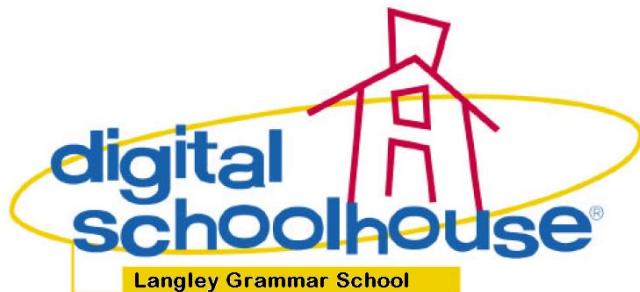


# Computing

## Databases Unplugged: Updated Version



[www.digitalschoolhouse.org.uk](http://www.digitalschoolhouse.org.uk)

### Abstract:

This report gives details of a series of computing lessons designed to relate fundamental concepts of database use and design to children in Primary and Secondary Education (ages of 6 to 16). The skills and concepts developed in these lessons begin at a very simple level but progress to cover abstract concepts such as Relational Databases. The series has been aligned to match the scope, range and targets recommended in the Computing At Schools document A Curriculum for Computing.

The controlling idea behind the creation and testing of these lessons has been to challenge the traditional view that such young children are not yet capable of the complex thinking required for these advanced topics.

This work has been carried out as part of the Digital Schoolhouse (DSH) accelerated learning model, which enables this teaching of KS3 (ages 11 – 14) and even KS4 (ages 14 – 16) concepts to KS2 (ages 7 – 11) children, and also focuses on investigating and developing new and more engaging ways of teaching existing Computing principles and concepts using examples of new technologies e.g. cloud computing, to enhance rather than replace good pedagogy.

This report builds on previous work entitled 'the TEACHING of databases', presented at the 9th Annual HEA Conference on The Teaching of Computing, to develop the DSH model as part of a process of ongoing feedback.

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# Computing

## Databases Unplugged: Updated Version

### Foreword

It's great to have this contribution to the CS Unplugged activities. It represents an extension of the traditional "Unplugged" activities because it (Computer Science) is gaining more traction in schools as a topic being taught around the world, this activity provides access to a topic that can lead directly to practical "plugged-in" activities on a computer.

Importantly, this resource has been trialled with many different classes - we've often found that things that look great turn out to be not so good when used with students, and vice versa, so the best endorsement for an activity always comes from students!

Tim Bell  
Computer Science Unplugged  
[www.csunplugged.org](http://www.csunplugged.org)

### Introduction

If we want to inspire children to become independent learners, evaluators and designers of new technologies then it is important that they have a clear understanding of the computing principles and concepts that underpin these technologies.

The focus of this practitioner research is on how to teach (where ever possible) computing without the use of computers. To accommodate the different learning styles, the Digital Schoolhouse (DSH) has developed a variety of audio, visual, and kinesthetic teaching activities. Examples include pupils performing a human database role-play and using SQL syntax to structure questions. The DSH aims to develop children's understanding of databases by breaking down abstract concepts and relating them to the children's existing understanding in a fun and interactive way. This project believes that it is important to develop children's developing Digital Literacy skills along side their understanding of Computer Science but that technology should only be used to enhance pedagogy, not replace it.

It is often said that Computing is the silent 'C' in STEM (Science, Technology, Engineering and Maths) and the author believes that Computing should stand on equal footing with the core STEM subjects. One can also take the position that there is a second and 'more' silent 'C' in STEM: Creativity. Creativity is equally important in generating children's interest in understanding how things work and in their future use of new technologies.

It is the position of DSH that this combination of Creativity and Computing will be critical to the UK and world economy in the 21st Century.

This report first gives detailed background on the Digital Schoolhouse project, and described how the processes used have continually evolved since their inception. The following sections both motivate the decisions taken by the project and show how the project both integrates with and benefits the core curriculum. Later sections give details of the thorough testing and review process that these lessons have undergone and also give a brief discussion on the contribution of this report and possible future work. The report finishes by giving the six lesson outlines, and includes references and information on the setup of the study.

