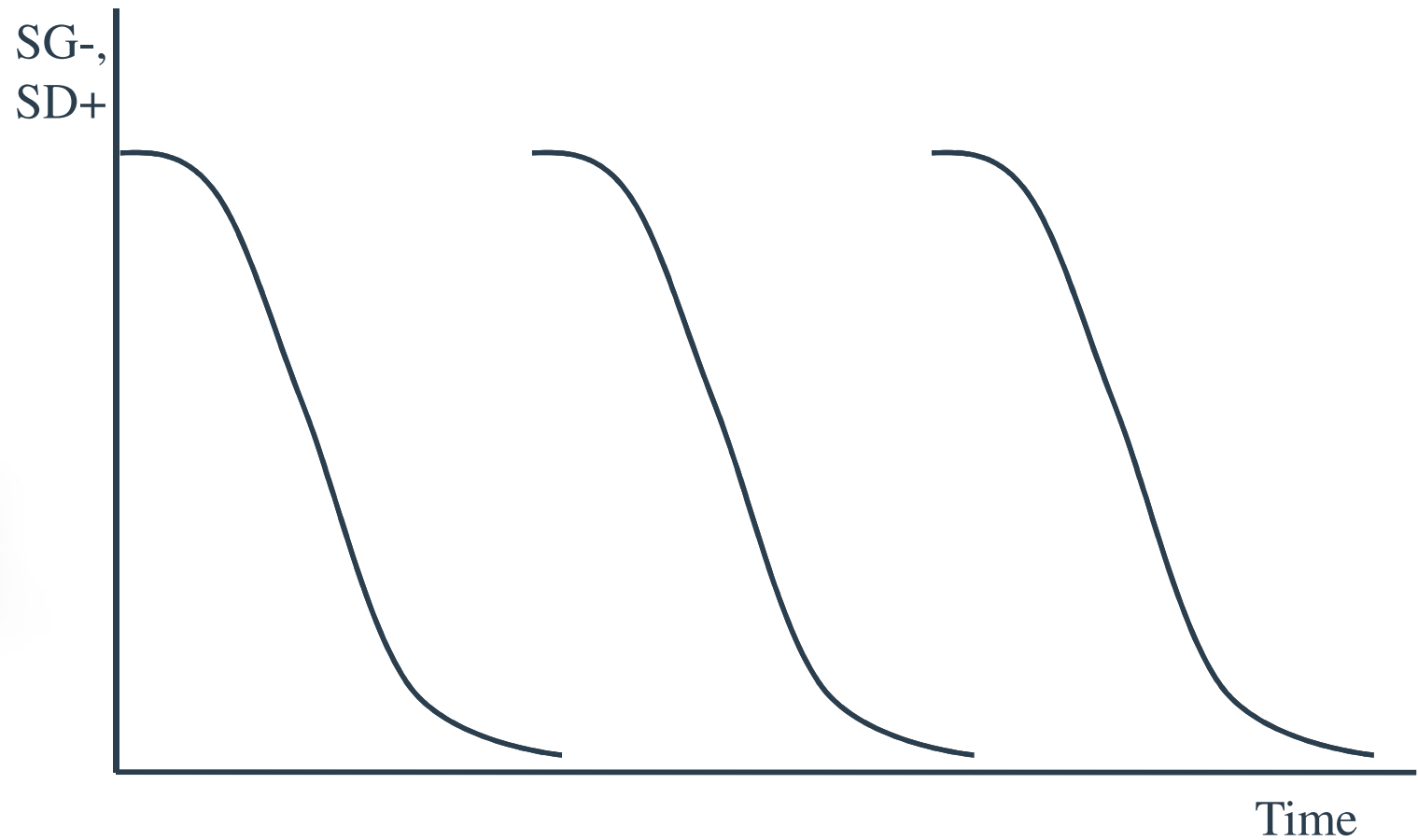
SG-,
SD+

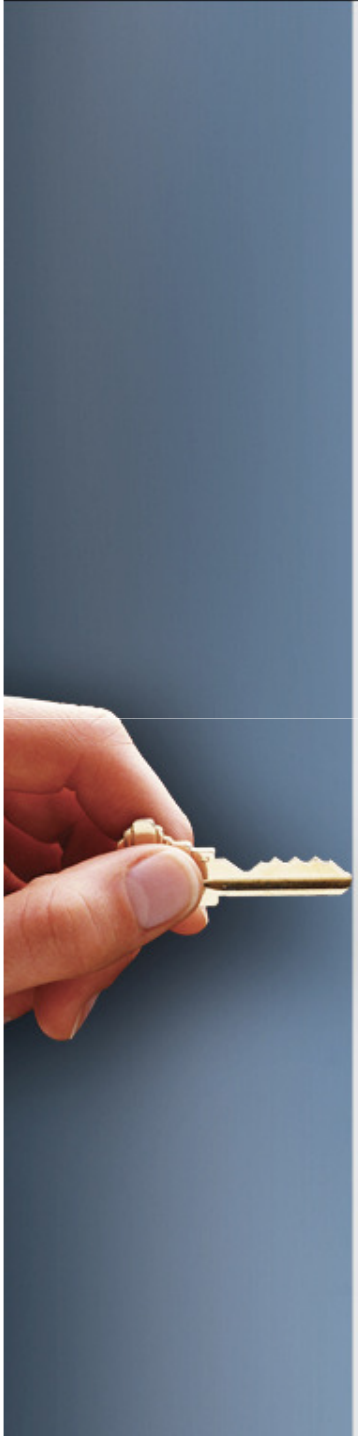


What's at stake

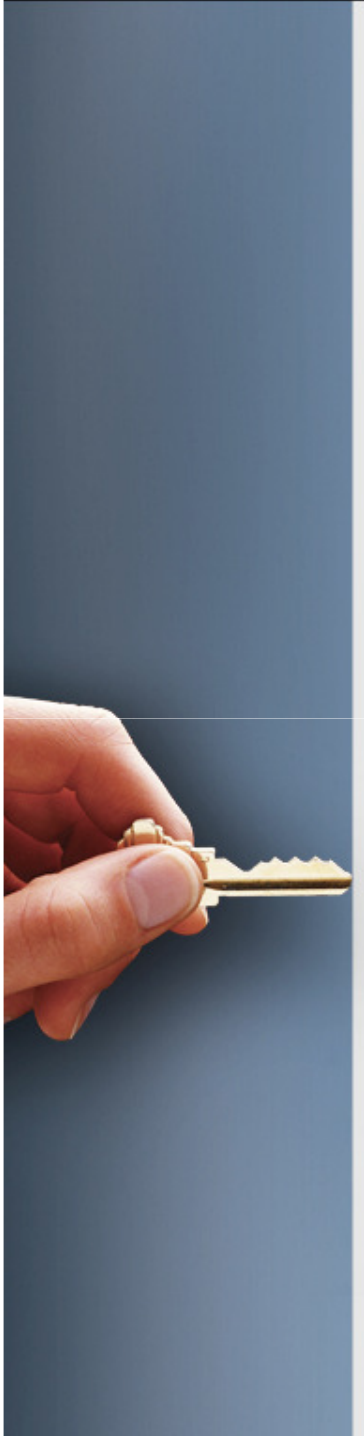


Half wave (the broken elevator)





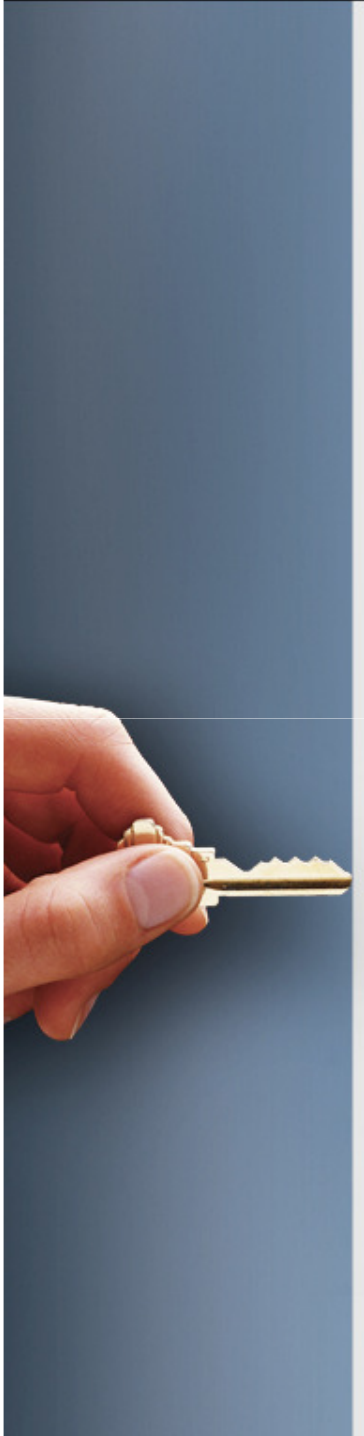
T This is a little bit hard, “H. THE INFLUENCE OF GREEK AND EGYPTIAN CULTURES”. What does that mean? What would the influence of Greek and Egyptian cultures mean, okay? No idea, right. What it means is, if we started to, look at all the things in Pompeii and Herculaneum, what objects may be showing Greek design? Or Egyptian design? Or Greek mythology? Or Egyptian mythology? Or what building techniques, like columns? Are there Greek columns? Do, you know, are the themes of their artwork reflecting it? So, it’s saying ...remember when we started, we said that Pompeii had originally been settled by Greeks? Okay? And if we look at where Italy is it’s not that far from Egypt at this time, umm, we’ve, we’ve had, umm ... Cleopatra has been killed by the time the volcano erupts, she and Mark Antony are dead and Egypt is part of the Roman empire.



T So, there would be massive amounts of trade going on, and umm, you know people visiting their diplomats you know or their, their, ambassadors... like their envoys and things like that all going back and forth across the countries. So, ideas. When you get trade in ideas - you wouldn't have heard this word before - we call it 'aesthetic trade'. Have you heard of it? Yeah

S You told us before

T Ohh! Told you before great, *excellent*! You remember aesthetic trade! 'Trade in ideas'. So, of course, when you've got contact with the country you're gonna get the trade in ideas coming as well.



T So that's what that one is. It looks hard, but all you've gotta do is have a look and think what things are there. Let me give you a big clue some of them are massive. Laah-la-lah-la- la-la-la-la-lahh, la-lah

