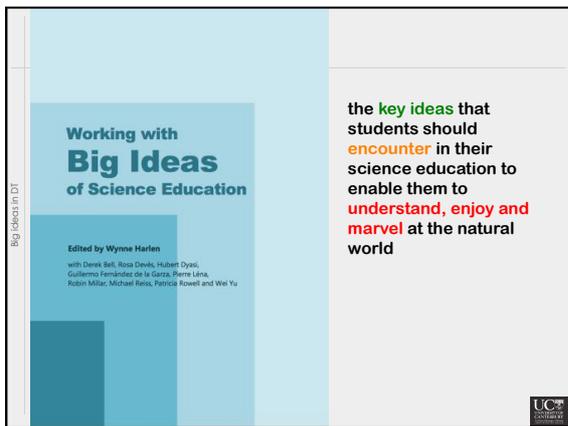




### Polls

- Thoughts about new curriculum
- Level of confidence
- Level of teaching



- to respond to students' perceptions of science as a fragmented collection of facts and theories of little relevance to them,
- help students to explain things they find important
- basis for selection from the enormous range of possible curriculum content
- inform the development of curriculum frameworks built on progression towards big ideas

### Big ideas in science

- All matter in the Universe is made of **very small particles**
- Objects can **affect other objects at a distance**
- Changing the movement of an object requires a **net force** to be acting on it
- The total **amount of energy in the universe is always the same** but can be transferred from one energy store to another during an event
- The composition of the earth and its atmosphere, and the processes occurring within them, **shape the earth's surface and its climate**
- Our solar system is a very small part of one of **billions of galaxies** in the universe
- Organisms are organised on a **cellular basis** and have a finite life span
- Organisms require a **supply of energy and materials** for which they often depend on, or compete with, other organisms
- Genetic information** is passed down from one generation of organisms to another
- The diversity of organisms, living and extinct, is the result of **evolution**

### $\lambda$ ?

the **key ideas** that students should **encounter** in their computing education to enable them to **understand, enjoy and marvel** at the digital world

Big Ideas in DT

- CMSC 2017
- Poznan workshop
- Expert forum (HDKF)
- WiPSCE 2017

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### Curriculum designers

- Jens Gallenbacher
- Paul Tymann
- Amiram Yehudai
- Ira Diethelm
- Juraj Hromkovič

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### The big ideas in CS/CT

1. **Data** is represented in digital form on a computer.
2. **Algorithms** interact with data to solve computational problems.
3. The **performance** of algorithms can be modelled and evaluated.
4. Some computational problems **cannot be solved** by algorithms.
5. **Programs** express algorithms and data in a form that can be implemented on a computer.
6. Computing systems are designed by **humans** to serve human needs.
7. Computing systems create **virtual** representations of natural and artificial phenomena.
8. **Protecting** data and system resources is critical in computing systems.
9. **Time dependent** operations in computing systems must be coordinated.
10. **Protocols** facilitate communication between computing systems.

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### Data is represented in digital form on a computer

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### Poll: Where are you at with binary representation?

- Confident with how it works
- Kind of get it
- Have dabbled
- Don't understand it
- Never heard of it

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### Digital technologies?

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### Digital technologies?

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### Digital technologies?

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<http://csfieldguide.org.nz/en/chapters/data-representation.html>

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### Binary cards

Big ideas in DT

1 dot is visible

<http://csfieldguide.org.nz/en/interactives/binary-cards/index.html?digits=5&start=B BBBB>

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### Binary cards

Chat: do you want the 16 card?

