

Computing Year 3

Unit 3.4 We are Network Engineers

Step 1: Physical and wireless connections

Karin Clark

Learning Expectations

This unit will enable the children to:

- ◆ understand the physical hardware connections necessary for computer networks to work
- ◆ understand some features of internet protocols
- ◆ understand some diagnostic tools for investigating network connections
- ◆ develop a basic understanding of how domain names are converted to IP addresses.

The assessment guidance on page 50 will help you to decide whether the children have met these expectations.

Assessment should focus on whether pupils retain knowledge of how these technologies work, and whether they understand the technical details of some of the commands and their output. Use observation, targeted open questions and self-assessment.

Curriculum Links for Unit 3.1—steps 1-6

Literacy	✓
Numeracy	✓
D & T	✓✓✓
Languages	✓✓✓
Science	✓
Geography	✓✓✓
History	✓

Main Session

Discuss this step with your network manager and adapt it so that it works in the context of your school's network.

Ask the children to list all the things they use the internet for. What would life be like without it?
Explain that the school's network and the internet are possible because of connections between computers. Display the reverse side of the unit poster to help pupils visualise the connections between computers. Trace a simple route to show how data can be passed across the internet. If pupils are using a wired connection, ask them to look at the back of their computers and work out what each cable does. Show which cable connects to the school network.
Ask the pupils to find what the cable connects to – typically a wall box or cable trunking. Where does this cable go? Follow the connection to the room's network switch and then follow the route of the cable connecting it to the school's network server(s). Talk about the school's server(s).
If the pupils are using Wi-Fi connections, show them the classroom's Wi-Fi access point and walk along the route of the cable connecting it to the school's server(s).
Show the pupils how the school network is connected to the internet, explaining about the router and any filter, cache or firewall hardware.

Resources and e-safety

There is a perceived risk associated with providing Windows users with access to the command prompt. On properly configured systems the command prompt can be used without risk to the network, system settings, programs or data, as this neither requires nor grants administration privileges. If the pupils use these tools, the computers must be properly configured so that they can only edit files in their own user directory.

Making changes to computer settings should require administrator privileges, which are denied to pupils. An alternative approach would be to use a Raspberry Pi or collection of equivalent web-based tools (see Useful links).

Emphasise that the pupils should not change settings or alter files on computers unless they have permission and can undo any harm done.

It's tricky to set a balance between encouraging experimentation and ensuring safe, respectful and responsible use.

Unit poster reverse – Networks

Computing Year 3

Unit 3.4 We are Network Engineers

Step 2: Passing messages across networks

Karin Clark

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Curriculum Links for Unit 3.1—steps 1-6

Literacy	✓
Numeracy	✓
D & T	✓✓✓
Languages	✓✓✓
Science	✓
Geography	✓✓✓
History	✓

Main Session

This step is a simulation of how modern computer networks (including the internet) pass data between computers. The description here assumes five tables of six pupils, but you can easily adapt this for different numbers. Read the activity stepby- step guidance on the CD-ROM before starting this step.

Explain that each computer on a network has a unique address – a short sequence of numbers that uniquely identifies it so that data can be sent to it. These are called IP addresses. Tell the pupils they are going to act out the roles of computers and networks to show how information can be passed across the internet. If appropriate, refresh the children's memories of how data is passed between computers by showing them the reverse side of the unit poster.

Run the passing messages activity (see the CD-ROM) to show how data is passed across networks, including the internet. If time permits, the pupils could repeat the activity, responding to the messages they've received.

While this activity represents most of the key ideas of the internet, explain that there are some significant differences.

- IP addresses are much longer.
- The switch for the sending network hardly ever communicates directly with the switch for the destination network – packets of data go through many different routers between the sender's switch and the recipient's switch.
- All the data (i.e. the text of the messages they sent) is transmitted in binary code (lots of 0s and 1s) – simple on/off electrical or optical signals.

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Passing messages activity step-by-step guidance
IP address cards for activity
Message slips for activity
Unit poster reverse – Networks

Computing Year 3

Unit 3.4 We are Network Engineers

Step 3: Testing network connections

Karin Clark

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Curriculum Links for Unit 3.1—steps 1-6

Literacy	✓
Numeracy	✓
D & T	✓✓✓
Languages	✓✓✓
Science	✓
Geography	✓✓✓
History	✓

Main Session

Ask your network manager to allow access to the Windows command prompt for this and the next two steps. Ask for the pupils to have access to the ipconfig, ping, tracert and nslookup commands. If this isn't possible, you can use the web-based tools listed in Resources. You'll also need a plan of the classroom to attach to the wall.

Explain that network engineers often need to test whether two machines are connected. To do this, they talk directly to the computer, using the command prompt (C:). Show the pupils the command prompt (C:) on Windows (accessed via the Start menu). Ask pupils to type 'ipconfig' into the command prompt and press the Enter key. Show them how to identify the IP (internet protocol) address of their computer. Ask them to write this down on the plan of the classroom. Do the children notice anything about the IP addresses on the plan? (The first set of numbers is always the same.) Remind them of their work in Step 1.

Explain that they can use another tool called 'ping' to check the connections between computers. Ping sends a very small message (packets of data) between two computers, collecting information about the time it takes for the packets to be transmitted.