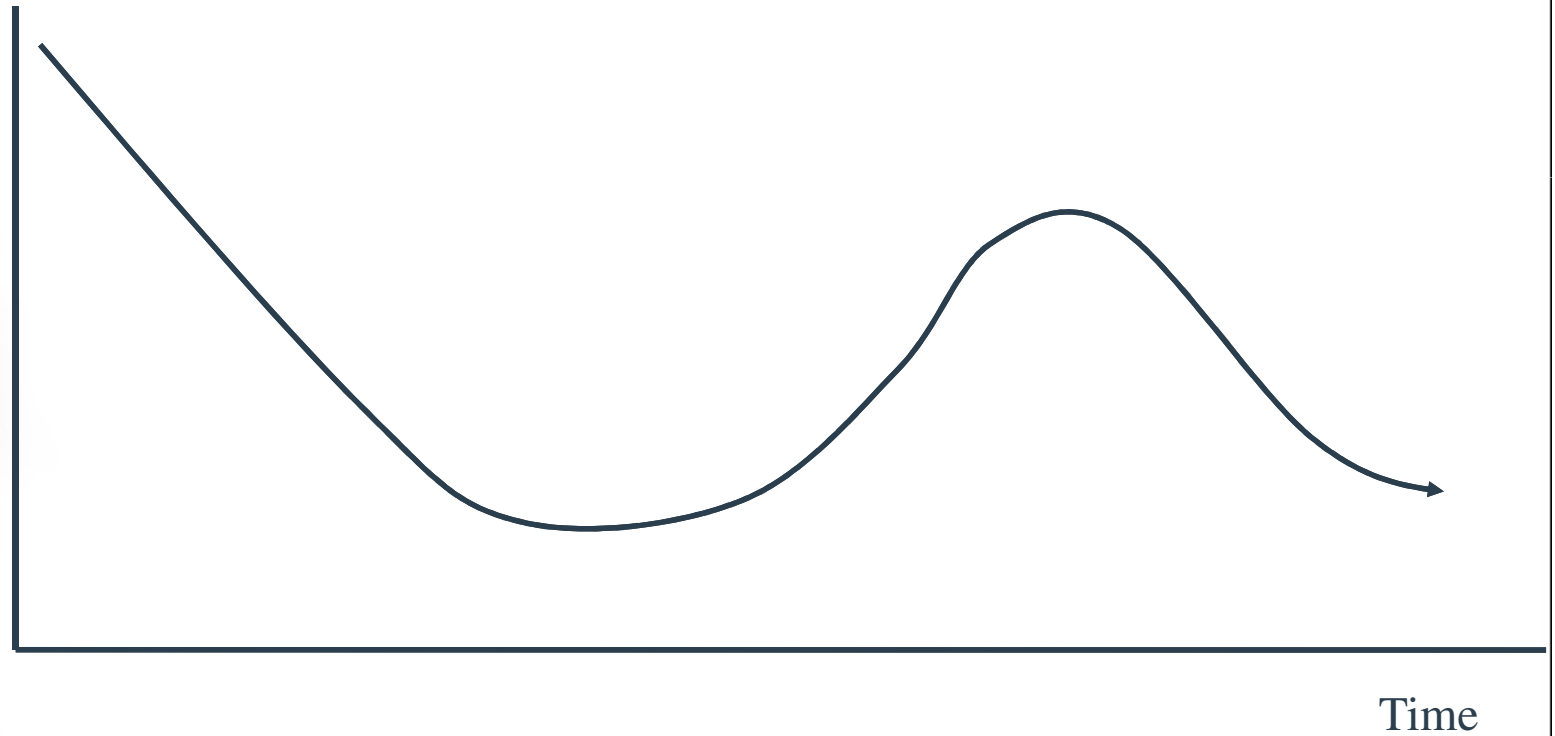
S Theatres

S La-lahh

T Theatres. Okay theatres are a Greek design. The Greeks invented the theatre, and then the Romans take the idea because they like it too. So, some of them are very obvious.

<i>question</i>	<i>unpacking with examples and grounding in context of period</i>	<i>repacking into 'aesthetic trade'</i>	<i>new examples</i>
-----------------	---	---	-------------------------

SG-,
SD+



Waving in biology

Re-enacting

S Disinfect the benches=

T Disinfect the benches. Why.

S To get rid of any other microbes?

T Good. Okay, next...

S Disinfect the benches and then we -
ahh, oh over the Bunsen burner
((inaudible)) and then the inoculation
loop...



Beginning to move up

T Alright you're doing more than one, so you've got the Bunsen burner, why.

S To kill the microbes

T Yes, which microbes.

S The one on the ((inaudible))

T Oh, when you're actually inoculating, yes you wanna make sure that any microbes on the loop are killed. Well, what else are we trying to-do? ((waving)) I'm trying to give you clues!

S Convections

T The convection currents, and remember what the convection currents is they move any microbes in the vicinity away. So they're not going to drop-on your sample.



So far...

- cumulative learning depends on mastering semantic waves
- moving down grounds knowledge in concrete examples and the already known
- moving up reaches beyond context and everyday language to enable transfer of knowledge across contexts and so build on the past
- Next: how does this happen in language?



How to ‘wave’ in language

- ‘power words’
 - terms with stronger density and weaker gravity
- ‘power grammar’
 - nominalisation
 - explanation (cause in the clause)