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1 dot is visible

<http://csfieldguide.org.nz/en/interactives/binary-cards/index.html?digits=5&start=B BBBB>

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### Binary cards

Big ideas in DT

<http://csunplugged.org/binary-numbers/>

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### Letters using digits

0 - 00000 -	9 - 01001 - I	18 - 10010 - R
1 - 00001 - A	10 - 01010 - J	19 - 10011 - S
2 - 00010 - B	11 - 01011 - K	20 - 10100 - T
3 - 00011 - C	12 - 01100 - L	21 - 10101 - U
4 - 00100 - D	13 - 01101 - M	22 - 10110 - V
5 - 00101 - E	14 - 01110 - N	23 - 10111 - W
6 - 00110 - F	15 - 01111 - O	24 - 11000 - X
7 - 00111 - G	16 - 10000 - P	25 - 11001 - Y
8 - 01000 - H	17 - 10001 - Q	26 - 11010 - Z

Big ideas in DT

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**Decoding a message**

What might this represent?

```

01000100 01101001 01100111 01101001
01110100 01100001 01101100 01010000
01010100 01100101 01100011 01101000
01101110 01101111 01101100 01101111
01100111 01101001 01100101 01100111
00100000 01001000 01110101 01100010
    
```

ASCII is an encoding system

Letter	ASCII Code	Binary	Letter	ASCII Code	Binary
a	97	01100001	A	65	01000001
b	98	01100010	B	66	01000010
c	99	01100011	C	67	01000011
d	100	01100100	D	68	01000100
e	101	01100101	E	69	01000101
f	102	01100110	F	70	01000110
g	103	01100111	G	71	01000111
h	104	01101000	H	72	01001000
i	105	01101001	I	73	01001001
j	106	01101010	J	74	01001010
k	107	01101011	K	75	01001011
l	108	01101100	L	76	01001100
m	109	01101101	M	77	01001101
n	110	01101110	N	78	01001110
o	111	01101111	O	79	01001111
p	112	01110000	P	80	01010000
q	113	01110001	Q	81	01010001
r	114	01110010	R	82	01010010
s	115	01110011	S	83	01010011
t	116	01110100	T	84	01010100
u	117	01110101	U	85	01010101
v	118	01110110	V	86	01010110
w	119	01110111	W	87	01010111
x	120	01111000	X	88	01011000
y	121	01111001	Y	89	01011001
z	122	01111010	Z	90	01011010

**Algorithms interact with data**  
to solve computational problems

$9 + 0 + 5 + 7 + 0 + 8 = (2)9$

$4 + 0 + 4 + 0 + 9 + 7 = (2)4$

$4 \times 3 = (1)2$

$9 + 2 = (1)1$

$\square + 1 = 10$

**Algorithms interact with data**  
to solve computational problems

**Algorithms interact with data**  
to solve computational problems

**Algorithms interact with data**  
to solve computational problems

R 121	R 120	R 116	R 91	R 96	R 99	R 97	R 87	R 89	R 141
G 31	G 35	G 51	G 66	G 73	G 79	G 81	G 84	G 107	G 151
B 40	B 42	B 46	B 41	B 44	B 44	B 43	B 49	B 90	B 137
R 120	R 119	R 128	R 111	R 89	R 96	R 80	R 76	R 150	R 148
G 32	G 33	G 38	G 58	G 72	G 72	G 83	G 106	G 164	G 164
B 42	B 44	B 45	B 41	B 38	B 42	B 51	B 78	B 144	B 138
R 120	R 120	R 130	R 129	R 94	R 86	R 78	R 133	R 143	R 142
G 35	G 37	G 41	G 51	G 62	G 87	G 184	G 156	G 155	G 155
B 44	B 46	B 51	B 53	B 42	B 62	B 83	B 134	B 135	B 136
R 128	R 119	R 108	R 101	R 81	R 60	R 128	R 132	R 136	R 141
G 56	G 48	G 45	G 47	G 83	G 99	G 153	G 145	G 150	G 155
B 67	B 52	B 37	B 30	B 60	B 73	B 129	B 125	B 130	B 133
R 168	R 175	R 170	R 166	R 63	R 66	R 93	R 131	R 132	R 138
G 136	G 150	G 151	G 150	G 68	G 94	G 121	G 149	G 146	G 151
B 87	B 90	B 81	B 83	B 23	B 62	B 97	B 128	B 121	B 131
R 171	R 173	R 174	R 168	R 151	R 165	R 78	R 101	R 127	R 134
G 162	G 162	G 164	G 155	G 133	G 156	G 88	G 123	G 145	G 147
B 95	B 99	B 100	B 89	B 60	B 86	B 46	B 101	B 125	B 127
R 173	R 173	R 173	R 142	R 164	R 162	R 165	R 64	R 102	R 129
G 165	G 163	G 160	G 126	G 149	G 151	G 152	G 75	G 127	G 144
B 107	B 101	B 95	B 57	B 80	B 75	B 83	B 36	B 105	B 121