# Computing

## Databases Unplugged: Updated Version

### Background

The Digital Schoolhouse (DSH) is a transition project established by Langley Grammar School (LGS) to offer predominately Year 6 (aged 10 and 11) children from local primary schools the opportunity to visit LGS for a day of specialist teaching in a dedicated Computing environment. Children work with a primary-trained teacher, who also has secondary teaching and IT industry experience, to learn new skills and concepts with a focus on how they are deployed in secondary education and the world of work and business.

There are no charges for the teaching provided at the DSH; the only cost incurred by the visiting school is the transportation to and from LGS and, where applicable, a small contribution towards the cost of any materials used. In circumstances where the visiting primary school has limited funds or a high proportion of free school meals, the DSH Trust would hope to support the school by contributing towards their costs.

### Continuous Development

Since the project's inception, a priority has been to meet with Head Teachers, Subject Specialists, Special Educational Needs Specialists and Gifted and Talented Coordinators from local primary and secondary schools to gain a holistic insight into the challenges of transition from primary to secondary school. This feedback helped shape the structure, content, and range of lessons offered by the project – for example the external ideas such as relating the database unplugged lesson to an Animal Sanctuary and CSI Science thematic have been brought into the sessions provided by the DSH.

Once the project started operating visiting class teachers indicated that they would like to be more involved in the lessons and use them as opportunities for their own professional development. DSH now provides Class teachers with post-lesson resources and team teaching opportunities; the effect is that teachers feel confident to deliver similar lessons in school, and use future DSH booking to experience a different lesson focus the following year.

### Transition and mapping to the curriculum

To ensure a solid foundation of skills and concepts, the DSH revisits relevant learning from previous years. Once consolidation has taken place, the teacher develops the learning to focus on the expected objectives and outcomes for that particular age group. Where applicable, the teacher builds on and extends the learning by introducing children to content from the next programmes of study in later years. Merging the curriculum of the various age groups provides exciting transitional opportunities, which are highlighted for the class teacher in the document.

The computing lessons presented here are aimed at children in Primary and Secondary Education (between the ages of 6 and 16) to learn about databases. The skills and concepts developed in these lessons start out very simple but develop to cover abstract concepts such as Relational Databases. This series of lessons has been aligned to the Computing At Schools document "*A Curriculum for Computing*" [1].

### Forget technology, it's pedagogy that matters!

The aim is to teach principles and concepts to children traditionally considered much too young.

The DSH accelerated learning model enables this teaching of KS3 (aged 11 – 14) and even KS4 (aged 14 – 16) concepts to KS2 (aged 7 – 11) children. It is achieved by challenging the children's percep-

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## Databases Unplugged: Updated Version

tions and expectations of working in a Computing suite, with Computing concepts being taught (wherever possible) without the use of computers and related to the children's existing 'real world' understanding.

To accommodate different learning styles, the DSH has developed a variety of audio, visual and kin-aesthetic (AVK) teaching activities. In addition, higher order questioning is used to relate concepts to their "real world" understanding. This enables children to better grasp the concepts being taught, and maximises learning in a limited time. At the end of each session, children complete a plenary activity to identify the existing skills that have been developed and new ones learnt. Where appropriate, individual or peer assessment is used to consolidate their learning.

This model also focuses on investigating and developing new and more engaging ways of teaching existing Computing principles and concepts using new technologies e.g. cloud computing, to enhance rather than replace good pedagogy.

### Creative curriculum

To more precisely align itself to the proposed changes to the National Curriculum in the 2009 Rose Report [2] and to following feedback from primary and secondary schools, the DSH started to teach Digital Literacy (ICT) skills discreetly within a creative curriculum, and to focus on the teaching of the different aspects of Computing.

Following this change, many new Computing focus lessons have been developed. Each lesson accommodates a wide range of creative curriculum links to the core and foundation subjects including: literacy, numeracy, science, geography and history, art, physical education (PE), and philosophy for children (P4C).