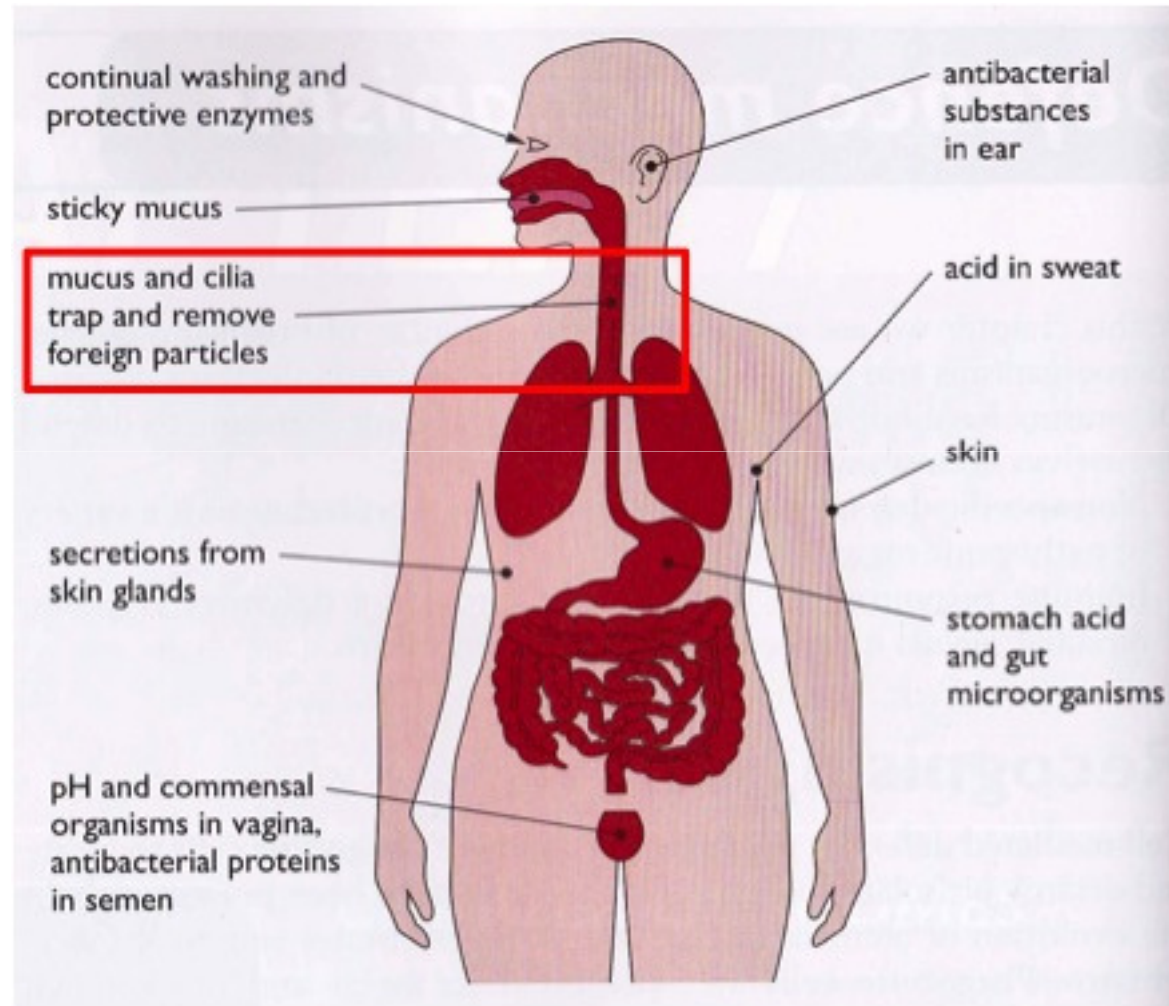


Biology example



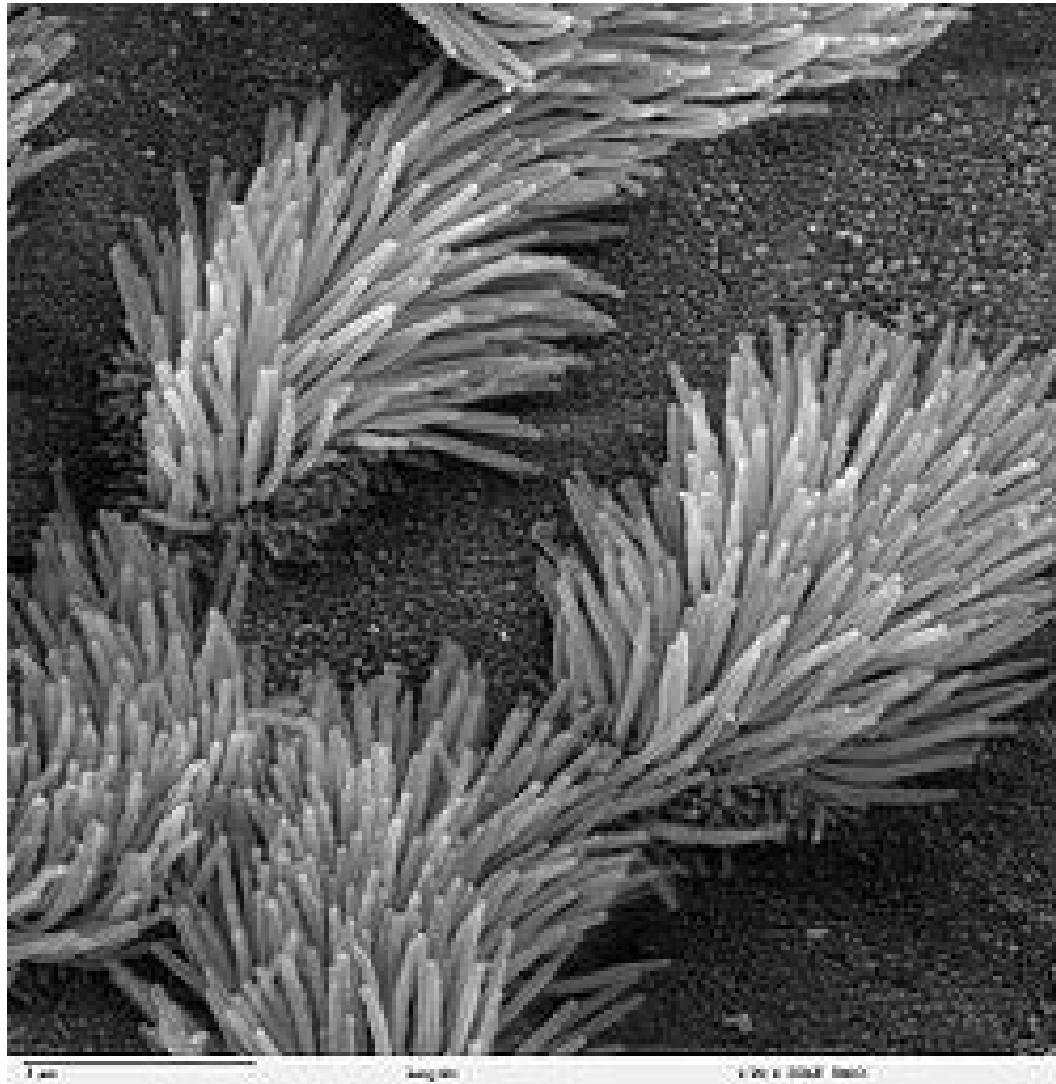
Composition

- location in body (physiology)