**Algorithms interact with data**  
to solve computational problems

R 63	R 63	R 70	R 71	R 76	R 82	R 82	R 83	R 101	R 155
G 63	G 63	G 70	G 71	G 76	G 82	G 82	G 83	G 101	G 155
B 63	B 63	B 70	B 71	B 76	B 82	B 82	B 83	B 101	B 155
R 63	R 62	R 68	R 72	R 74	R 76	R 81	R 98	R 160	R 159
G 63	G 62	G 68	G 72	G 74	G 76	G 81	G 98	G 160	G 159
B 63	B 62	B 68	B 72	B 74	B 76	B 81	B 98	B 160	B 159
R 63	R 64	R 71	R 75	R 69	R 85	R 97	R 150	R 150	R 150
G 63	G 64	G 71	G 75	G 69	G 85	G 97	G 150	G 150	G 150
B 63	B 64	B 71	B 75	B 69	B 85	B 97	B 150	B 150	B 150
R 78	R 70	R 64	R 62	R 80	R 89	R 146	R 141	R 146	R 150
G 78	G 70	G 64	G 62	G 80	G 89	G 146	G 141	G 146	G 150
B 78	B 70	B 64	B 62	B 80	B 89	B 146	B 141	B 146	B 150
R 141	R 152	R 151	R 149	R 65	R 87	R 113	R 144	R 141	R 147
G 141	G 152	G 151	G 149	G 65	G 87	G 113	G 144	G 141	G 147
B 141	B 152	B 151	B 149	B 65	B 87	B 113	B 144	B 141	B 147
R 160	R 160	R 162	R 155	R 133	R 154	R 83	R 117	R 140	R 143
G 160	G 160	G 162	G 155	G 133	G 154	G 83	G 117	G 140	G 143
B 160	B 160	B 162	B 155	B 133	B 154	B 83	B 117	B 140	B 143
R 162	R 162	R 159	R 126	R 149	R 150	R 151	R 71	R 121	R 140
G 162	G 162	G 159	G 126	G 149	G 150	G 151	G 71	G 121	G 140
B 162	B 162	B 159	B 126	B 149	B 150	B 151	B 71	B 121	B 140

**Algorithms interact with data**  
to solve computational problems

R	120
G	32
B	42

$120+32+42$   
3

R	63
G	63
B	63

Big Ideas in DT

**Algorithms interact with data**  
to solve computational problems

Add 1

Big Ideas in DT

**The performance of algorithms**  
can be modelled and evaluated

<https://www.youtube.com/watch?v=IDVH3oCTc2c>

Big Ideas in DT

**The performance of algorithms**  
can be modelled and evaluated

<http://csunplugged.org/sorting-algorithms/>

Big Ideas in DT

**Some computational problems**  
**cannot be solved** by algorithms

Big Ideas in DT

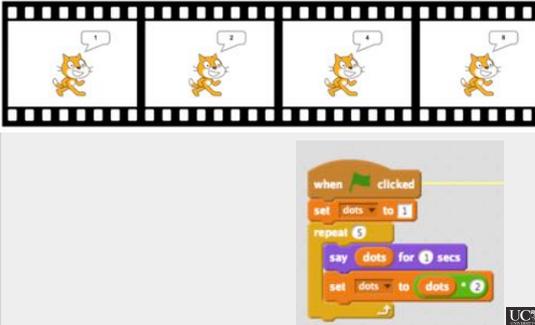
**Some computational problems**  
**cannot be solved** by algorithms

