

Computing Science: Now and The Future

Inc. Computer Security



Prof Bill Buchanan, Twitter: @billatnapier
Web: asecuritysite.com, brightredbooks.net

**Xmas Cyber
Lectures** (3000
pupils – 4 cities) +
IET Xmas this year



**IT4U (Sensors, Cyber,
Games, etc)**
- 400 pupils/17 schools

Why Computing?



**Bright Red
Digital Zone
(8,000
users)**

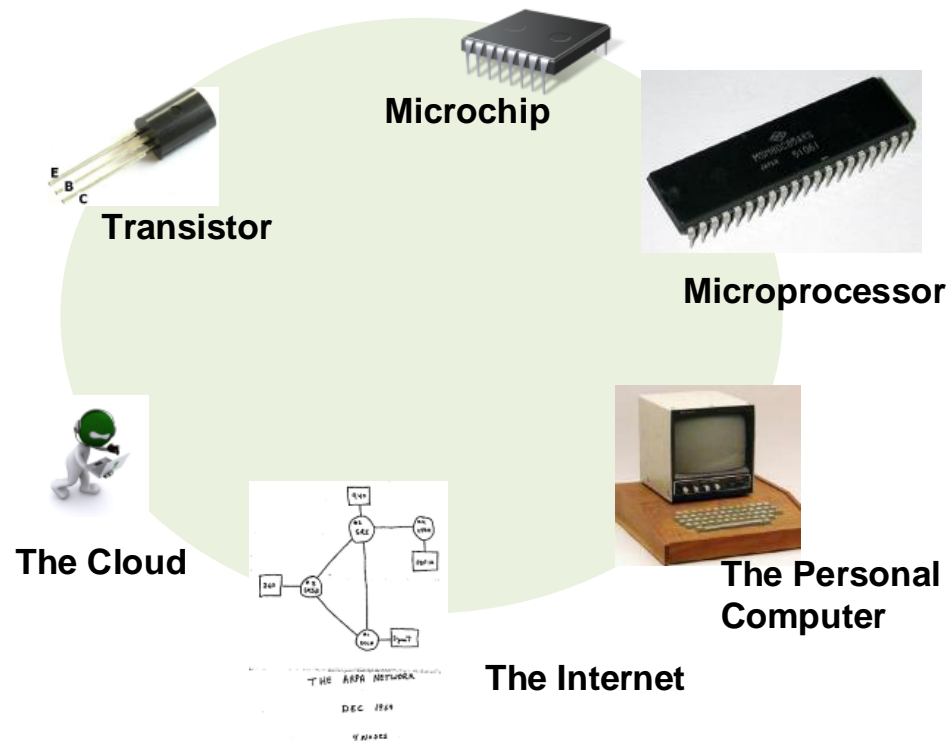


Engagement

- Cyber Security
- Asecuritysite.com
- As Seen on TV



Cloud is a disruptive
technology ... probably
the most disruptive since
the **transistor**



Large demand for IT graduates



We architecture, we design, we analyse, we build, and we test

Why Computing?



There's lots of different jobs

- Networking.
- Security.
- Software Development.
- Media Design
- Mobile Devices
- Web Development.

New areas every day ...

- Cloud Computing.
- Big Data.
- Mobile Devices.

**Data
increases
every day:**



- 12TB of Tweets.
- 90% of all data in the Cloud produced in the last two years.
- 2,500,000,000,000,000 bytes of data produced every data 2.5 Quintillion Bytes – 1 billion hard disks

**It's part of every
aspect of our lives...**

Why Computing?



**Everything
Is
dependent
on the
Internet**

- Banking.
- Oil and Gas.
- E-Commerce.
- Transport.
- ... virtually everthing



**It's all going
digital:**

- Data.
- Voice.
- Video.
- Sensors.





SecureWorks

Tech
Companies



It's part of most
companies ...

Why Computing?



Finance Industry



... and
lots of
others

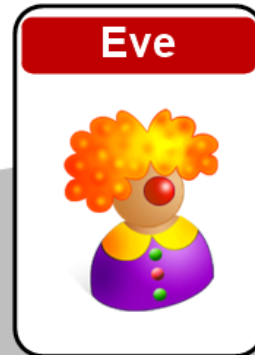
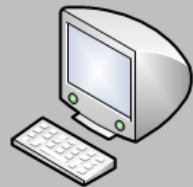
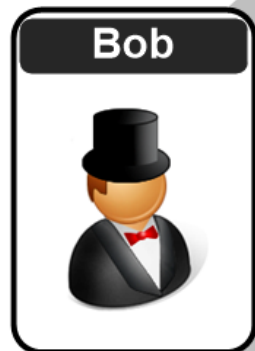
School of Computing

Security and Digital
Forensics

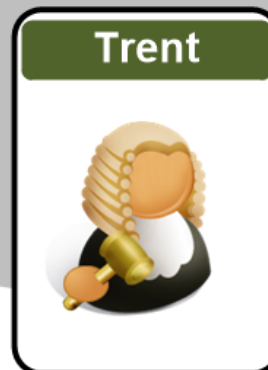


Meet the Cast ...

Meet the Cast ...

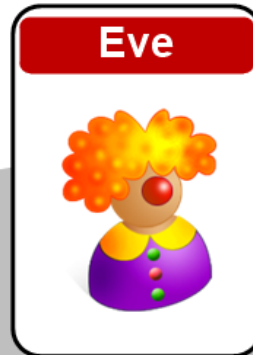
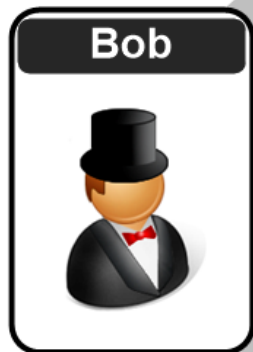


Intruder



Trusted third party

Meet the Cast ...



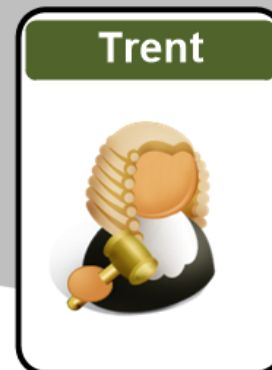
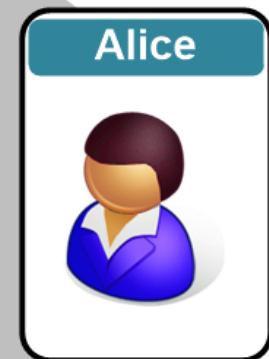
Jake Davis, Shetland Islands

**Gary
McKinnon**

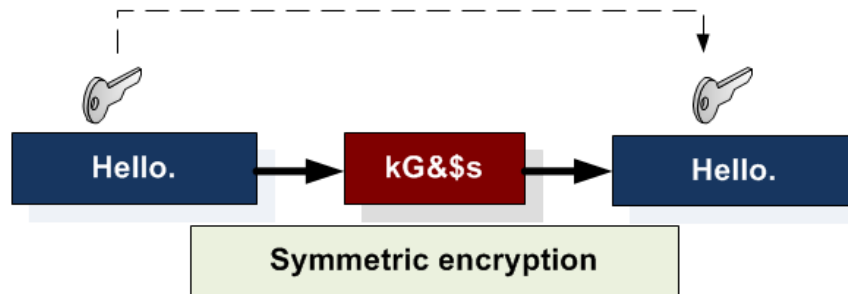


Lulzsec

Intruder

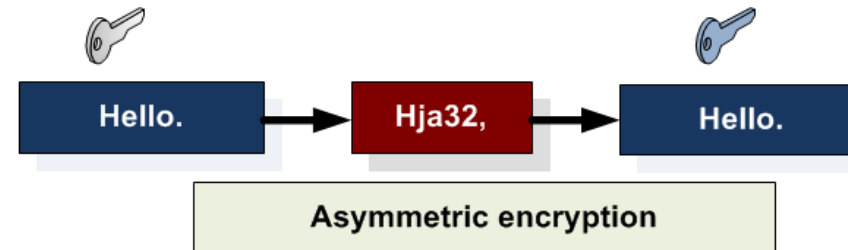


**Trusted third
party**



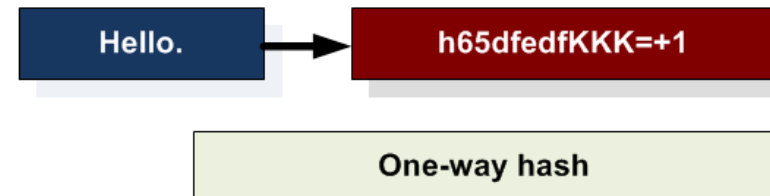
Private-key

Private-key:
RC2, RC4,
DES, 3DES,
AES



Public-key

Public-key:
RSA, DSA
(factoring prime
numbers)
FIPS 186-2,
ElGamal
(Elliptic curve)



Hashing

Hashing:
MD5, SHA-1

Strength: 80-bit
DES -> 1024 RSA
-> 160 bit Elliptic



Areas:



- Networks.
- Operating Systems.
- People/Motivations.
- Application Software.
- Encryption/Identity.
- Mobile Devices.
- Wireless ...

**It's about
understanding
everything ...**

Computer Security and Digital Forensics



**Every
changing
field**

- New applications.
- New threats.
- Cloud and Mobility makes it an every great challenge.
- Lots of opportunities for different careers.



**It's all going
digital:**

- Banking.
- On-line shopping.
- Media/News.
- Government.
- Health.

**MSc in Advanced Security
and Digital Forensics**

MSc in Cybercrime

MSc in Advanced SEng



BEng (Hons)