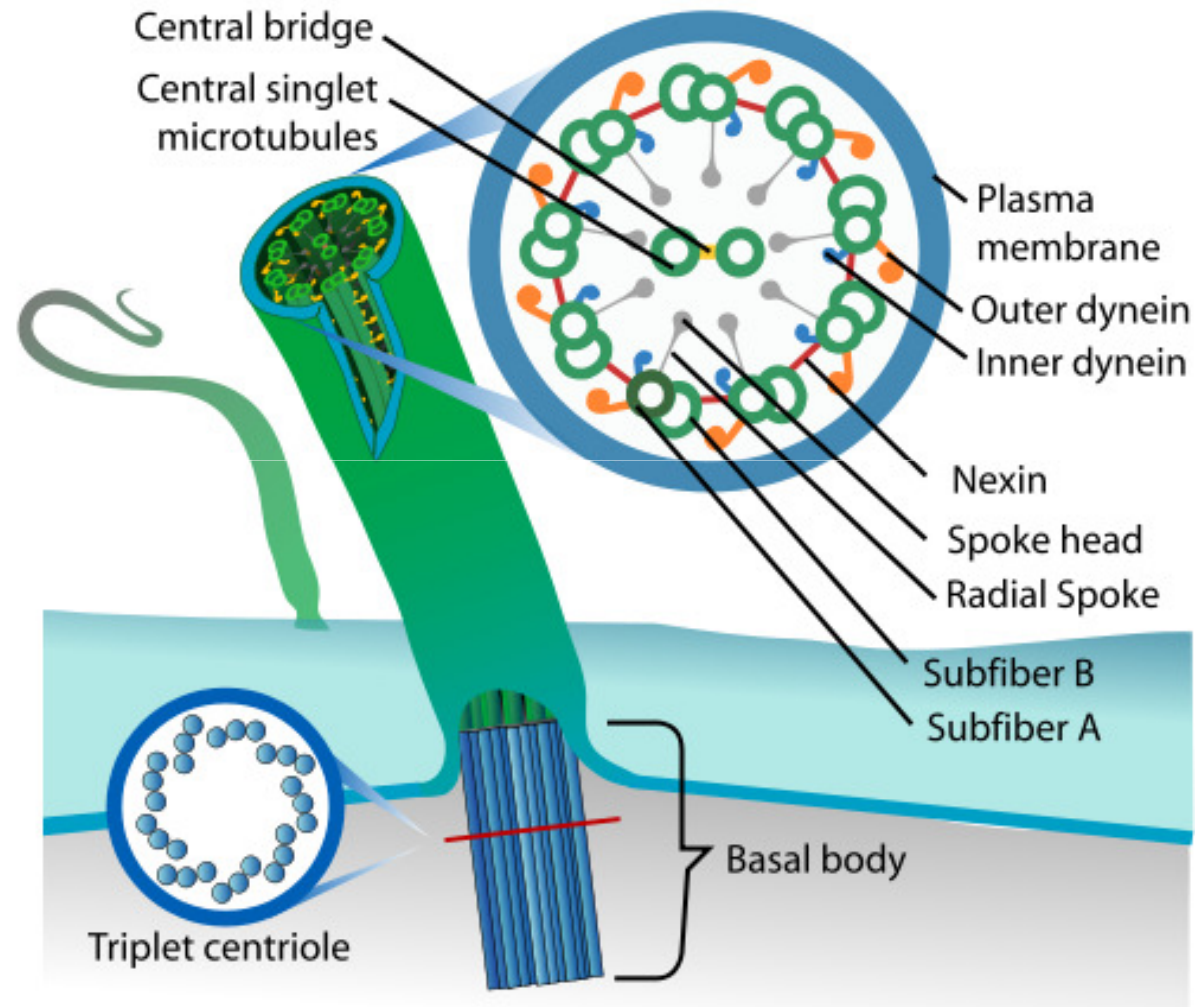
Composition

- ‘decomposing’ under the microscope...

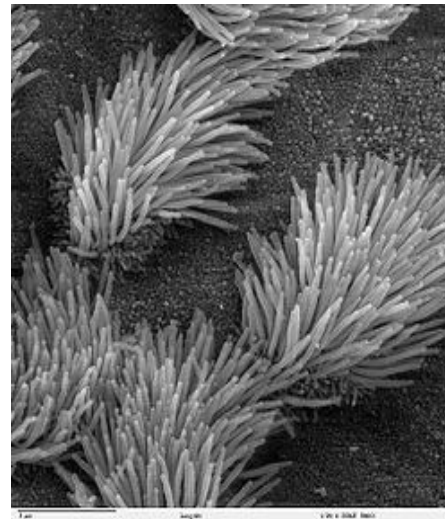
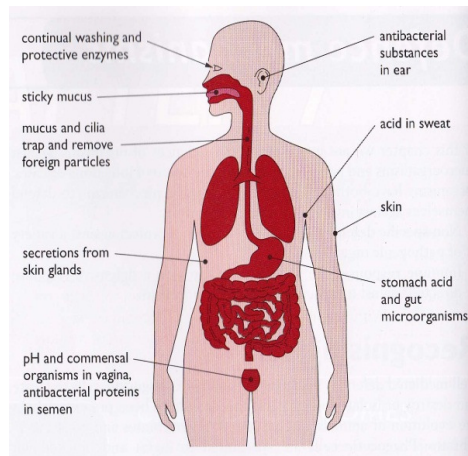


Composition

- internal structure

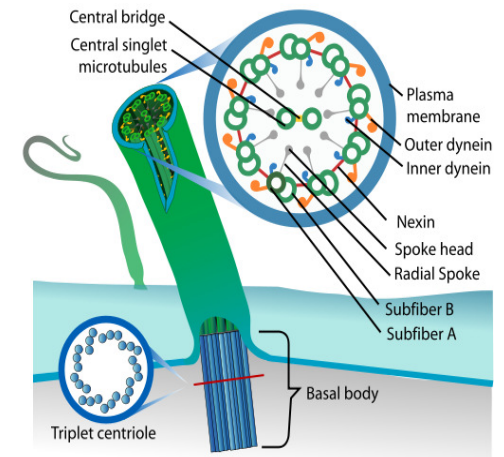


Composition



decomposing

composing

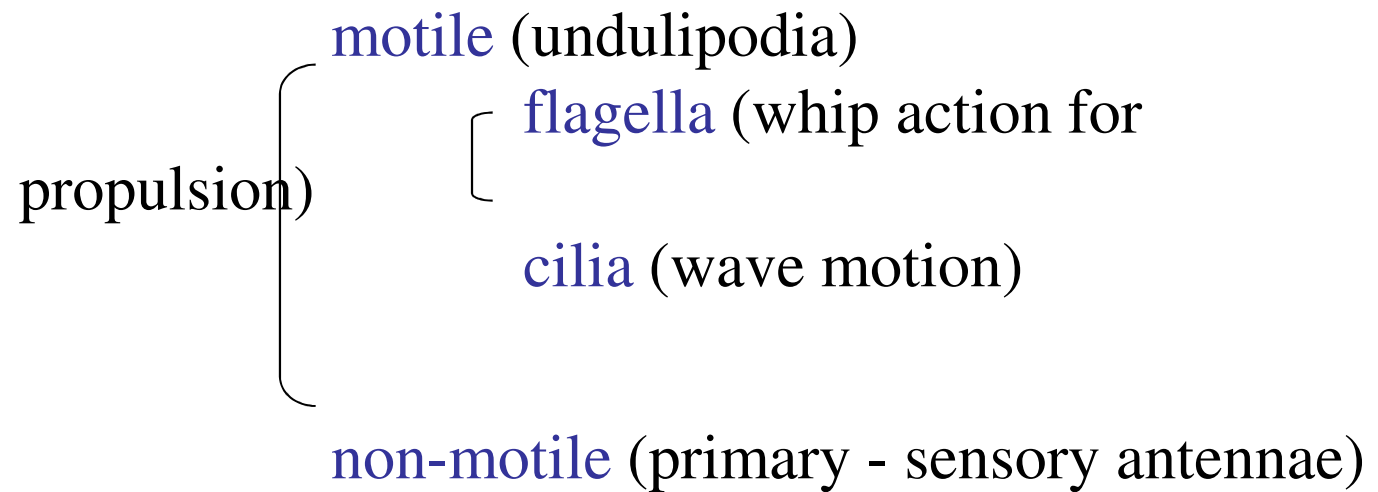


Classification

- organ type

organelle (eukaryotic cells)

cilia (protuberance from cell)



Classification

- alternative classification for immunology (lines of defence)...