Ask the pupils to type in 'ping' followed by the IP address of another computer in the room, and then press the Enter key. Show the pupils how to read how long the packets took to transmit. If appropriate, explain that 'ms' means millisecond (one thousandth of a second – very fast indeed!).

The pupils should now experiment with 'pinging' packets of data to other computers on the internet, e.g. typing 'ping risingstars-uk.com', and then trying some of their favourite web servers. Compare and contrast the time the ping packets take to get through.

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Unit 3.4 We are Network Engineers

Step 4: Getting from here to there

Karin Clark

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Curriculum Links for Unit 3.1—steps 1-6

Literacy	✓
Numeracy	✓
D & T	✓✓✓
Languages	✓✓✓
Science	✓
Geography	✓✓✓
History	✓

Main Session

Ask each pupil to use the web to plan a trip from school to Mountain View, California. If time allows, invite them to plot the stages of their journey on a shared Google Maps layer. Were there big differences between routes? Did many pupils take the same route?

Explain that the way a message travels across the internet is not that different, although packets in a message usually take the same, most efficient route. Using your finger, trace a possible route of data on the reverse side of the unit poster to clarify this point.

Explain that sometimes a network engineer needs to find out the route an individual packet of data takes, and they use another tool, *tracert*, to do this. Open a command prompt and type '*tracert www.risingstars-uk.com*'. Explain that the packet of data has 'hopped' between all the IP addresses shown to reach its destination.

Ask the pupils to use *tracert* for some favourite web servers, such as *www.bbc.co.uk*. Which web servers took the smallest number of hops? Which took the largest? Did any fail to respond to *tracert* requests? Explain that this information helps network engineers to spot problems with the network if it takes a long time to respond.

Show the pupils how to use one or more of the web-based geolocation tools listed in *Resources* to estimate the location of the switches and routers the packet travels through. Ask the pupils to use a geolocation tool to work out the approximate location of all the hops to a web server of their choice, plotting these as a layer on Google Maps. What locations are common to all pupils' maps? Why might that be? (Common locations will include the school, your internet service provider and London's Linx, Telehouse or GlobalSwitch.)

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Unit poster reverse – Networks
Google Maps:

<http://maps.google.com>

Geolocation tools:

www.iplocation.net

www.infosniper.net

www.ipligence.com/geolocation

www.yougetsignal.com/tools/visualtracert

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Unit 3.4 We are Network Engineers

Step 5: From names to numbers

Karin Clark

Learning Expectations

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Curriculum Links for Unit 3.1—steps 1-6

Literacy	✓
Numeracy	✓
D & T	✓✓✓
Languages	✓✓✓
Science	✓
Geography	✓✓✓
History	✓

Main Session

Talk to the pupils about how you (or your parents) used to keep a physical address book with the phone numbers of your friends and family, how BT still produce a printed phone book and how other telephone numbers can be obtained through directory enquiries.

Draw an analogy with the way the internet works: the internet uses IP addresses (numbers) to transmit data, but we find it much more helpful to work with names, and so the Domain Name Service (DNS) has been invented to make it easy to convert from numbers to names.

Explain to pupils that the DNS works in a similar way to phone books, with a local cache (quick access copy) of numbers, the ISP's (internet service provider's) own cache, and a master list.

There are occasions when the DNS doesn't work quite as it should, and so network engineers need to use a tool, in this case the nslookup command, to identify these problems in order to solve them.

Ask the pupils to build up their own small 'cache' of IP addresses for some of their favourite websites. Ask them to write down five websites that they regularly use. The pupils can then use the nslookup command (via the Windows command prompt) to look up the IP address for any website, e.g. 'nslookup www.google.com'.

Ask pupils if they can think of any way they could have sped up this process. Would it have been quicker if they'd all shared their lists, so that they didn't need to look up addresses if someone else already had? Explain that this sharing of IP address lookups is done automatically by the DNS.

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Pupils can do name-server lookups online, e.g. www.centralops.net/co

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Unit 3.4 We are Network Engineers

Step 6: Physical and wireless connections

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D & T	✓✓✓
Languages	✓✓✓
Science	✓
Geography	✓✓✓
History	✓

Main Session

Ask the pupils to imagine they want to send a private message to a friend through the post. In how many ways could someone either read their message or substitute a different message for it? Would they, or their friend, be able to tell that this had happened?

Remind the pupils that packets of data on the internet make lots of hops on the journey from sender to recipient. Explain that any of the switches or routers along the way *could* read the data in the packet (like sending a postcard through the mail). How do the pupils feel about that? Are there occasions when this might be a problem or would worry them? Suggest examples of internet banking that their parents or carers use, or typing in passwords for other accounts.

Explain that any time a computer sends or receives packets of data, the computer, and perhaps the routers and switches, can log that data has been sent or received. Remind the pupils that each computer on the internet has its own unique IP address, and that these can be located on a map. Do the pupils mind that there might be a record of all that they do using the internet?

Ask the pupils to think about what could happen if the IP address for a web server was changed to point to another computer on the internet. Would it be a problem if, when they thought they were connecting to the school learning platform, they were actually using a different web server? What if it were their parents doing online banking?

Ask the pupils to create a poster illustrating one or more of these issues, and drawing on their knowledge of how the internet works. The pupils should provide feedback on one another's posters.

Finally, ask the pupils to reflect on what they have learned in this unit.

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