**Security Testing and
Advanced Network Forensics**

Mobile Communications

Hons Project

**Information – Society and
Security**

XML Web Services

BEng

Work Place Learning

Networked Services

**Network Security and
Cryptography**

Applications Development

**Direct entry
from other
institutions**

Diploma

**Applied Cisco Networking
(Security/Wireless)**

Option

Database Systems

Systems and Services

Practical Networks 2

Software Development 2

**Introduction to Human
Computer Interaction**

**Information Systems in
Organisations**

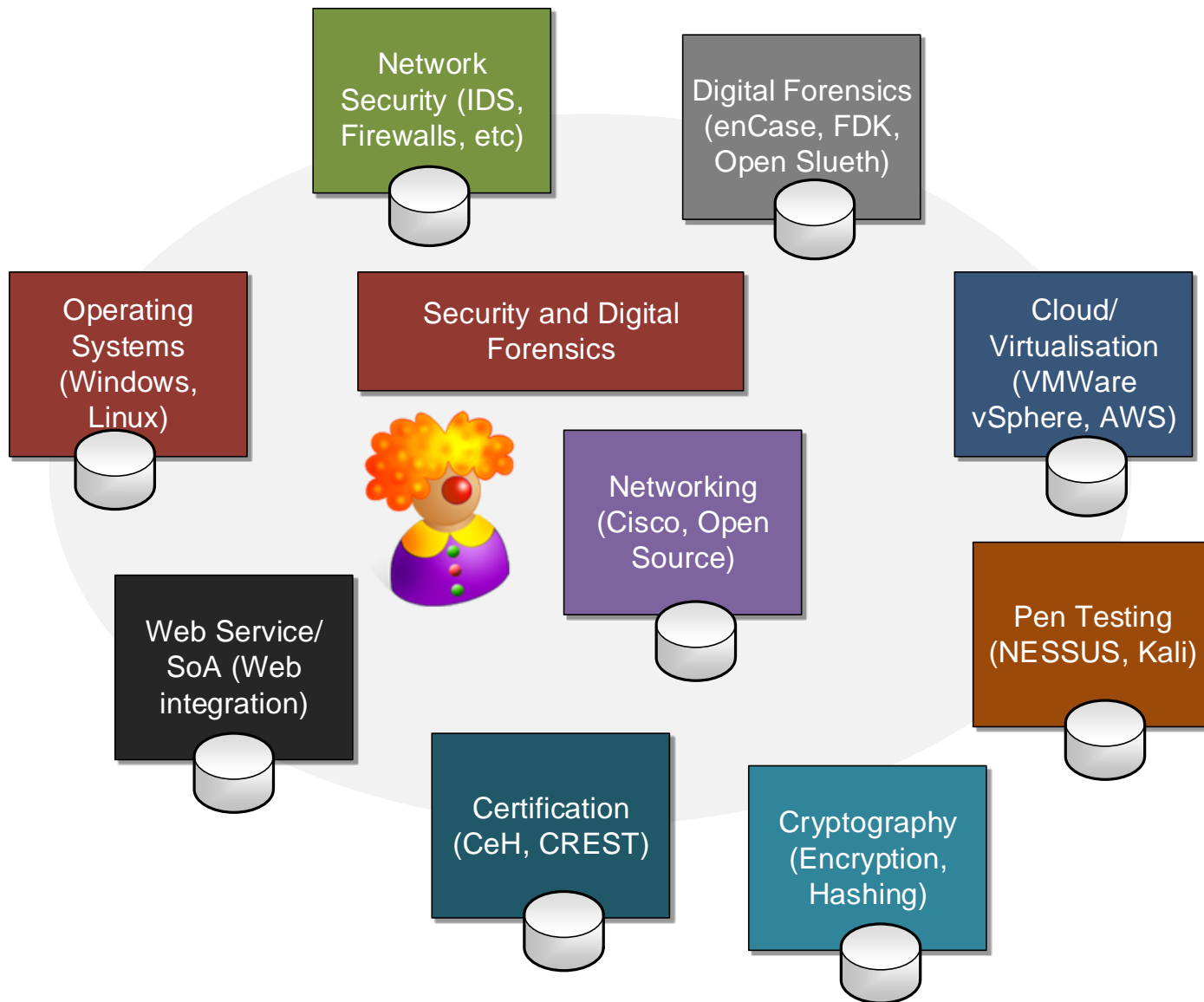
Option

Computer Systems 1

Practical Networks 1

Software Development 1

**Articulation
to/from other
programmes**





Security/Forensics Training in DFET Cloud

Campus-based
access

Off-site access

Mac Forensics.
Open Source Data Investigations.
Red Team v Blue Team.
Network Investigator.
Threat/Vulnerability Analysis.
Critical Incident Response.
Disaster Recovery.
EnCase v7.



vc2003.napier.ac.uk - vSphere Client

File Edit View Inventory Administration Plug-ins Help

Home Inventory VMs and Templates Search Inventory

Backtrack
Came
Desktops
Encase
Firewalls
pfSense - User: admin, Pass
vyatta - User: vyatta, Passw
002_vyatta
003_vyatta
004_vyatta
005_vyatta
006_vyatta
007_vyatta
008_vyatta
009_vyatta
010_vyatta
011_vyatta
012_vyatta
013_vyatta
014_vyatta
015_vyatta
016_vyatta
017_vyatta
018_vyatta
020_vyatta
Kali
001_kali
002_kali
003_kali
004_kali
005_kali
006_kali
007_kali
008_kali
009_kali
010_kali
011_kali
012_kali
Linux - VLAN 200 - DHCP on 10
Malware
Metasploitable
Pen_Testing (DHCP on 192.168
Kali - User: root, Password:
001_kali
002_kali
003_kali

Recent Tasks

Name	Target
Power On virtual machine	001_win2003
Initialize powering On	Napier Datacenter
Power On virtual machine	003_kali

001_win2003

Getting Started Summary Resource Allocation Performance Tasks & Events Alarms Console Permissions Maps Storage Views

close tab

What is a Virtual Machine?

A virtual machine is a software computer that, like a physical computer, runs an operating system and applications.

001_win2003 on 146.176.166.71

File View VM

My Documents My Computer Recycle Bin My Network Places Internet Explorer Mozilla Firefox Security Configuration VNC Viewer

Microsoft Windows (Version 5.2.3790)
(C) Copyright 1985-2003 Microsoft Corp.

C:\Documents and Settings\Administrator>ping 10.200.0.110

Pinging 10.200.0.110 with 32 bytes of data:

Reply from 10.200.0.110: bytes=32 time=1ms TTL=64

Reply from 10.200.0.110: bytes=32 time<1ms TTL=64

Ping statistics for 10.200.0.110:

Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms

Control-C

C:\Documents and Settings\Administrator>

003_kali on 146.176.166.69

File View VM

Applications Places Thu Mar 20, 3:31 AM

root@kali: ~

File Edit View Search Terminal Help

root@kali:~# ifconfig

eth0

Link encap:Ethernet HWaddr 00:50:56:ab:32:54

inet addr:10.200.0.110 Bcast:10.200.0.255 Mask:255.255.255.0

inet6 addr: fe80::250:56ff:feab:3254/64 Scope:Link

UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1

RX packets:99 errors:0 dropped:0 overruns:0 frame:0

TX packets:33 errors:0 dropped:0 overruns:0 carrier:0

collisions:0 txqueueLen:1000

RX bytes:21910 (21.3 KiB) TX bytes:2670 (2.6 KiB)

Interrupt:19 Base address:0x2000

lo

Link encap:Local Loopback

inet addr:127.0.0.1 Mask:255.0.0.0

inet6 addr: ::1/128 Scope:Host

UP LOOPBACK RUNNING MTU:65536 Metric:1

RX packets:4 errors:0 dropped:0 overruns:0 frame:0

TX packets:4 errors:0 dropped:0 overruns:0 carrier:0

collisions:0 txqueueLen:0

RX bytes:240 (240.0 B) TX bytes:240 (240.0 B)

root@kali:~#

To release cursor, press CTRL + ALT

Keep your computer up to date

Click here to have Windows automatically keep your computer current with important updates.

7:31 AM 20-Mar-14

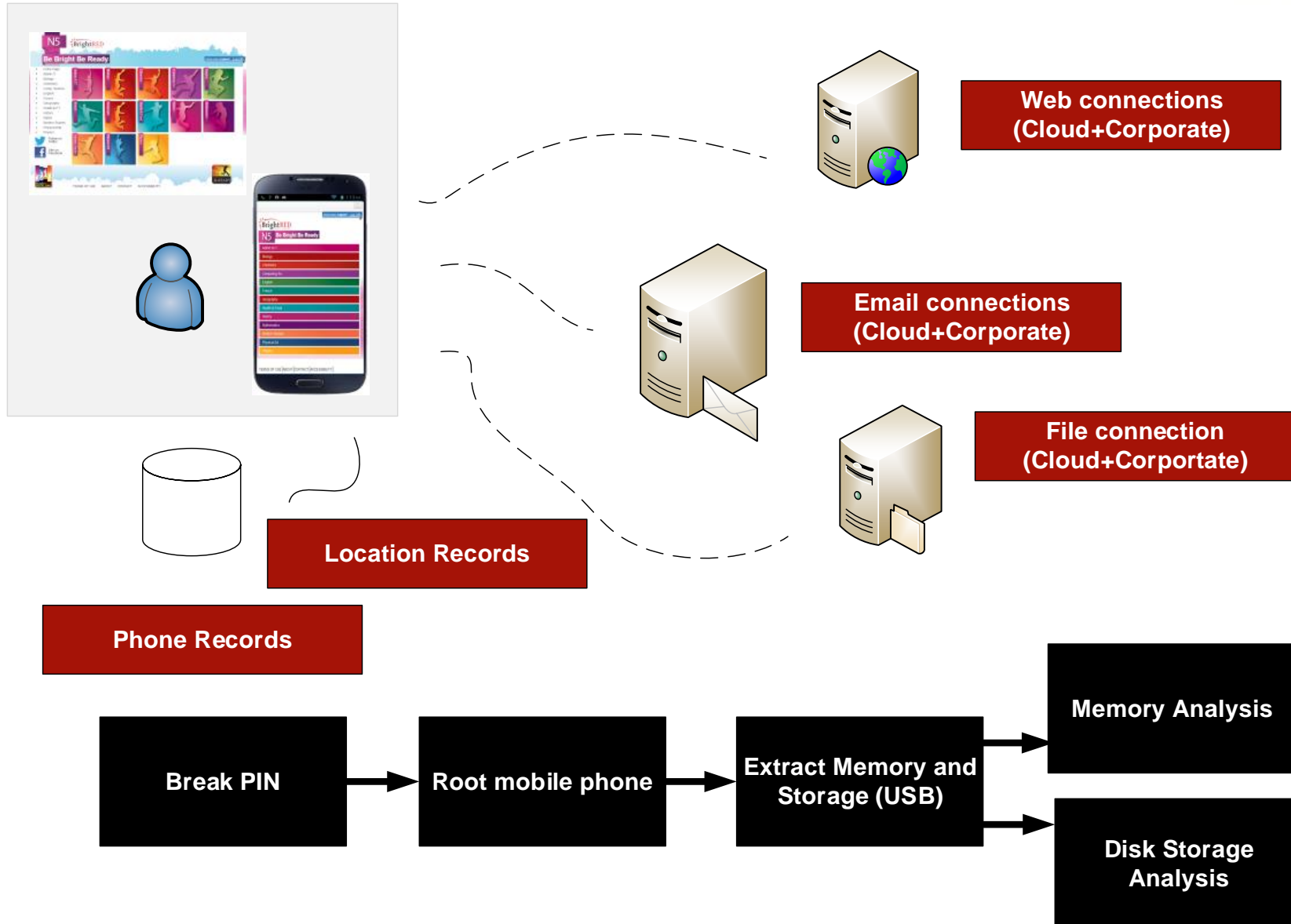
A Few Security Risks in Mobile Working

Mobile Working

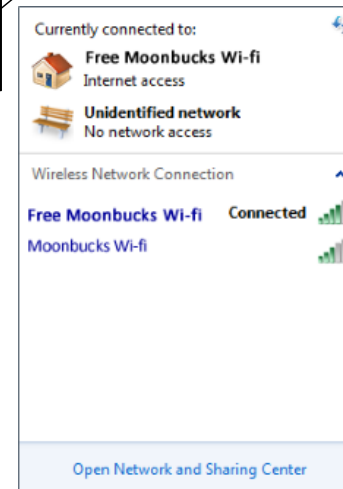
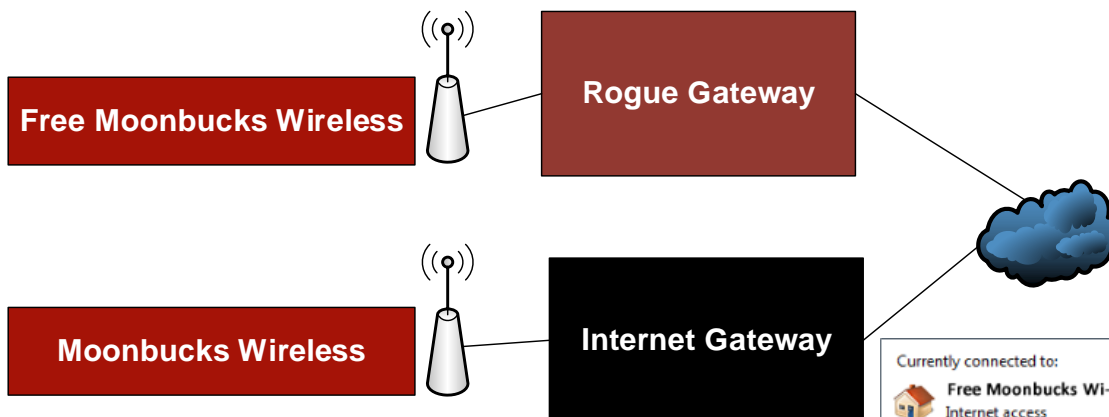
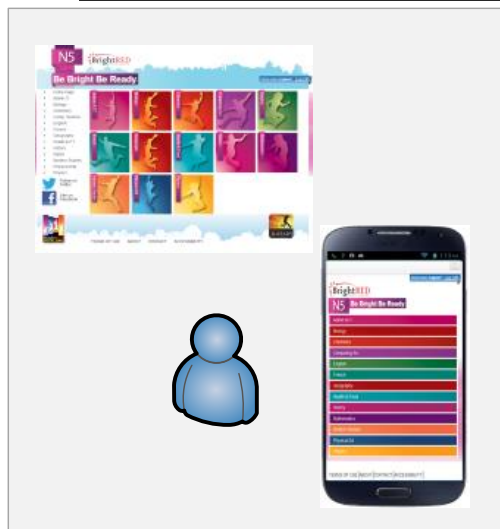