Summary of the body's own protection and immune response		
Defence barriers	Defence adaptations	Immune response
the skin mucous membranes body fluids pH saliva tears secretions cilia	<p>Phagocytes</p> <div> <div>found in the blood</div> <div>found in the tissues</div> </div> <p>inflammation response macrophage lymph system cell death to seal off the pathogen</p>	<p>Immune response</p> <div> <div> <p>cellular — performed by a special group of lymphocytes</p> <p>T cells — sensitised in the thymus</p> <div> <div>secrete substances that destroy the antigen</div> <div>attract macrophages and activate phagocytes</div> </div> </div> <div> <p>performed by antibodies produced by a type of lymphocyte</p> <p>B cells — made in bone marrow</p> <p>B cells differentiate into:</p> <div> <div> <p>plasma cells that make antibodies</p> </div> <div> <p>memory cells stored in lymph nodes; subsequent exposure to specific antigen changes the memory cells to plasma cells</p> </div> </div> </div> </div>

non-specific

specific

1st

2nd

3rd

Stages in inflammation

Increased diameter and permeability of blood vessels

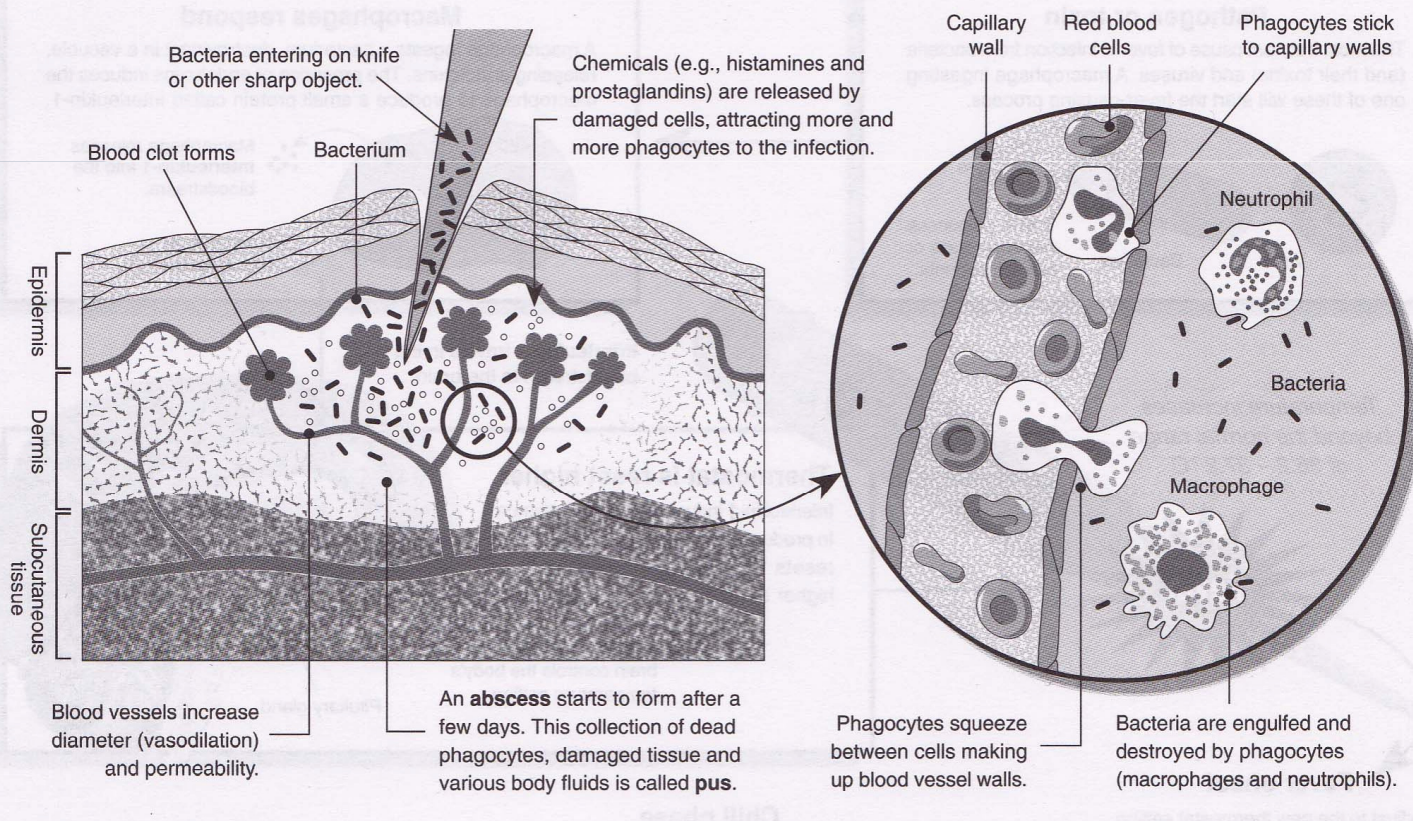
Blood vessels increase their diameter and permeability in the area of damage. This increases blood flow to the area and allows defensive substances to leak into tissue spaces.

Phagocyte migration and phagocytosis

Within one hour of injury, phagocytes appear on the scene. They squeeze between cells of blood vessel walls to reach the damaged area where they destroy invading microbes.

Tissue repair

Functioning cells or supporting connective cells create new tissue to replace dead or damaged cells. Some tissue regenerates easily (skin) while others do not at all (cardiac muscle).



(1) nominalisation

Teacher notes on board:

Inflammatory Response

Fever helps reduce the reproduction of pathogen cells in localised areas. There is increased blood flow to the infected area due to VASO-DILATION (widening of capillaries). This means more phagocytes and macrophages can quickly travel to the infection site.