**Proof That Computers Can't Do Everything**  
**(The Halting Problem)**

<https://www.youtube.com/watch?v=92WHN-pAFCs>

Big Ideas in DT

### Programs express algorithms and data in a form that can be implemented on a computer.



Big Ideas in DT

UC

The slide shows a Scratch script starting with 'when clicked', followed by 'set dots to 1', a 'repeat 3' loop containing 'say dots for 1 secs' and 'set dots to dots + 2'.

### Programs express algorithms and data in a form that can be implemented on a computer.

Storage

amount\_owing 75  
customer\_name Tim

Input/output

ask How much change do you need to give? and wait  
say Join Pay out current\_denomination\_value for 1 secs

Sequence, selection, iteration



Big Ideas in DT

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The slide displays a Scratch script for a payment process. It includes 'say' blocks for denominations, an 'ask' block for change, and an 'if' block with a 'repeat until' loop to handle the remaining amount.

### Alan Turing

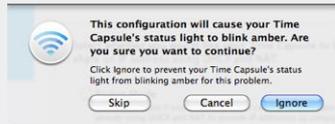


Big Ideas in DT

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A black and white portrait of a young Alan Turing in a suit and tie.

### Computing systems are designed by humans to serve human needs



Big Ideas in DT

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The screenshot shows a dialog box with a Wi-Fi icon and the text: 'This configuration will cause your Time Capsule's status light to blink amber. Are you sure you want to continue? Click Ignore to prevent your Time Capsule's status light from blinking amber for this problem.' Buttons for 'Skip', 'Cancel', and 'Ignore' are visible.

### Computing systems are designed by humans to serve human needs



Big Ideas in DT

[https://www.youtube.com/watch?v=q\\_R9wQY4GSJ](https://www.youtube.com/watch?v=q_R9wQY4GSJ)

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A photograph of several people in a meeting room, standing around a table with many colorful sticky notes attached to a whiteboard.

### Diversity – broadening participation



Big Ideas in DT

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The slide features two images: one of a marching band in green uniforms and another of a person using a shopping cart in a store.

**Computing systems create **virtual** representations of natural and artificial phenomena**



<https://www.kiwinet.org.nz/images/success-stories/AugmentedReality.jpg>

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**Protecting data and system resources is critical in computing systems.**

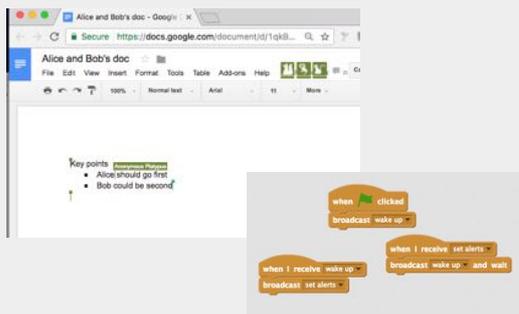


<https://blogs.technet.microsoft.com/seanearp/2007/08/01/layers-defense-in-depth-part-1/>

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**Time dependent operations in computing systems must be coordinated**



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**Protocols facilitate communication between computing systems**