Prof Bill Buchanan

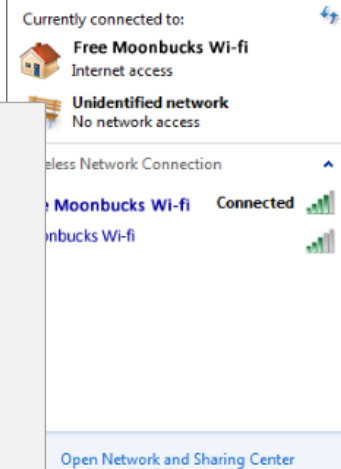
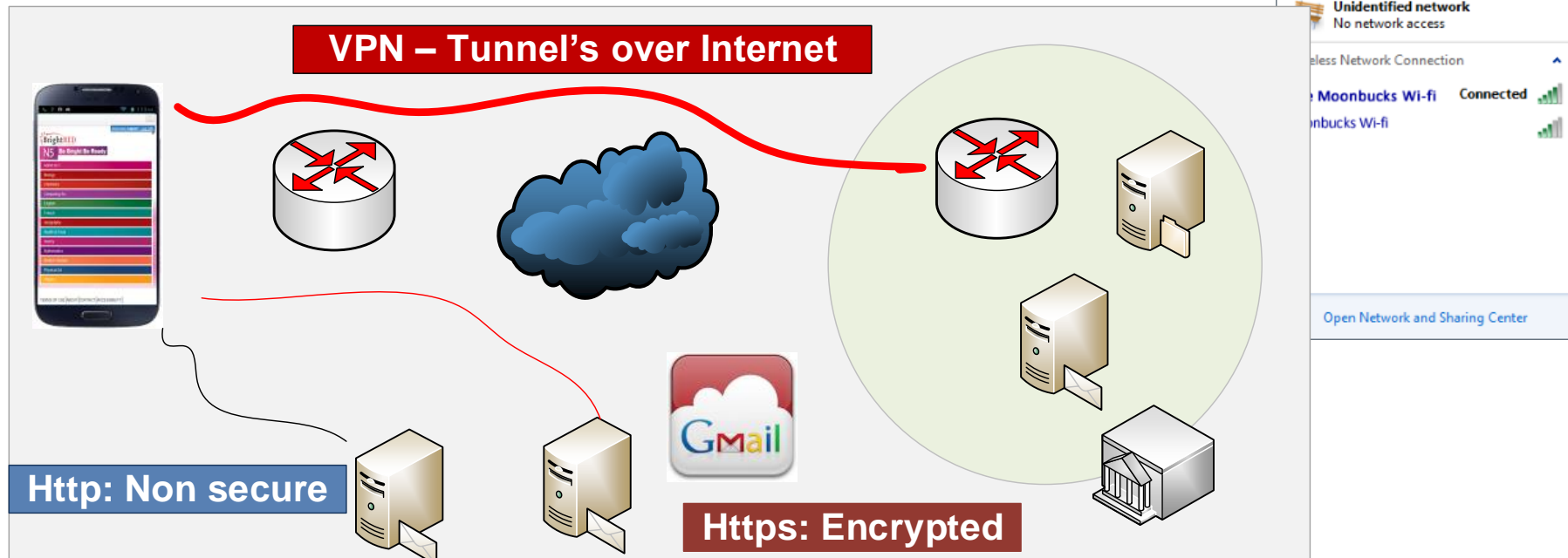
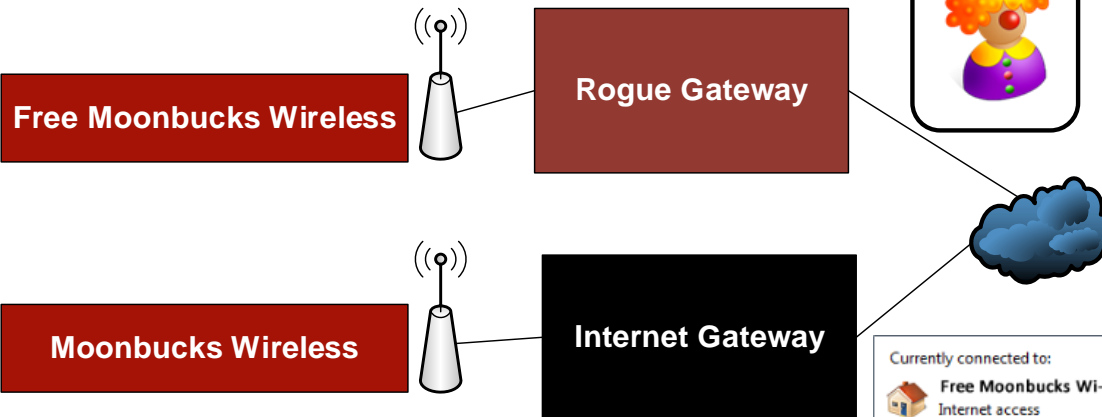
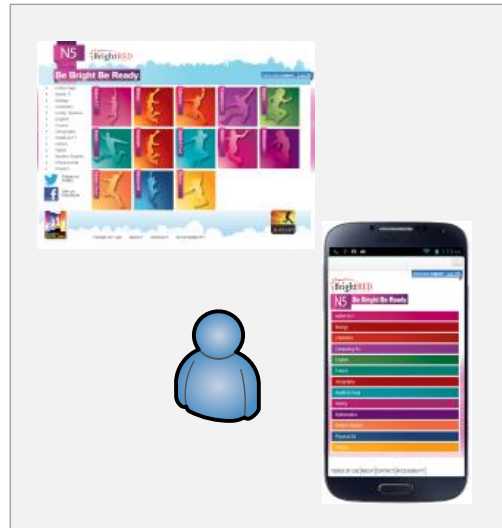
Risk 1: Loss of Device



Risk 2: Rogue SSID/Gateway



Risk 2: Rogue SSID/Gateway





Risk 3: Lack of Separation



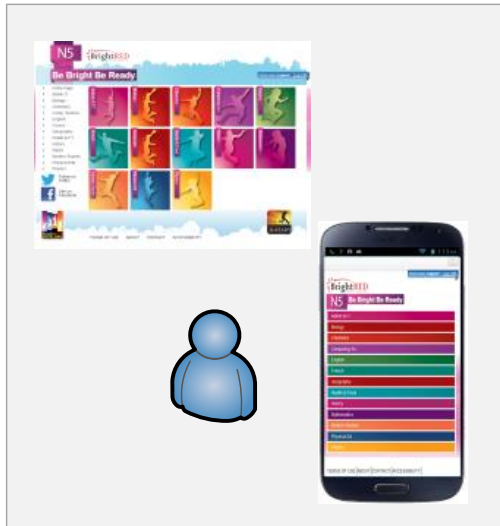


Risk 4: One Password Fits All



150 million accounts
compromised

#	Count	Ciphertext	Plaintext
1.	1911938	EQ7fIpT7i/Q=	123456
2.	446162	j9p+HwtWWT86aMjgZFLzYg==	123456789
3.	345834	L8qbAD3j13jioxG6CatHBw==	password
4.	211659	BB4e6X+b2xLioxG6CatHBw==	adobe123
5.	201580	j9p+HwtWWT/i oxG6CatHBw==	12345678
6.	130832	5djv7ZCI2ws=	qwerty
7.	124253	dQi0asWPYvQ=	1234567
8.	113884	7LqYzKVeQ8I=	111111
9.	83411	PMDTbP0LZXu03SwrFUVYGA==	photoshop
10.	82694	e6MPXQ5G6a8=	123123



47 million accounts



6.5 million accounts
(June 2013)



1 million accounts – in
plain text. 77 million
compromised



One account hack ... leads to others



Dropbox
compromised 2013



200,000 client accounts



Risk 4: One Password Fits All

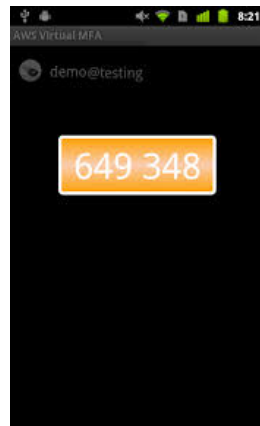


150 million accounts
compromised

#	Count	Ciphertext	Plaintext
1.	1911938	EQ7fIpT7i/Q=	123456
2.	446162	j9p+HwtWWT86aMjgZFLZYg==	123456789
3.	345834	L8qbAD3j13jioxG6CatHBw==	password
4.	211659	BB4e6X+b2xLioxG6CatHBw==	adobe123
5.	201580	j9p+HwtWWT/ioxG6CatHBw==	12345678
6.	130832	5djv7ZCI2ws=	qwerty
7.	124253	dQi0asWPYvQ=	1234567
8.	113884	7LqYzKVeQ8I=	111111
9.	83411	PMDTbP0LZxu03SwrFUVYGA==	photoshop
10.	82694	e6MPXQ5G6a8=	123123



Two-factor everything in
the Cloud



Enter security code

We sent a security code to your phone number
ending in

6-digit code

Submit code

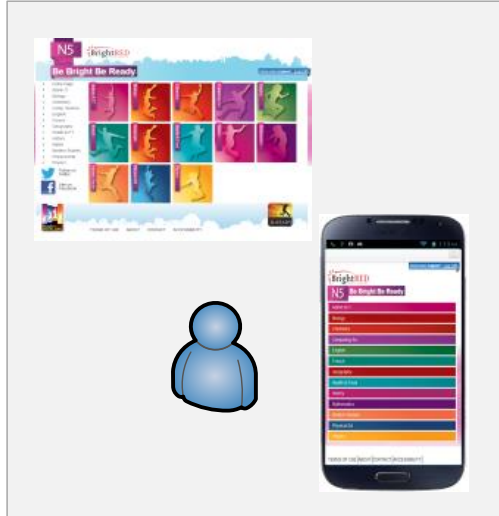
☐ Trust this computer ⓘ

[Didn't receive one?](#)

[I lost my phone](#)

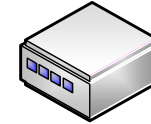


Risk 5: Device Poisoning



Who has this IP
address (192.168.0.1)?

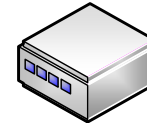
Here is my MAC
address
(11:22:33:44:55:66)



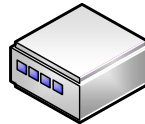
Gateway
(192.168.0.1)

ARP
Poisoning

Here is my MAC
address
(22:33:44:55:66)



DHCP Request ...



Here is your IP address,
Gateway, and DNS IP



DNS
Poisoning



1 0.000000 0.0.0.0 255.255.255.255 DHCP 314 DHCP Discover - Transaction ID 0x3d1d
Frame 1: 314 bytes on wire (2512 bits), 314 bytes captured (2512 bits)
Ethernet II, Src: Grandstr_01:fc:42 (00:0b:82:01:fc:42), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0 (0.0.0.0), Dst: 255.255.255.255 (255.255.255.255)
User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)

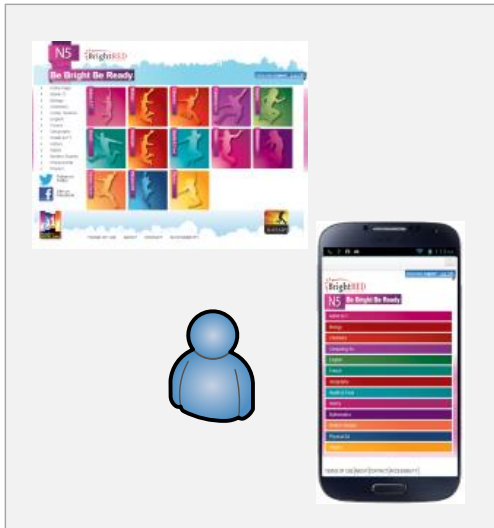
2 0.000295 192.168.0.1 192.168.0.10 DHCP 342 DHCP Offer - Transaction ID 0x3d1d
Frame 2: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)

3 0.070031 0.0.0.0 255.255.255.255 DHCP 314 DHCP Request - Transaction ID 0x3d1e
Frame 3: 314 bytes on wire (2512 bits), 314 bytes captured (2512 bits)
Ethernet II, Src: Grandstr_01:fc:42 (00:0b:82:01:fc:42), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Internet Protocol Version 4, Src: 0.0.0.0 (0.0.0.0), Dst: 255.255.255.255 (255.255.255.255)
User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)

4 0.070345 192.168.0.1 192.168.0.10 DHCP 342 DHCP ACK - Transaction ID 0x3d1e
Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)



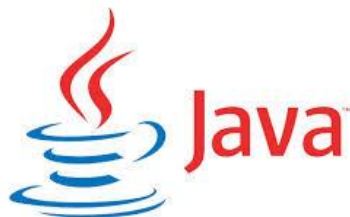
Risk 6: Unpatched Systems



CVE-2007-0071
Adobe Flash Player.
Integer overflow



Phoenix Exploit Kit



CVE-2013-5331
Adobe Flash Player.
Run code on
machine.