(1) nominalisation

Teacher notes on board:

Inflammatory Response

Fever helps reduce the **reproduction** of pathogen cells in localised areas. There is increased blood **flow** to the infected area due to **VASO-DILATION** (widening of capillaries). This means more phagocytes and macrophages can quickly travel to the **infection** site.

Power grammar



- the **reproduction** of pathogen cells
 - “reproducing pathogen cells”
- increased blood **flow**
 - “blood flow increases”
 - “blood flows (more quickly/voluminously?)”
- **VASO-DILATION**
 - “the capillaries dilate/widen”
- the **infection** site
 - “the site/spot that was infected”

(2) explanation ('cause in the clause')

Teacher notes on board:

Inflammatory Response

Fever **helps reduce** the reproduction of pathogen cells in localised areas. There is increased blood flow to the infected area **due to** VASO-DILATION (widening of capillaries). This **means** more phagocytes and macrophages can quickly travel to the infection site.



- Fever **helps reduce** the reproduction of pathogen cells in localised areas.
≈
Body temperature rises
and so
pathogen cells reproduce more slowly in localised areas
- There is increased blood flow to the infected area **due to** VASO-DILATION (widening of capillaries).
≈
Blood flows more voluminously to the infected area
because
the capillaries widen/dilate

History

- power words
 - Mycenaean society, New Kingdom Egypt, the Augustan Age, garum, forum, Gaul
- classifications
 - e.g. ancient societies
 - Society in Old Kingdom Egypt; Persian Society at the time of Darius and Xerxes; Mycenaean society
 - e.g. historical periods
 - New Kingdom Egypt to the death of Thutmose IV; The Greek world 446-399 BC; Rome: The Augustan Age 44BC-AD 14

(1) nominalisation

‘spoken’

Mt Vesuvius erupting

nominalised

the eruption of Mt Vesuvius

‘spoken’

when did he excavate Pompeii

nominalised

his excavation of Pompeii

‘spoken’

he died

nominalised

his death

(2) cause in the clause

The **revolution** at Pompeii in regards to archaeological methods **began with** Fiorelli's stage of **occupation** in the 19th century...

...Fiorelli's stage of **occupation** **allowed for** greater **documentation**, more archaeological artifacts left in site and the breakthrough **process** of injecting liquid plaster into the body-shaped cavities made by solidified ash and the **eventual decomposition** of bodies.

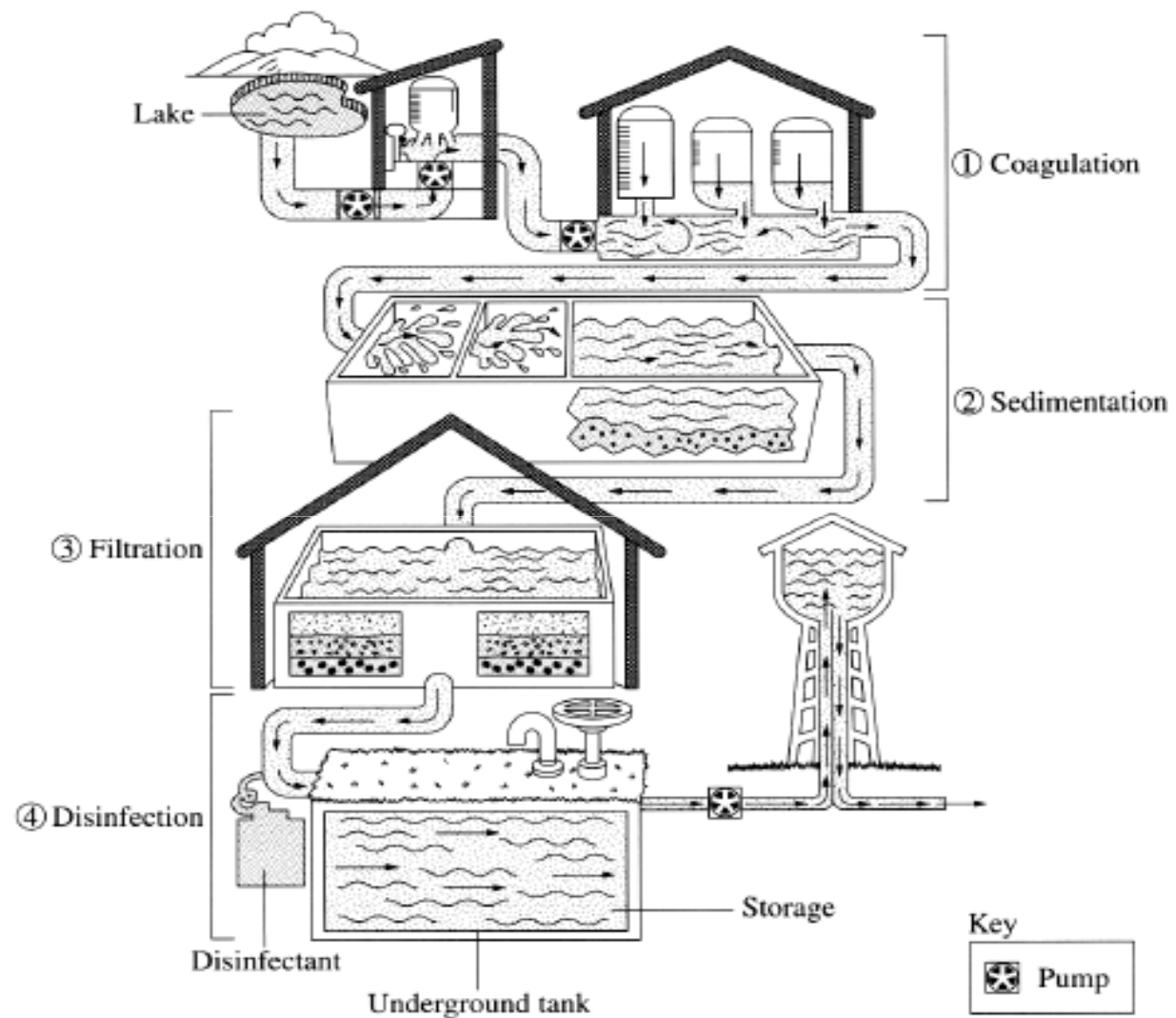
Summary so far....

- need to reach higher up semantic wave
- two key ways:
 - power words
 - power grammar: **nominalisation** and **explanation** to make a ‘cause in the clause sandwich’
- Next question: how teach students to achieve this?