### Development of lesson suite

In the last two years the activities presented in this paper have been taught on at least 20 occasions to children from an age range of 7 – 10. An example of the lesson feedback is included below:

*"I was completely inspired by the day, I couldn't believe how much could be covered in just one day! Our children went from having never seen a database to inputting data, using search criteria in certain fields and picking up the correct computer vocabulary e.g. SQL Syntax when asking questions of the human database, and the key concepts behind relational databases. Their behaviour all day was immaculate which was a big surprise as this particular class had a lot of challenging behavioural issues. The murder theme was very engaging for both the boys and girls, all of the children were actively involved (and completely fooled as they thought they were playing games) in the learning. The build up throughout the day kept all of our kids on the edge of the seats. The climax was definitely finding out who the murderer was using clues to refine their searches. It was a great way to teach a boring piece of software like Microsoft Access. Not only did the class learn a massive amount which is evident from the online pupil voice (feedback), I definitely picked up a thing or two that even to this day (nearly a year later) I can still clearly recall. A truly memorable day delivered by a super ICT and Computing teacher."*

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## Databases Unplugged: Updated Version

### Summary and future work

This work has provided further development of the DSH model discussed in 'the TEACHING of databases' presented at the 9th Annual Higher Education Academy Conference on The Teaching of Computing, and has provided tested and structured lesson templates which enables this teaching of KS3 (aged 11 – 14) and even KS4 (aged 14 – 16) concepts to KS2 (aged 7 – 11) children.

The lessons in this report have been designed to relate fundamental concepts of database use and design to children in Primary and Secondary Education (ages of 6 to 16) and have challenge the traditional view that such young children are not yet cable of the complex thinking required for such an advanced topic.

There remain a number of open avenues for future development of this work, both at the level of individual lesson plans, but also in terms of the DSH model itself. Firstly, to continue to develop a broader range of lesson stimuli e.g. CSI etc. around the effective use of databases as well as looking at integrating MySQL tasks into the technology section of the paper than using a application with a graphical user interface.

To further complement this work the DSH is developing a scheme of work to teach encryption techniques using spreadsheets. This scheme of work will further develop the murder mystery thematic outlined in this work. The answers to the encryption challenges form the clues that are used in this work to filter the data imported into the database: demonstrating why encryption is relevant to users of the internet, and relating this back to binary and hexadecimal.

The DSH is also in the process of adapting the kinaesthetic teaching techniques developed in this scheme of work to cover effective use of the internet, for example, Boolean searches, and how the internet works i.e. MAC addresses, Internet Protocol Addresses and packet switching.

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## Databases Unplugged: Updated Version

### Human Branching Databases

#### Summary

- ✓ A *kinaesthetic* learning activity called “Human Branching Databases”, which is a little like playing a game of 20 questions. The class teacher asks a series of questions based on physical differences between the children. Children model the activity forming a “Human Tree Diagram”.

#### Cross curriculum links

- ✓ Science
- ✓ Citizenship
- ✓ Mathematics (for the extension activity)

#### Age group

- ✓ 6 and up

#### Materials

- ✓ A large classroom, school hall or playing field
- ✓ Large Tree Diagram to display to children on flip chart, projector or interactive whiteboard
- ✓ A4 personal whiteboard with pens or paper and pencils for each child
- ✓ Masking tape or chalk for drawing the Tree diagram on the floor
- ✓ A pack of Top Trump cards for the extension activity

#### Introduction

##### Where and how do I introduce Databases?

A branching database (also known as a binary tree) is an easy and effective way of introducing children to the foundations of databases because it provides a way of grouping objects.

##### What is a Branching Database?

Branching database is a little bit like playing the game “[20 questions](#)”.

##### How does it work?

This game is played by asking a series of questions. The person giving the answer only has the choice to answer the question with a “yes” or “no”. Using this technique of questioning it is possible to narrow down the number of objects to only one if you ask the right questions - in the right order [3].

##### Where does the database come in?

This simple game can be adapted for educational purposes when combined with a visual aid such as a tree diagram. The purpose of the Tree Diagram is to focus children on what physical features does each object have that makes it different from others, and to ask questions where the answer is either “Yes” or “No”.

##### Relating Branching Databases to basics of binary?

In general, Binary refers to a unit of data which can take on only two possible values, traditionally termed 0 and 1 in accordance with the binary numeral system. Binary data is used to represent two possible outcomes i.e. “success” and “failure”, for a single question e.g. Does the insect

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## Databases Unplugged: Updated Version

have two legs or was the new born baby a boy? If the answer is “yes” then the answer is represented with a “1” and if the answer equals “no” then it is represented with a “0”.