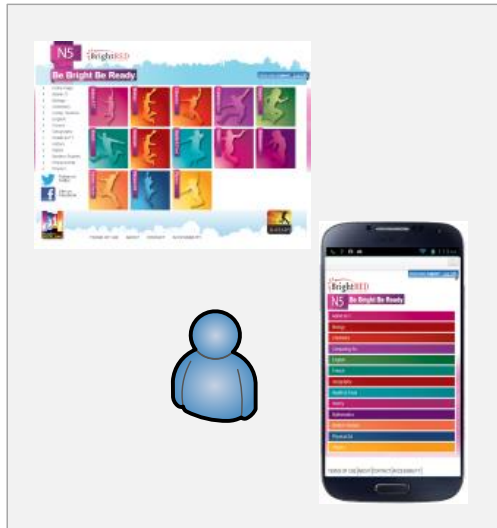
CVE-2013-1723
Java Exploit

CrimeBoss





Risk 7: Shoulder Surfing

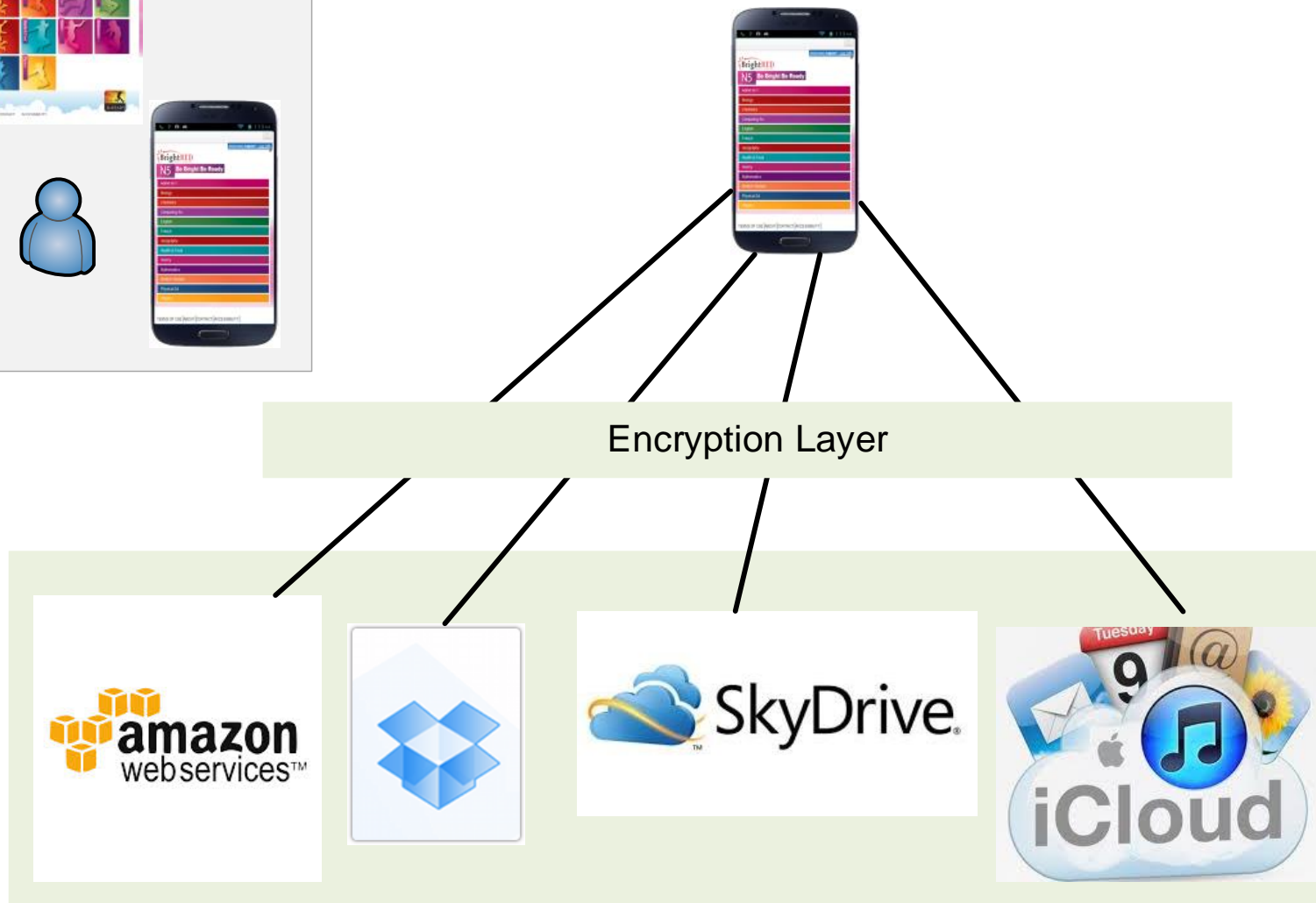
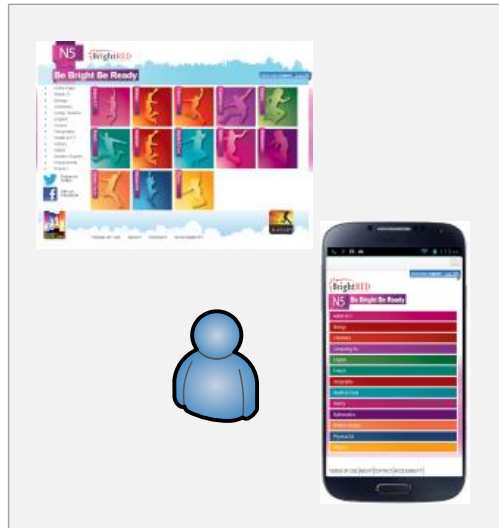


Passwords, customer details, emails, usernames, etc can all be shoulder surfed. Privacy filter is an inexpensive investment.

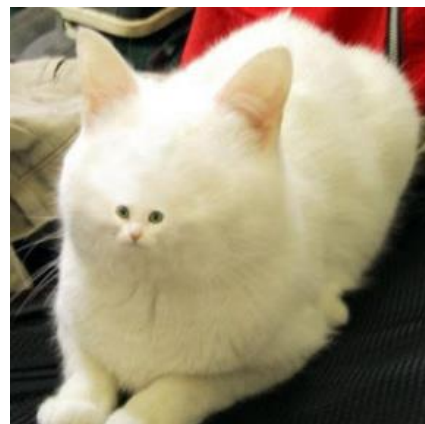




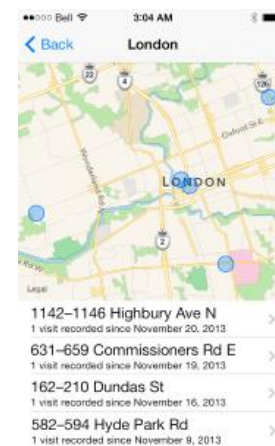
Risk 8: Storing Non-encrypted to the Cloud



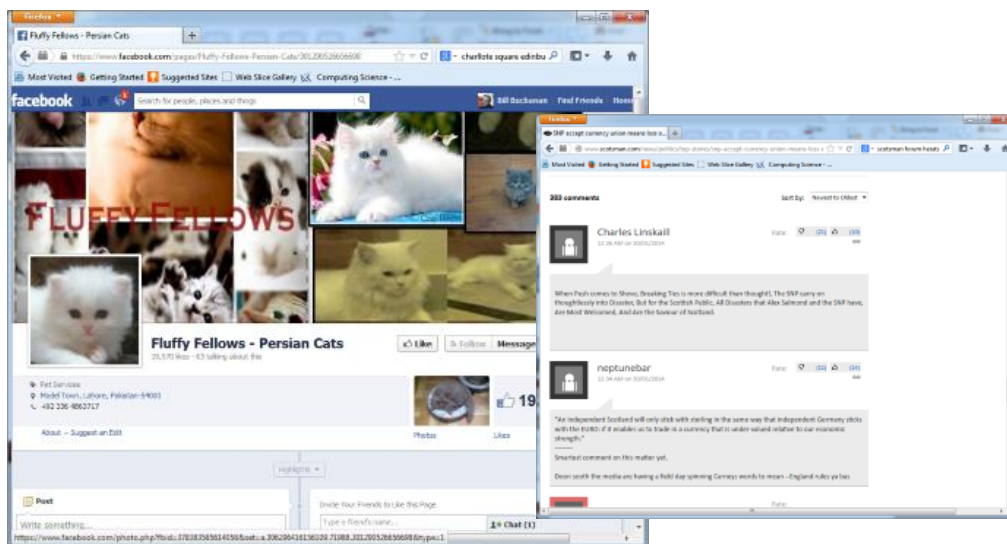
Non-UK/EU storage. Open to hack.



Photos

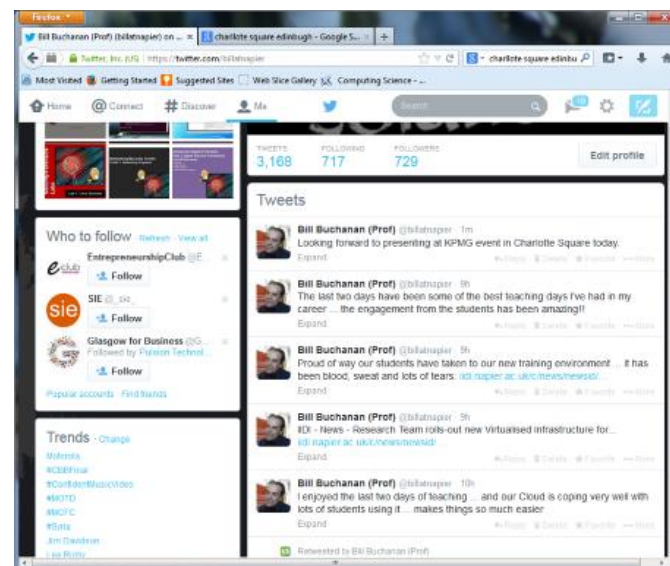


Device Records



Facebook

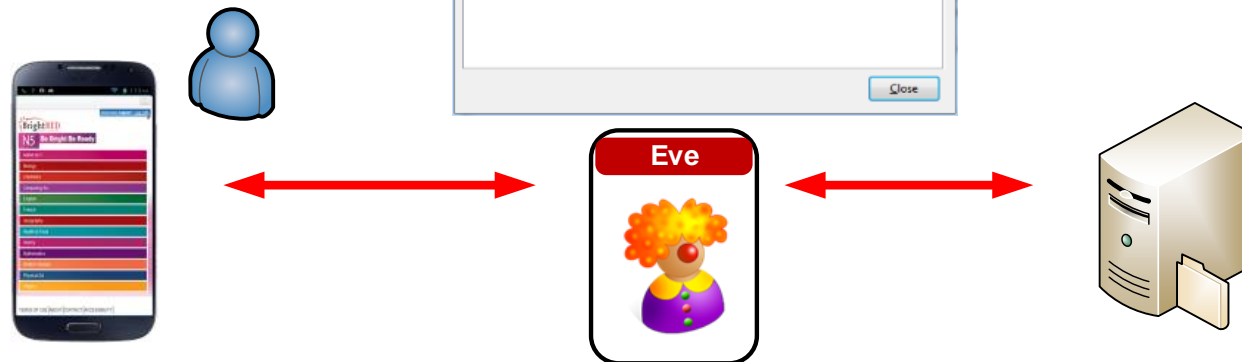
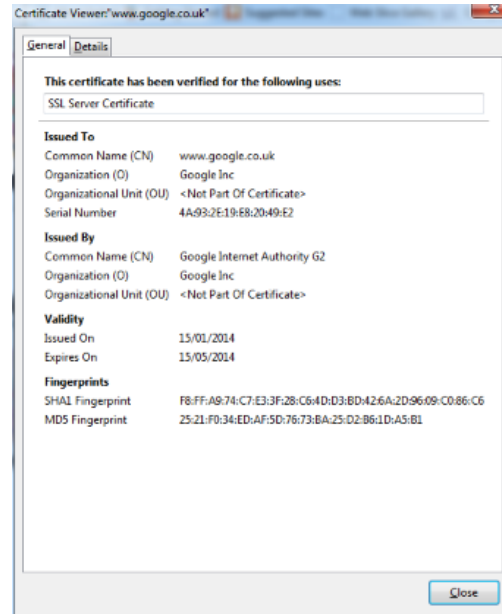
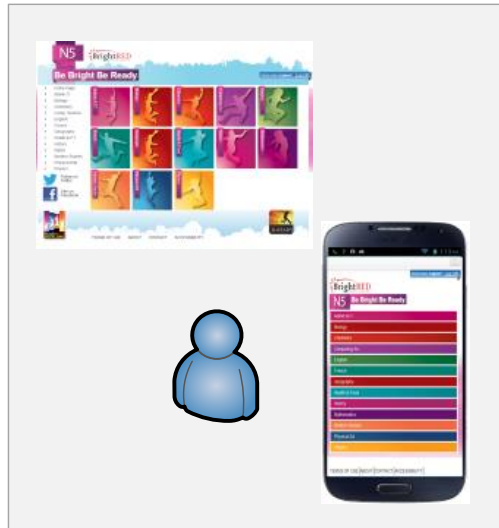
Forums