Question 19 (3 marks)

The diagram summarises one method used to treat water to make it suitable for drinking.



Exam question

The treatment method illustrated on page 14 has four processes which can remove the contaminants that may be found in water extracted from the lake.

Select ONE of the four processes and explain how this process reduces the risk of infection from pathogens.



Student answer: grade 3-4

Disinfection. This adds chemicals to the water that is very likely to kill any micro-organisms. Chlorine is often used for example to balance the water and make it a standard that is good enough for drinking



Student answer: grade 5-6

Disinfecting water involves the process of chlorination (the addition of chlorine). Also, chloroamination is used as chlorine and ammine compounds serve as a longer lasting disinfectant. These disinfectants kill pathogens, such as giardia and cryptosporidium, which could otherwise contaminate the water. Therefore, they reduce the risk of infection caused by pathogens in water used for drinking and food preparation.



Technical terms: grade 3-4

Disinfection. This adds **chemicals** to the water that is very likely to kill any **micro-organisms**. **Chlorine** is often used for example to balance the water and make it a standard that is good enough for drinking



Technical terms: grade 5-6

Disinfecting water involves the process of **chlorination** (the addition of chlorine). Also, **chloroamination** is used as chlorine and **amine compounds** serve as a longer lasting disinfectant. These disinfectants kill **pathogens**, such as **giardia** and **cryptosporidium**, which could otherwise contaminate the water. Therefore, they reduce the risk of infection caused by **pathogens** in water used for drinking and food preparation.



Nominalisation: grade 3-4

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Explanation: grade 3-4

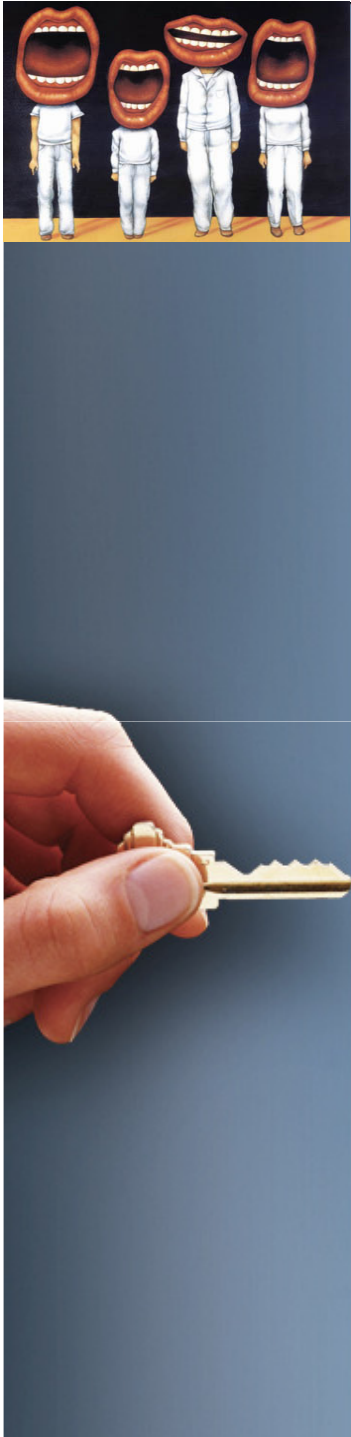
Disinfection. This adds chemicals to the water that is very likely to kill any micro-organisms. Chlorine is often used for example to balance the water and make it a standard that is good enough for drinking



Explanation: grade 5-6

Disinfecting water **involves** the process of chlorination (the addition of chlorine). Also, chloroamination is used as chlorine and ammine compounds **serve** as a longer lasting disinfectant. These disinfectants kill pathogens, such as giardia and cryptosporidium, which could otherwise **contaminate** the water. Therefore, they **reduce** the risk of infection **caused by** pathogens in water used for drinking and food preparation.





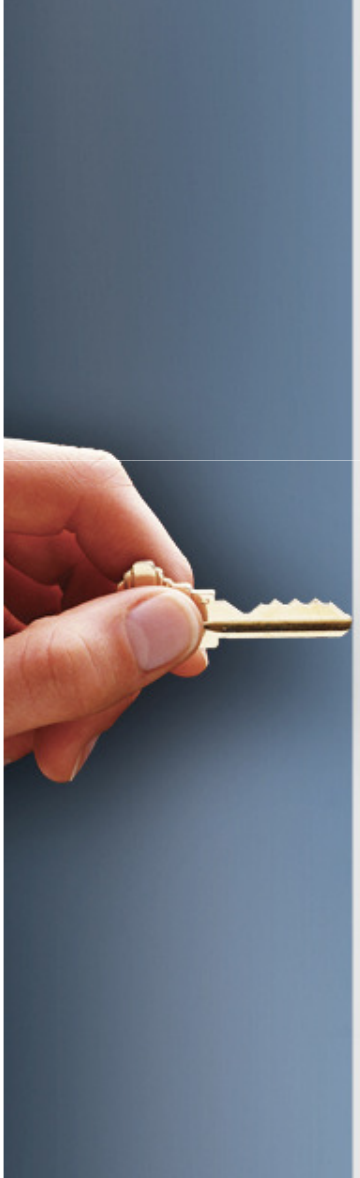
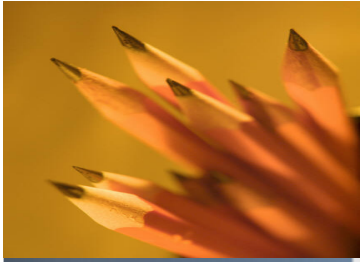
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it comes about as a result of the pathogen having passed the first and second line of defence.

it's actually designed specifically to attack that particular kind of antigen.. your first line of defence is essentially like your infantry, it's the barrier, your second line of defence is like your artillery, it just knocks out everything that is foreign. The third line of defence is like a sniper, it basically comes in and..

There are different types of lymphocytes, these being T and B cells



The third line of defence is a specific response which targets identified antigens which have breached the first and second lines of defence. This process involves different types of lymphocytes, including T cells and B cells.

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Conclusion

- overcoming segmentalism is central to education
- understanding how requires overcoming segmental thinking in theory
- LCT(Semantics) offers analysis:
 - of organising principles of practices
 - of many kinds of practices
 - of change over time
 - has itself considerable semantic range