### How could I teach this in my classroom?

#### New vocabulary

- ✓ Tree Diagram or Branching database
- ✓ Criteria
- ✓ Grouping
- ✓ Greater-than, Less-than and Equals to

#### Instructions

Before beginning the activity it is best to demonstrate the principles of Branching databases using stimuli such as the science topic Mini-Beasts [4, 5 and 6]. For this activity you will need to display a Tree Diagram and with some images of insects, as shown in Figure 1 below:

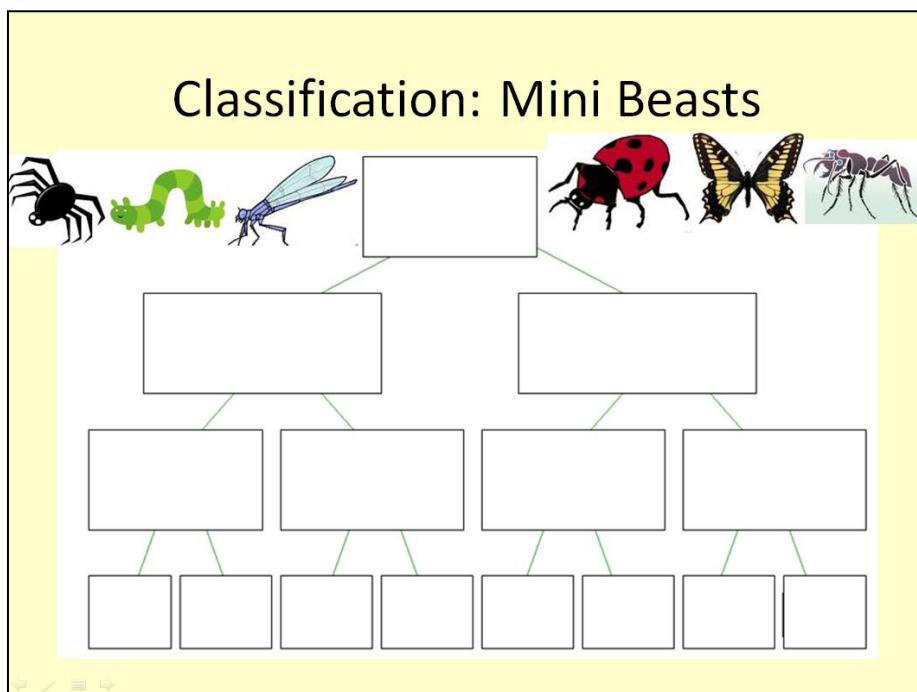


Figure 1: Branching database

#### Discussion

- What physical differences do you notice between the insects?
- What questions could we ask these insects to split them into two groups?
- What do you notice that changes each time you ask a different question?

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### Demonstration

After the children have identified the differences between the insects, record them as a class. Then record the questions the children could ask to enable them to split the insects into two smaller groups e.g. equal to six legs. For each question, model the outcome on the Tree Diagram, see Figure 2 below. To extend the More Able children, encourage them to notice that depending on the question, the insects in each group will change.

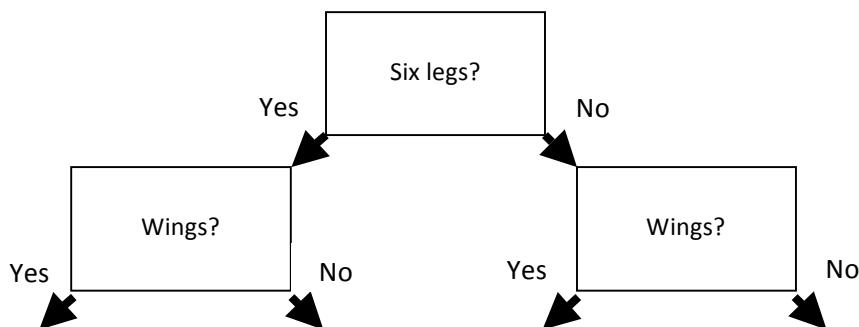


Figure 2: Branching database example

### Activity

Begin by encouraging children to identify what make them different from their friends, promoting each child's unique features as a positive thing i.e. "I am different because I have brown eyes". Ask children to note on paper some of the differences in the class. Challenge the more able children to think about how they record and layout the information, or provide support to the less able children by providing a table, as shown in Table 1 below:

Child name:	Mark
Hair colour:	Brown
Eye colour:	Brown
Glasses:	Yes

Table 1: Child's data

### Kinaesthetic learning

Then in a large classroom, school hall or playing field, children will take part in the Human Branching Databases activity. Ask children to link up in single file in front of you at the top of the Tree diagram, marked out on the floor.