Twitter

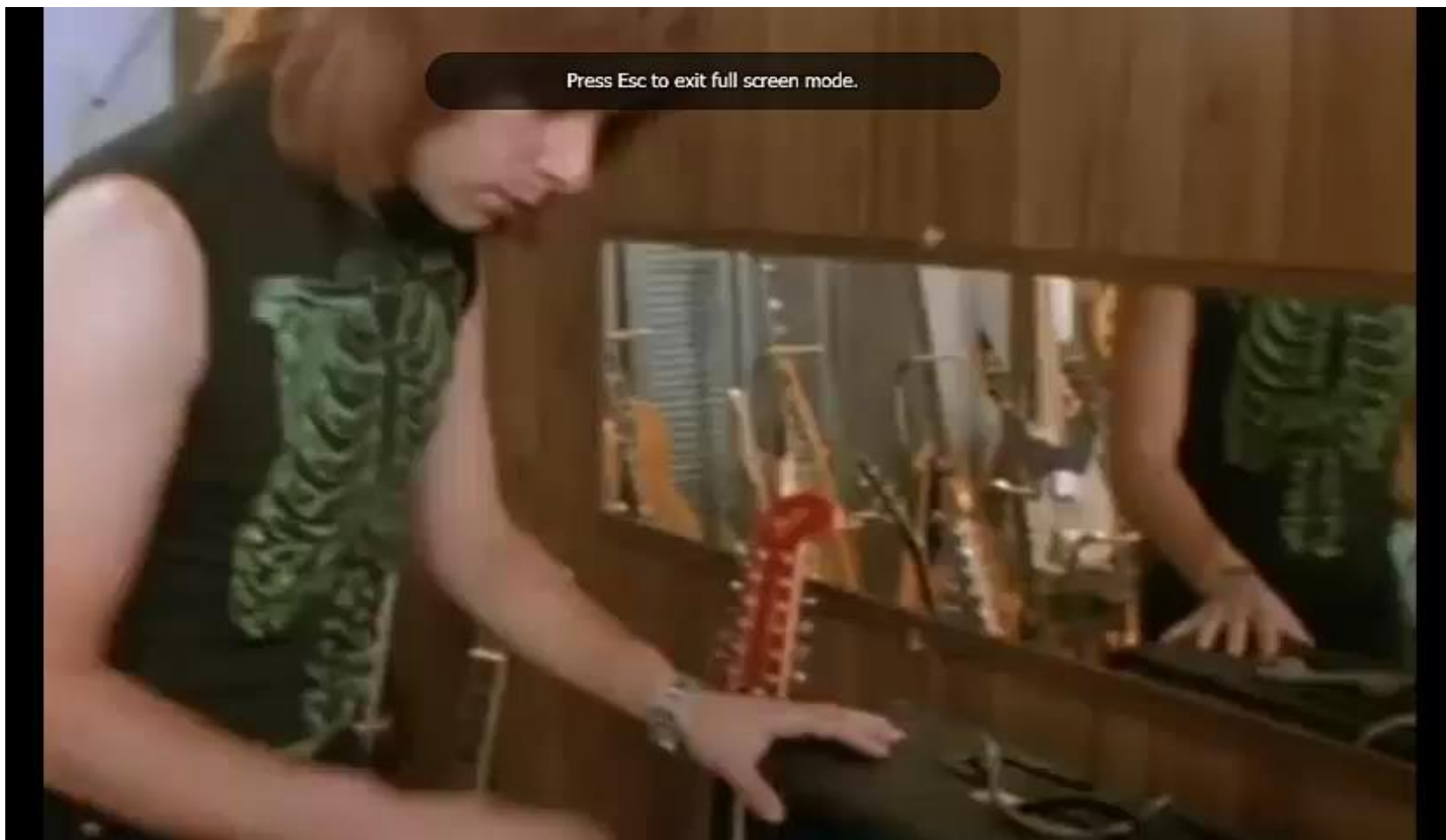


Risk 10: Trusting https and fake cert



Eve-in-the-middle (Proxy/Fake
Certificates)

Press Esc to exit full screen mode.

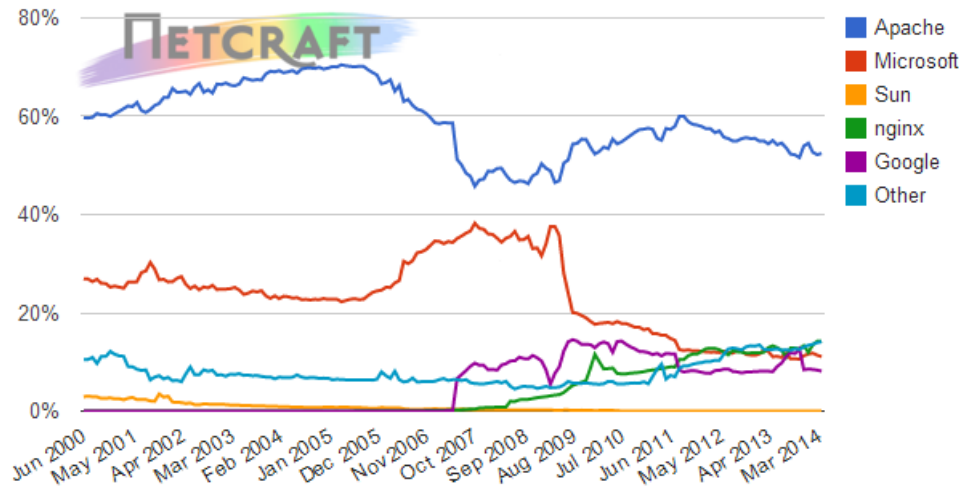


**"On the scale of 1 to 10, this is an 11.
Half a million sites are vulnerable,
including my own."**

**Has anyone looked at all the low-
margin non-upgradable embedded
systems that use OpenSSL? An
upgrade path that involves the trash, a
visit to Best Buy, and a credit card
isn't going to be fun for anyone.**



**... a 'catastrophic' revelation and
suggested it could have been created
deliberately to help snoop through
firms' data.**



**I'm hearing that the CAs are
completely clogged, trying to reissue
so many new certificates. And I'm not
sure we have anything close to the
infrastructure necessary to revoke half
a million certificates.**

N5 Integration

Motivation: Creating engaging and stimulating Web based material

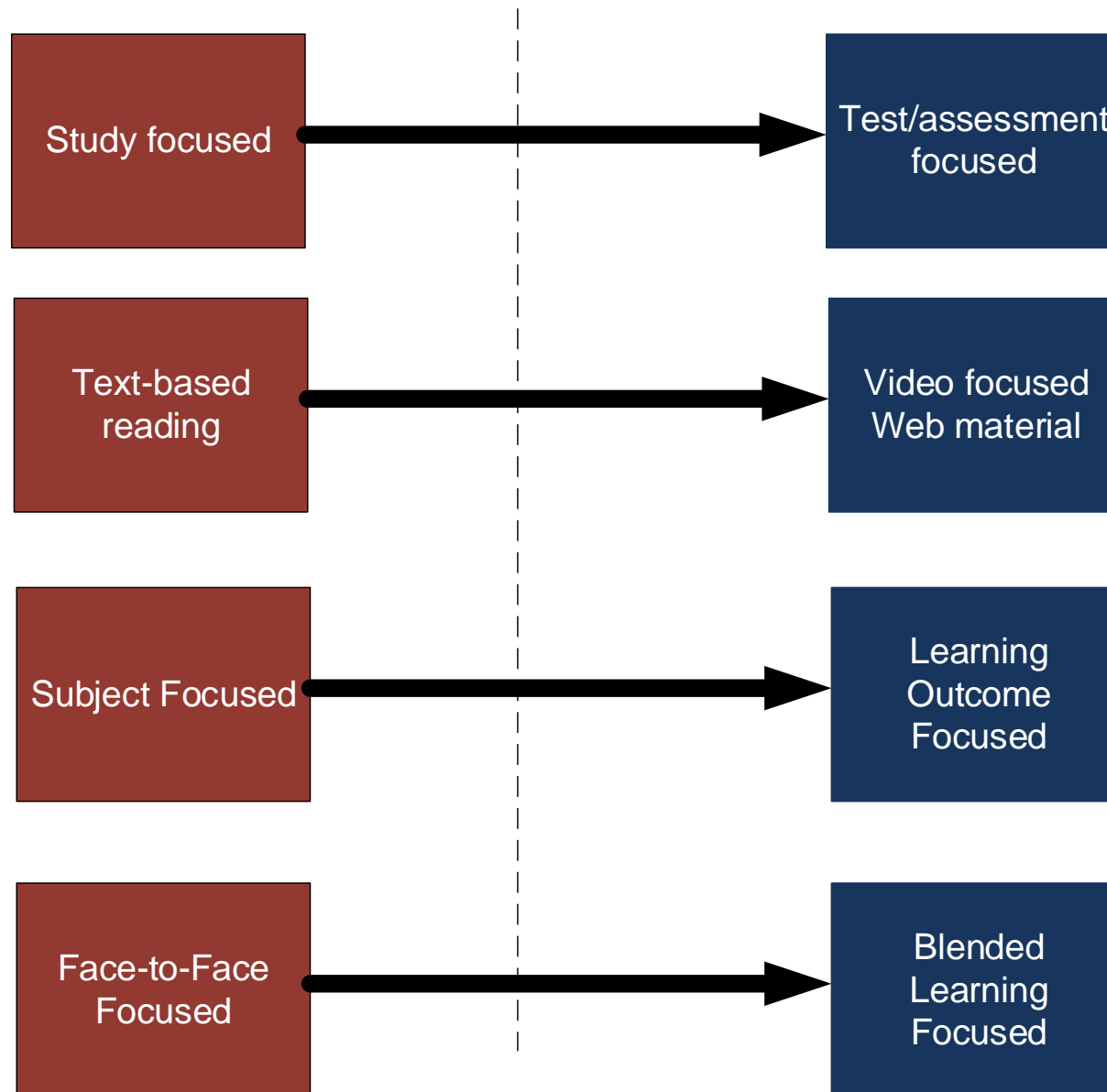
- Blended Learning.
- Cloud Integration.
- Stimulating material.
- Evaluation of On-line Material.