Name	Method	Status	Type	Initiator	Size	Time	Successful
www.google.com	GET	302	text...	Other	433B	50ms	✓
7yfls_m-cv8ei-5v6VWNgfhts-8Auo0pCA	GET	200	docu...	https://www...	38.2KB	263ms	✓
gms.super.p-84.gif	GET	200	gif	https://www...	21.8KB	325ms	✓
googlelogo_color_180x60dp.png	GET	200	png	https://www...	7.0KB	181ms	✓
u-AAZHYVvYpG6mngU_r8ayDpRatW02Ung	GET	200	script	https://www...	30.3KB	50ms	✓
gls_20x60fast.png	GET	300	png	https://www...	3.3KB	48ms	✓
gH4ts.jpg	GET	300	jpeg	https://www...	From disk...	21ms	✓
data:image/png;base64...	GET	200	png	https://www...	From mem...	0ms	✓
u-ACT300vHv4z_AKMMRLZOBv6t0zpaZ8yvw	GET	200	script	https://www...	128KB	74ms	✓
u-ACT300vHv4z_AKMMRLZOBv6t0zpaZ8yvw	GET	200	script	https://www...	22.8KB	52ms	✓
search?client=mobile-gae-hp&hl=en-NZ&ip...	GET	200	xhr	https://www...	443B	219ms	✓
new.kyq02.png	GET	200	png	Other	From disk...	21ms	✓
gen_2047y-mc20ewshz0k0tpu-ca8ei-5_K2Wk...	GET	204	text...	Other	23B	183ms	✓
u-AAZHYVvYpG6mngU_r8ayDpRatW02Ung	GET	200	style...	https://www...	2.7KB	65ms	✓
gen_2047ytp-ic8c-148cad-v8agen-18d-19001...	GET	204	text...	Other	23B	185ms	✓
count	POST	200	xhr	https://www...	570B	536ms	✓
gen_2047ytp-ic8c-148cad-v8agen-18d-19001...	GET	204	text...	Other	48B	185ms	✓

Big Ideas in DT

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**The big ideas**

1. **Data** is represented in digital form on a computer.
2. **Algorithms** interact with data to solve computational problems.
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10. **Protocols** facilitate communication between computing systems.

Big Ideas in DT

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www.barefootcs.org.uk

Big Ideas in DT

“The greatest tragedy I know of is that so many young people **never discover what they really want to do.**”

Edna Kerr  
(quoted by Dale Carnegie)



Big Ideas in DT

### Digital technologies is about... people

- Communication
- Information
- Interfaces
- Privacy
- Safety
- Solving real problems
- Careers




Ho aha te mea ma te tangata? He tangata, he tangata, he tangata.



Big Ideas in DT



**CS UNPLUGGED**  
Computer Science without a computer

Home The Book Activities Videos Community Promotional About

Update: New version of CS Unplugged in development

Free activities for classroom or home



Big Ideas in DT

**CS Unplugged: Database**

Format	Web page
Content type	Learning materials
Key audiences	Teacher
Bands	F-2, 3-4, 5-6, 7-8, 9-10
DT curriculum code(s)	ACTDIP03, ACTDIP09, ACTDIP16, ACTDIP26, ACTDIP37
Unplugged	🟢

Use these unplugged activities to introduce the idea of database queries.

**CS Unplugged: Moderns Unplugged**

Format	Web page
Content type	Learning materials
Key audiences	Teacher
Bands	5-6, 7-8
DT curriculum code(s)	ACTDIK015, ACTDIK024
Unplugged	🟢

This activity involves listening to songs and finding hidden messages based on the same principle as a modern.



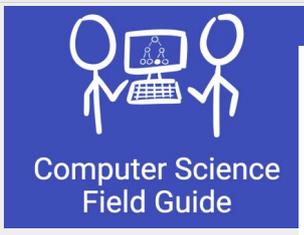
Big Ideas in DT

## Department of Fun Stuff




Big Ideas in DT

**csfieldguide.org.nz**



- Algorithms
- Programming Languages
- Human Computer Interaction
- Data Representation
- Coding - Introduction
- Coding - Compression
- Coding - Encryption
- Coding - Error Control
- Artificial Intelligence
- Complexity and tractability
- Computer Graphics
- Computer Vision
- Formal Languages
- Network Communication Protocols
- Software Engineering



Tim Bell

Big Ideas in DT

**Video about the big picture:**  
**<https://goo.gl/84Q1rQ>**



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