Using the list of differences generated during the first activity to split the class into two smaller groups. The class teacher could begin the activity by taking a register, where children are present the teacher marks the children as present "Yes" or absent "No". If one has children absent from the lesson you could write their names on sheets of A4 paper and model the first grouping exercise based on attendance to the lesson e.g. children who are present go to the left and the names on the sheet of paper are moved to the right of the teacher.

Otherwise, begin by asking the first child the first question, then, depending on the answer, the child will stand to the left or right of you, depending on whether they answer "yes" or "no". Do the same for the second child, third child, and so on.

After all the children have answered this question, perform a Peer Assessment activity by asking them if they agree with who is standing in their group. If they do, record the names of the children in each group on a Tree

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Diagram. If the children disagree with the groupings then it is important to discuss why. Do this by reworking your way through the questions and responses – checking the children to check and agree on the results of each question before moving on.

Repeat the process described above for a second time to split each smaller group into still smaller groups (you should have a total of four groups by now). Again repeat the process of Peer Assessment and recording the name of each child, against each smaller group.

After asking the second question, the Digital Schoolhouse would recommend that the class teacher make two deliberate mistakes:

- a) Ask a question which can not be answered with a “yes” or “no” answer.
- b) Ask a question which does not separate the group any further than the previous question.

Encourage children to ask “Were you able to answer that question”, “Was there any value in that question” in which case you can ask a more open question to encourage children to explain and justify their answers “Was it a good question or not?”.

Depending upon the children’ grasp of the concept, you may want to play another game of Human Branching Databases. This time, use the activity to single out a particular child. Make it clear to children that you are asking the questions to only the group of children that answered “yes” (or if you so prefer answered “no”) to the first question first. Explain to children that as we are looking for only one child so it is not necessary to group the children who do not meet the criteria from the first question.

### **Extension**

For more able or older children who have missed out on computing studies in the lower years, who have a grasp of, Greater-than, and Less-than, to combine with Equals to, using the game of Top Trumps (on a topic of choice) as the stimuli. Each child is given a profile card from the game, then the Human Branching Database activity is repeated, but this time combining Equal to, Greater-than, and Less-than, to split the children into smaller groups.

### ***Binary and data transfer extension***

By completing these activities the children will grasp that they need to present questions in a format that the computer can process. This provides an excellent opportunity to extend their understanding to know that data needs to be converted into binary to be processed by a computer. You can do this by repeating the branching database by getting them to represent the “yes” and “no” answers as binary “1” and “0”.

One fantastic way of being creative with teaching binary is to use morse-code with the children transmitting the answers across the classroom using torches or sound. You can combine this with using the answers from your branching database. Ask the children to record the answers to find a specific animal in the branching database i.e. “yes”, “yes”, “yes”. Referring back to our explanation above this would equal “1”, “1”, “1”. Obviously morse-code doesn’t use “1” and “0” but “dots” and “dashes”. Therefore, our answer would now be “dot”, “dot”, “dot”.

An excellent extension older students (aged 9-10 years old) who have been introduced to how the internet work is to turn the “dots” and “dash” into letters. Then use the entire morse-code alphabet to transfer messages across a classroom relating this to how messages are transferred through the internet in binary .

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## Databases Unplugged: Updated Version

### Human Databases: Introduction

#### Summary

- ✓ A kinaesthetic learning activity called “Human Databases” to teach the children the basics of asking questions to get answers.

#### Curriculum links

- ✓ Science
- ✓ Citizenship
- ✓ Mathematics
- ✓ Literacy

#### Age group

- ✓ 8 and up

#### Materials

- ✓ A large classroom, school hall or playing field
- ✓ Two large signs, one with the word “yes” and the other with the word “no”

### Introduction

#### What is a Database?

Databases offer a convenient and powerful way to store and organise information.

#### What is a Human Database?

Human Database activity is a little like playing a game of [Guess Who](#) - the children are the data and the room is the base [7].

#### Difference between data and information

Data consists of raw facts and figures and has no meaning because it has not been processed i.e. had a question asked of it. Examples of data are presented in the table below:

Data	Information
12345678911	Your winning lottery ticket number
140593	Your date of birth
Aaabbcccd	The grade you wanted in your exams

Table 2: Example of data

Information is data that has been processed (had a question asked of it) to add context, and is presented in such a way that it is meaningful to the reader.