Prof Bill Buchanan, School of Computing

Twitter: @billatnapier

Web: <http://asecuritysite.com>
<http://brightredbooks.net>



Twitter



On-line Lectures



Fun Tests



Cloud Storage



Cloud-based teaching

On-line tests



Itemized Feedback



Ever changing challenges





Responsive Designs

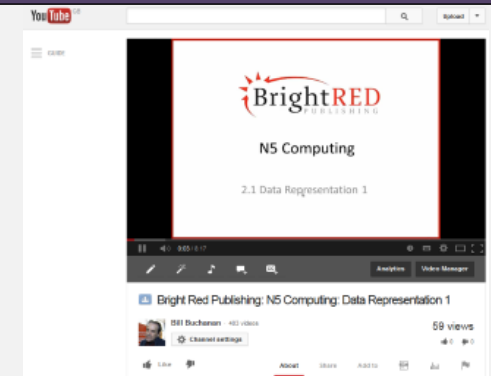


The Cloud can enhance teaching ... but good teachers are the key!



Focusing on supporting deep learning

Allow for many ways of learning and delivery mechanisms





ATOMIC STRUCTURE: THE STRUCTURE O...

[Back](#) [Home](#)

Overview

This section supports pages 14-15 of the BrightRED N5 Chemistry Study Guide which covers the Structure of the Atom. Ancient Greek philosophers originally had the idea that if something was broken down into smaller and smaller pieces eventually it would not be possible to break it down into anything simpler. At the start of the nineteenth century, the English scientist John Dalton (1776-1803) put forward atomic theory to explain his experimental observations. Dalton was the first person to use the word atom, which comes from the Greek word atomus, meaning unsplitable. Atoms are tiny particles that are present in all elements and each element in the Periodic Table has its own atomic number. The atomic number of an element is equal to the number of protons in its nucleus. When learning about the Structure of the Atom, the key topics explored are:

- The History of the Atom
- The Modern Atomic Model
- Atomic Number and Mass Number

Tests

Click a link below to take a topic test:

[The Structure of the Atom](#)

Video link

To see more about basic atomic structure, click on this link and watch the clip - [Link](#)

Learn more about the Structure of an Atom by watching this video -



Increase in test-based learning

2.1 Data Representation 1

[Back](#) Click your answer, then NEXT and END when you are done to find out how you got on! ([Roll over for hint](#))

8 of 6 | [Prev](#) | [Next](#) | [End](#)

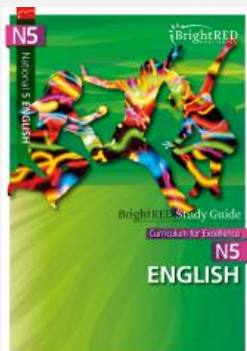
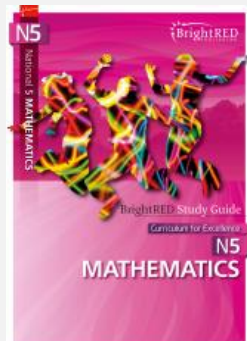
6. What is -128 in 2's complement.

- | | |
|---|----------|
| A | 01111111 |
| B | 10111010 |
| C | 11001110 |
| D | 10000000 |
| E | 11100111 |
| F | 11111111 |

Ever-changing "infinite" tests

Increasing Integration with Youtube

Increase enforcing feedback during and after tests



TRANSPORT ACROSS CELL MEM

[Back](#) Click your answer, then NEXT and END when you are done to find out

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1. The concentration of tissue which surrounds cells is about 1%. If liver cells were placed in a 10% sugar solution, they would...

- | | |
|---|-----------------------------------|
| A | Lose water and become plasmolysed |
| B | Gain water and become turgid |
| C | Lose water and shrivel out |
| D | Gain water and burst |

If a solution is 10% sugar, this means that it is 90% water. Water moves from a high water concentration to a lower water concentration.

TRANSPORT ACROSS CELL MEMBRANES

[Back](#) [My results](#)

Score: 25% Fairly good.

Correct

Question	Your Answer	Feedback
The following graph shows the concentration of ions in a pondweed and the surrounding pond water. Which of the ions were taken into the plant by active transport?	Potassium and chloride	

Incorrect

Question	Your Answer	Feedback
Which pair of structures numbered in the diagram are correctly identified?	Phospholipid - 3, Protein - 7	
During diffusion, molecules always move...	Against a concentration gradient from low to high concentration	
The concentration of tissue which surrounds cells is about 1%. If liver cells were placed in a 10% sugar solution, they would...	Gain water and become turgid	



Interquartile Range and Boxplots

Back Enter your values

Values

You can enter values separated by commas:

10,11,11,13,15,17,21,26,26,27,24,20

Calc

Calculations

Ordered: 10.00 11.00 11.00 13.00 15.00 17.00
20.00 21.00 24.00 26.00 26.00 27.00

Min: 10.00
Max: 27.00
Lower Quartile (Q_1): 12.00
Median (Q_2): 18.50
Upper Quartile (Q_3): 25.00
Interquartile range ($Q_3 - Q_1$): 13.00

Examples

- 1,2,3,4,5,6,7,8. Median=4.5. [Try](#)
- 1,2,3,4,5,6,7. Median=4. [Try](#)
- 1.09,1.26,1.05,1.43,1.00,1.15,1.25,1.03,1.19,1.36. Median=1.17. [Try](#)
- 18,23,23,26,32,36,46,56,70. Median (Q_2)=32, Q_1 =46, Q_3 =51. [Try](#)
- 20,25,18,26,21,35,30,26,25,29,31,18,35,30,27. Median (Q_2)=26, Q_1 =21, Q_3 =30. [Try](#)

Box Plot Example

Supportive environments with solutions to problems

Integration of advanced Web services (eg Language translator)

English Language Translator

Back Press the button for the translation [I love Paris in the Springtime][Can you tell me where I can purchase some coffee?][What is the capital of Scotland?][Hello (German)][Hello (Italian)]

Parameters

Enter English phrase:
Hello to the Learning Through Technology Conference. So nice to be able to present some of our ideas.

Translate

English to French: French to English:

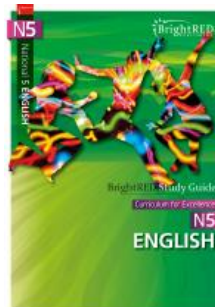
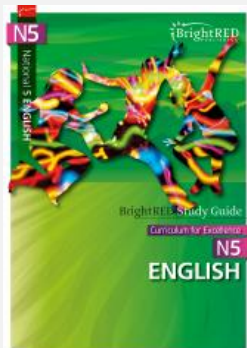
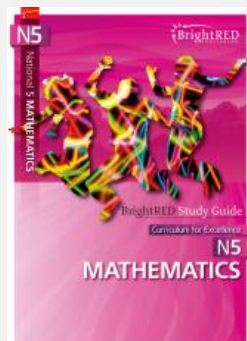
Other translations to English:
German: Polish: Russian: Italian:
Spanish: Danish: Japanese: Dutch:
Norwegian: Chinese: Finnish: Greek:
Turkish:

Translation

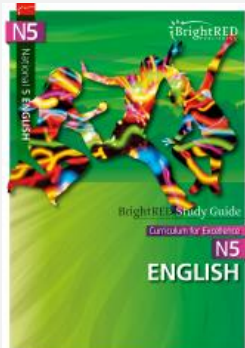
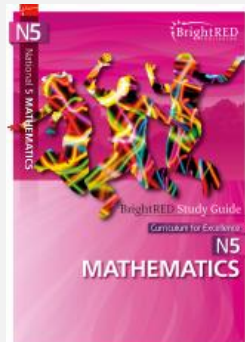
Bonjour sur l'apprentissage par le biais de conférence sur la technologie. Tellement agréable d'être en mesure de présenter certaines de nos idées.

Audio

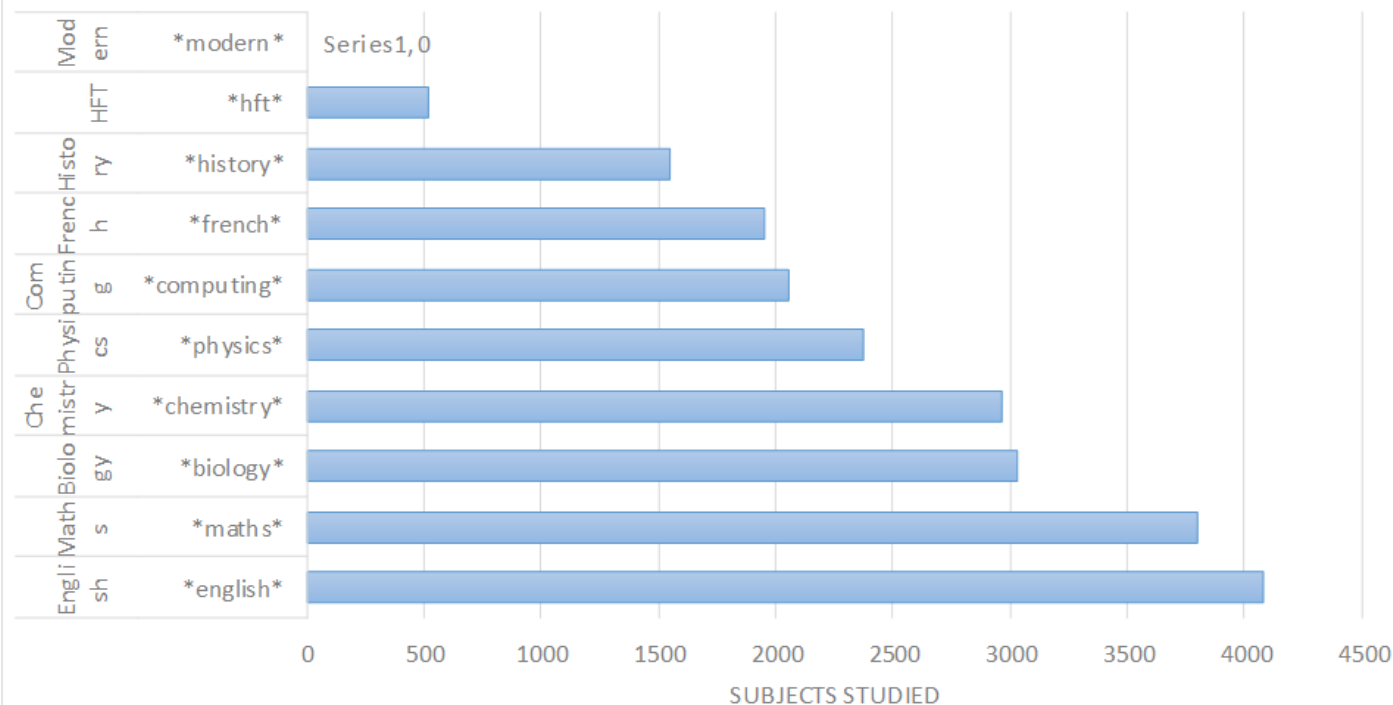
Automated conversion of books to Web site