Data	Context	Meaning
21041926	It is a British date	The birth date of Queen Elizabeth.

Table 3: Example of information

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## Databases Unplugged: Updated Version

### How could I teach this in my classroom?

#### New vocabulary

- ✓ Database
- ✓ Records and fields
- ✓ Import
- ✓ Criteria
- ✓ Data and information

#### Instructions

Begin this lesson with a discussion, ask children what are the two largest words they can see within the word *Database* i.e. *data* and *base*. Play a game of Human Dictionary to gain their ‘real word’ understanding of what the words mean. Use paired discussion combined with teacher-lead class discussions. At the conclusion of this activity, children will combine their understanding of both words to develop a ‘real word’ understanding of what the word *database* means.

Usual explanations for what *data* are:

- ✓ Data is usually numbers like in maths
- ✓ Data is stuff that you collect in surveys and put in a graph

Use key questioning to steer the discussion to the graph being the thing that adds meaning to the data; therefore, *data is information without meaning*.

Usual explanations for the word *base* are:

- ✓ Base is at the bottom of something holding it up
- ✓ Base is a safe place in a playground game or game of Baseball
- ✓ Base is somewhere that everyone goes to in a game

Use the key questioning to get children to summarise the three main purposes of a base.

#### Demonstration

Before beginning the activity it is best to introduce to key vocabulary *fields* being the same as column headings in a table e.g. the different data we can see about them, and *records* being each person i.e. a row in a spreadsheet. Demonstrate this by using a spreadsheet application to store the details of 5 children in the class, as shown in Figure 3 below:

Name	Gender	Eye colour	Hair colour	Shoe size
Mark	Male	Blue	Brown	7
Priscila	Female	Brown	Blonde	6
Hassan	Male	Brown	Brown	4
Iman	Female	Brown	Brown	5
Demi	Female	Blonde	Blue	3

Figure 3: Spreadsheet of the example children’s data

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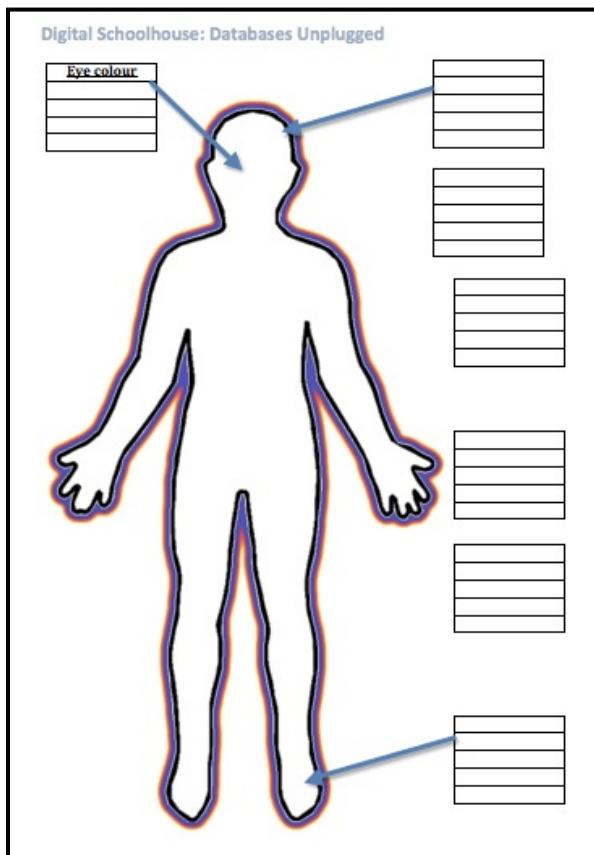
## Databases Unplugged: Updated Version

Encourage children to work together using personal whiteboards and to think firstly of data that we can see about each of them (mirroring what we did during the Human Branching Database lesson) and then think up appropriate and generic field names i.e. than saying “brown eyes”, use “eye colour” with the criteria of “brown”, “blue”, “green” etc. Challenge your more able children to think about how they can record this data logically i.e. using a table similar to Table 4 shown below.