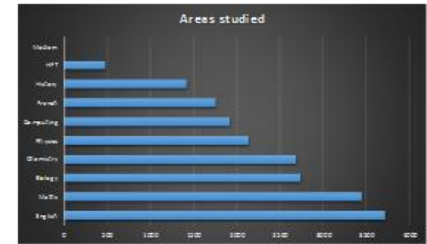
Study Areas



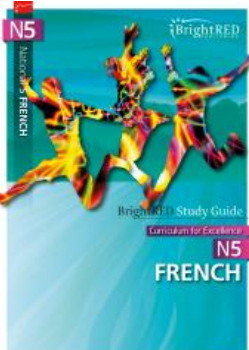
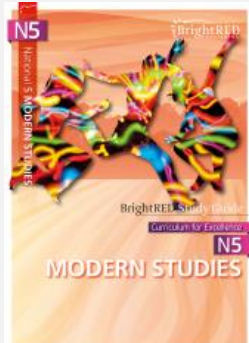
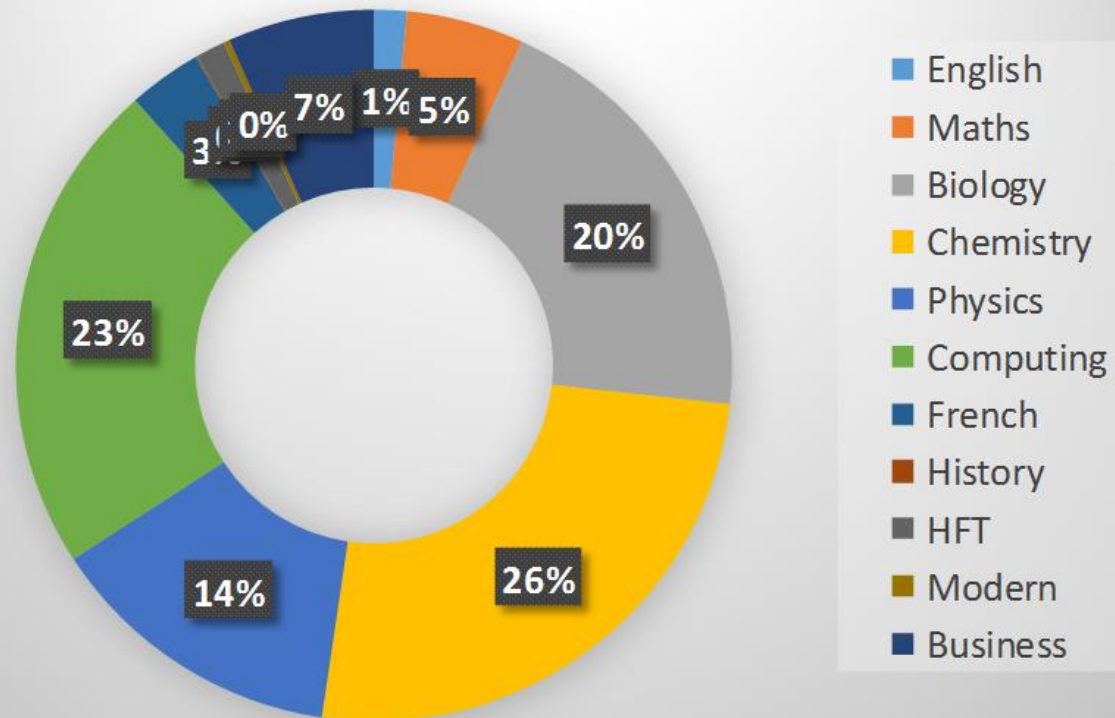
Areas studied



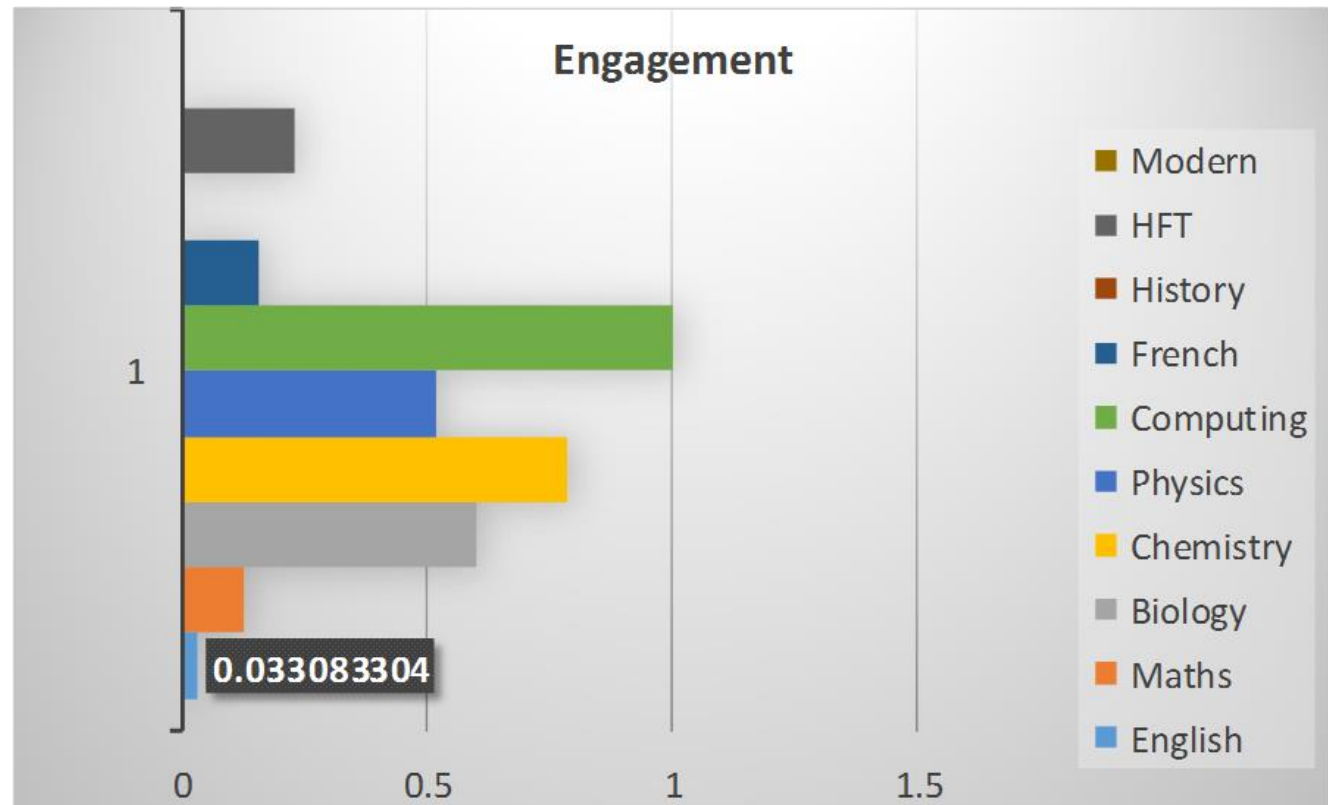
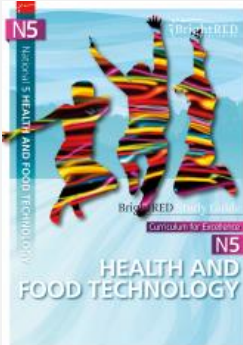
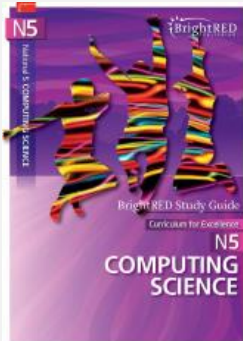
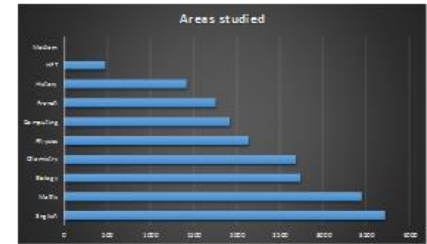
Tests Undertaken (May 2014)



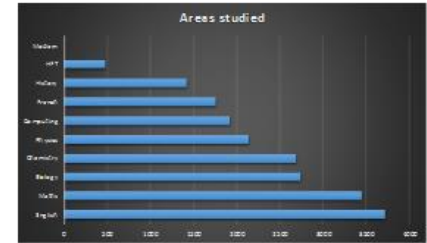
Tests Undertaken (May 2014)



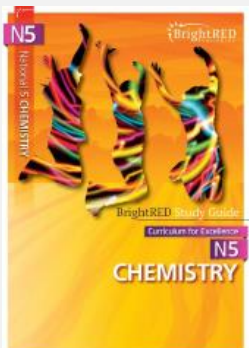
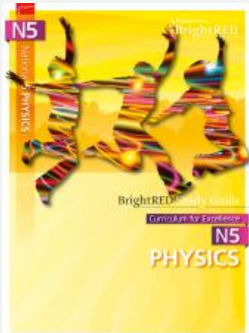
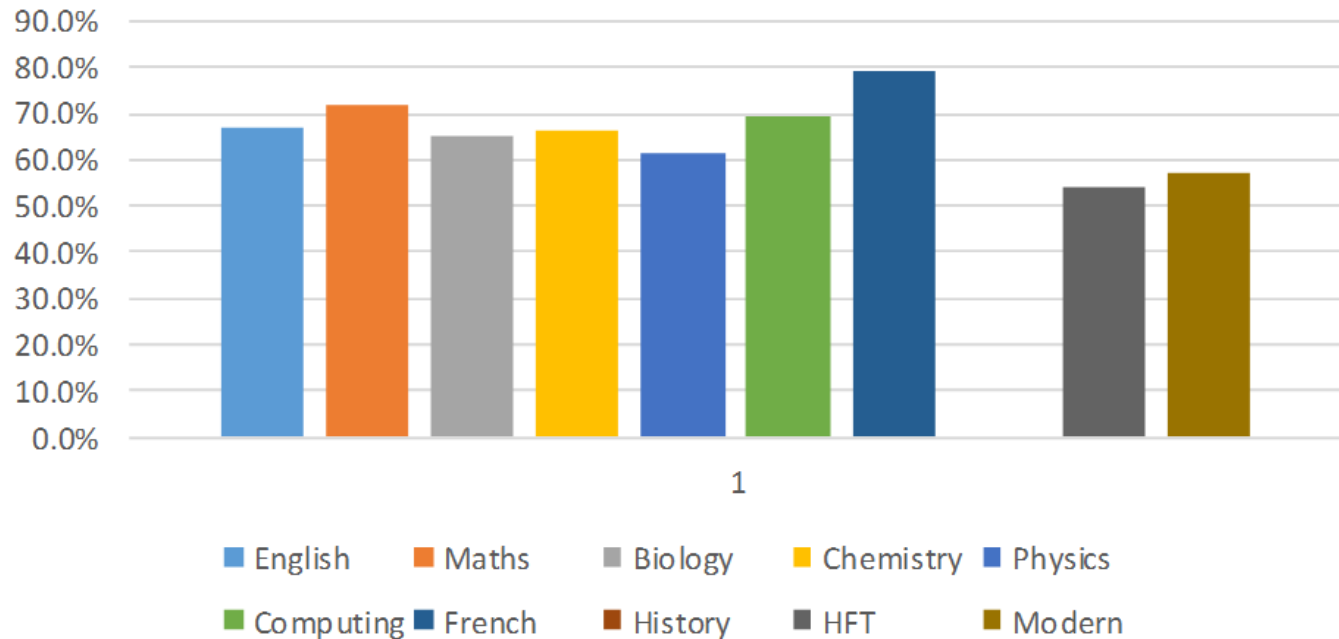
Engagement (May 2014)



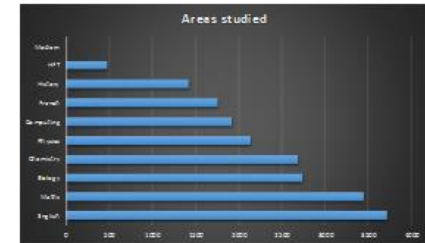
Average Grades



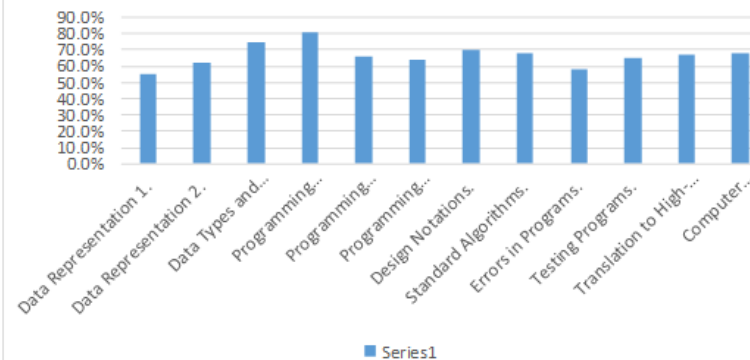
Average Grade



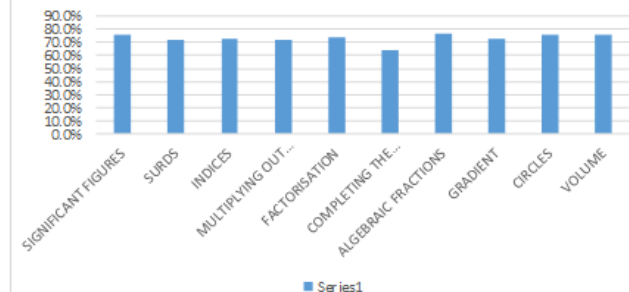
Scores for subjects



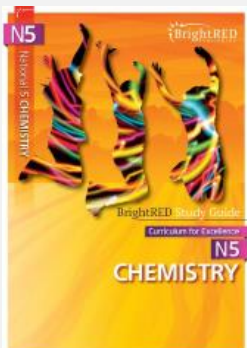
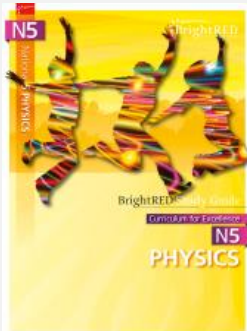
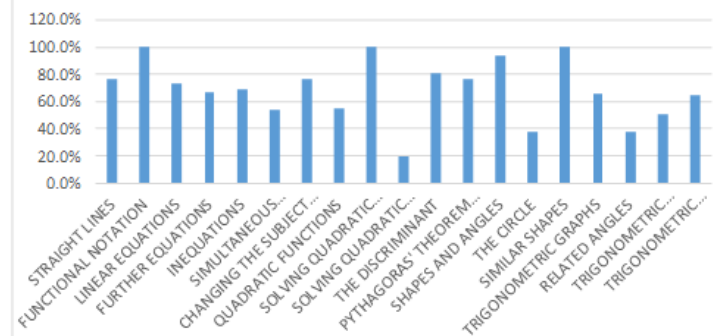
Computing (Software Development)



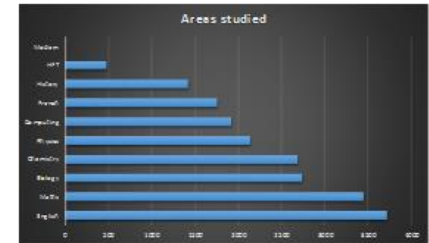
Maths (Expressions)



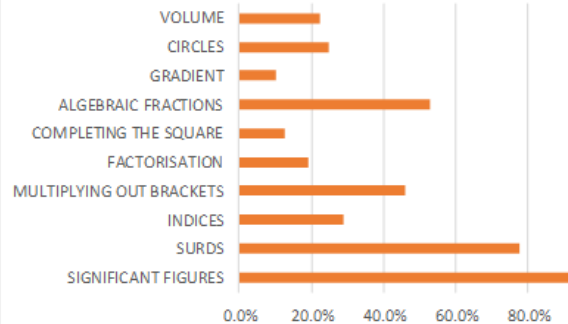
Maths (Relationships)



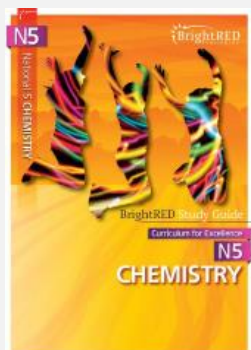
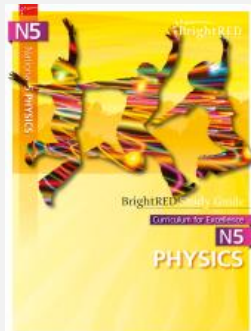
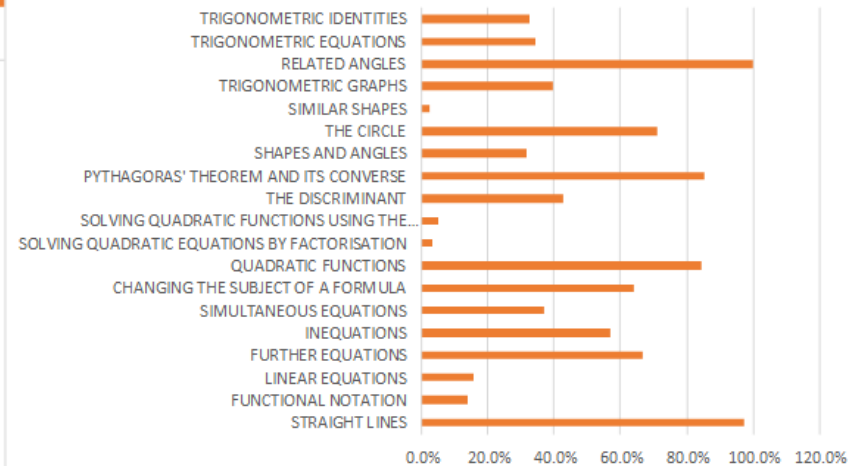
Engagement (Maths)



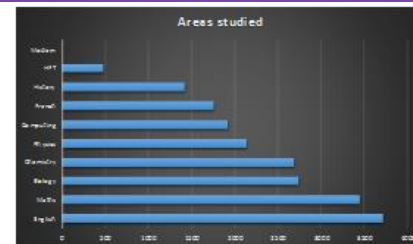
Engagement (Expressions)



Engagement (Relationships)



The most difficult question ...



THE CIRCLE

[Back](#) Click your answer, then NEXT and END when you are done to find out how you got on!

Graphic

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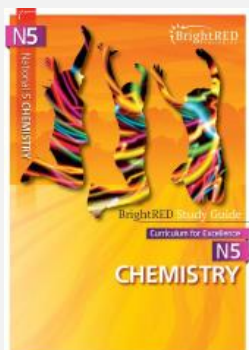
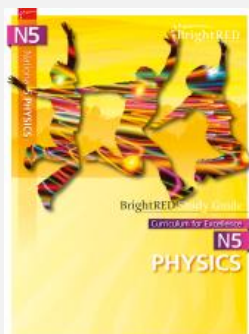
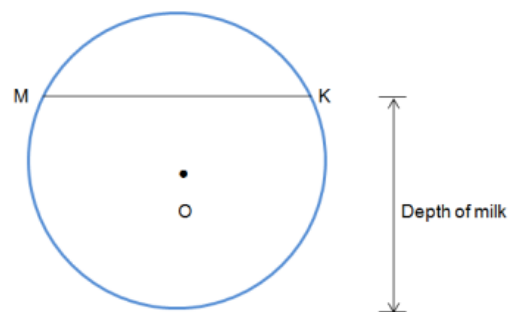
4. Milk is stored in a tank with a circular cross-section as shown below. The centre of the circle is O. MK is a chord of the circle. MK is 1.5 metres. The radius of the circle is 1.2 metres. Calculate the depth of the milk in the tank.

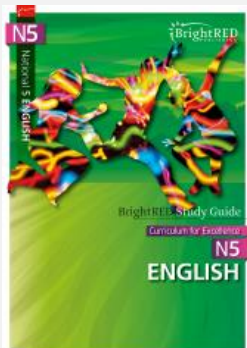
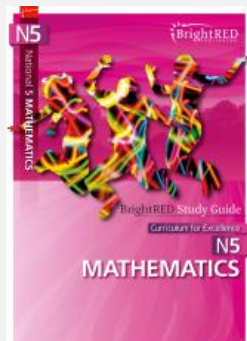
A 1.14 m

B 3.14 m

C 2.14 m

D 4.14 m





ATOMIC STRUCTURE: THE STRUCTURE O...

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Overview

This section supports pages 14-15 of the BrightRED N5 Chemistry Study Guide which covers the Structure of the Atom. Ancient Greek philosophers originally had the idea that if something was broken down into smaller and smaller pieces eventually it would not be possible to break it down into anything simpler. At the start of the nineteenth century, the English scientist John Dalton (1776-1803) put forward atomic theory to explain his experimental observations. Dalton was the first person to use the word atom, which comes from the Greek word atomus, meaning unsplitable. Atoms are tiny particles that are present in all elements and each element in the Periodic Table has its own atomic number. The atomic number of an element is equal to the number of protons in its nucleus. When learning about the Structure of the Atom, the key topics explored are:

- The History of the Atom
- The Modern Atomic Model
- Atomic Number and Mass Number

Tests

Click a link below to take a topic test:
[The Structure of the Atom](#)

Video link

To see more about basic atomic structure, click on this link and watch the clip - [Link](#).
Learn more about the Structure of an Atom by watching this video -



Increase in test-based learning

Increasing Integration with Youtube

Increase enforcing feedback during and after tests

TRANSPORT ACROSS CELL MEM

[Back](#) Click your answer, then NEXT and END when you are done to find out

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1. The concentration of tissue which surrounds cells is about 1%. If liver cells were placed in a 10% sugar solution, they would...

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If a solution is 10% sugar, this means that it is 90% water. Water moves from a high water concentration to a lower water concentration.

TRANSPORT ACROSS CELL MEMBRANES

[Back](#) [My results](#)

Score: 25% Fairly good.

Correct

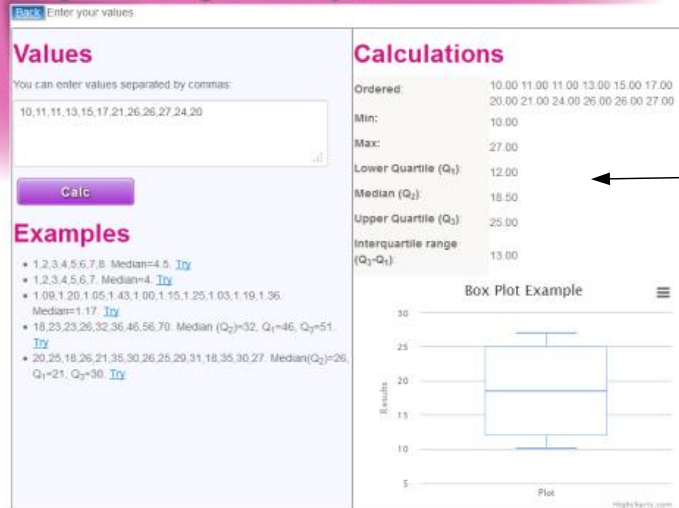
Question	Your Answer	Feedback
The following graph shows the concentration of ions in a pondweed and the surrounding pond water. Which of the ions were taken into the plant by active transport?	Potassium and chloride	

Incorrect

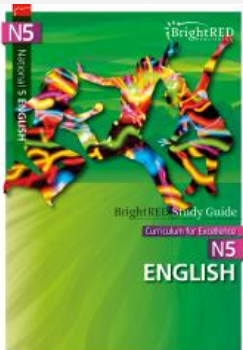
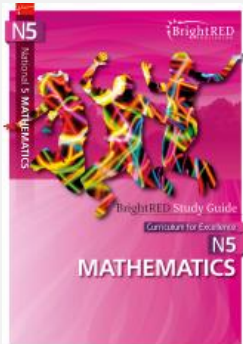
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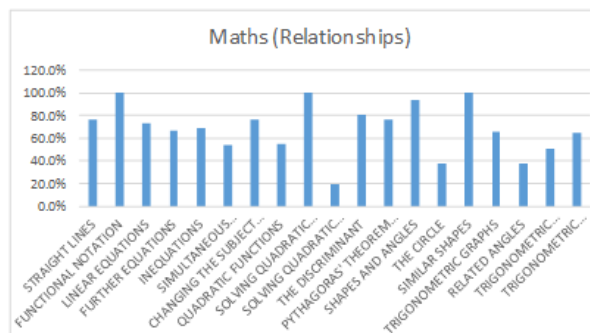
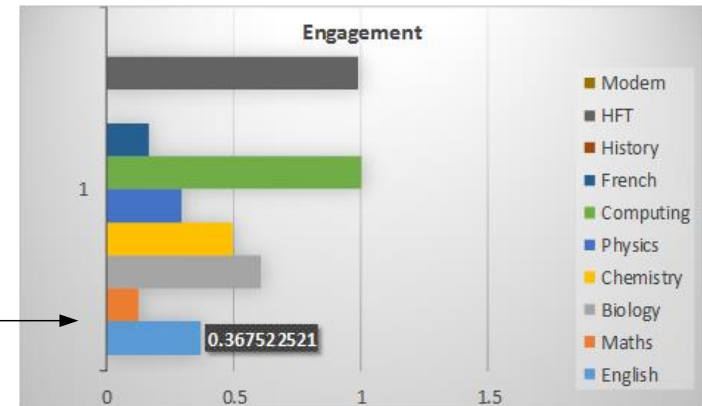
Interquartile Range and Boxplots



Supportive environments with solutions to problems



Knowledge-based subjects have more engagement on testing.
Strong: Modern Studies, HFT, Computing, Biology, and Chemistry.
Weaker: Maths, Physics.



Engagement and grades can vary widely in subjects

Computing Science: Now and The Future

Inc. Computer Security



Prof Bill Buchanan, Twitter: @billatnapier
Web: asecuritysite.com, brightredbooks.net

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