Eye Colour:
Brown
Blue
Green

**Table 4: Example data for a given field**

For less able children you could have a human body with arrows pointing to tables already provided [8], children could draw or write an eye then use coloured pencils to represent the colours of eyes in the class, see Figure 4 below for an example.



**Figure 4: Differentiated worksheet to support data for given fields**

When children have completed their list of the different types of data we can see about one another, for example eye colour. Work with children to develop appropriate questions using the field names they have created with answers to the question being either “yes” or “no”.

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## Databases Unplugged: Updated Version

For example:

- “I want to find all the children in the class with Eye Colour (field) Brown (criteria)”
- “I want to find all the children in the class that are Gender (field) Boys (criteria)”

### Kinaesthetic learning

Instruct the children to line up outside the classroom. Introduce the children to the concept of the classroom being the database, with each of the children being a *record* in the database. Children are then *imported* into the database and stand behind their chairs.

Test some of the questions developed by the children in the previous activity by performing a human database role-play. Place a sign at opposite ends of a classroom. On one of the signs would be placed a “Yes” and the other a “No”.

The class teacher or children can lead this activity by reading out the questions. After each question, children then move around the classroom to stand in groups under the relevant sign, depending on the answer to the question.

The children will probably create questions in the previous activity based on measurements i.e. “tall” or “short”. It is best to try and test the question as it creates an excellent discussion point for children on what defines “tall” or “short”; therefore, it would not be possible for the children to answer the question with “yes” or “no”. It is important that you highlight this as a positive learning experience, which will be addressed in the Human Databases Advanced lesson.

### Discussion

After completing the kinaesthetic learning activity, discuss with children their understanding of what data and information is, and how data becomes information by adding meaning to it i.e. through asking a question.

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## Databases Unplugged: Updated Version

### Human Databases: Intermediate

#### Summary

- ✓ A *kinaesthetic* learning activity where children repeat the Human database role-play activity but it is extended to cover Structure Query Language (SQL) syntax to structure questions.

#### Curriculum links

- ✓ Science
- ✓ Citizenship
- ✓ Mathematics
- ✓ Literacy

#### Age group

- ✓ 9 and up

#### Materials

- ✓ A large classroom, school hall or playing field
- ✓ Two large signs, one with the word “Yes” and the other with the word “No”.
- ✓ Flip chart, projector or interactive whiteboard to display the SQL questions
- ✓ A pack of Top Trump cards or Digital Schoolhouse suspect profile cards

### Introduction

#### Structured Query Language

SQL is an abbreviation of structured query language. SQL is an internationally recognised, and standar-dized language for managing data and requesting information from a database.

#### Boolean searches

Boolean searches allow a database user to combine words and phrases using connective words (otherwise known as Boolean operators) such as AND, OR and NOT when asking questions of the database. The purpose of using these Boolean operators can be to limit, widen, or define your search.

#### Wild card

The Wildcard ‘\*’ represents any number of characters. For example, if you were doing a search on the field called First Name for suspect names beginning with the letter ‘B’, you would enter wild card after the letter being search for e.g. ‘B\*’, refer to Figure 7c below for an example. On the other hand if you wanted to identify the suspects with their first name ending in a particular letter e.g. ‘k’, then you would place the wild card in front of the letter ‘\*k’, refer to Figure 7d below for an example.

The use of the ‘\*’ at the start of a query represents all the fields. If you wanted the data that meets the criteria for only selected fields in the database then you would replace the ‘\*’ with a list of the fields, Refer to example in Figure 7b.

#### Where clause brackets

The use of brackets within the where clause of a query is similar to the use of brackets in a mathematical equation.

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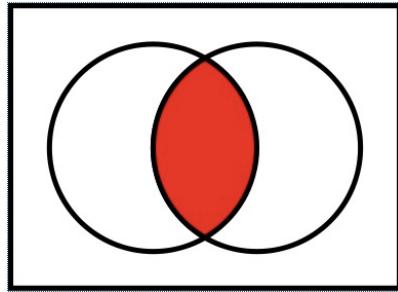
## Databases Unplugged: Updated Version

The computer is expected to identify the data that meets the first criteria before performing a second filter on only the records that met the first criteria. In Figure 8c, the records must meet the criteria of 'Yes' for the field Ear Ring and then either meet the criteria of wearing glasses or be female. Refer to Figure 8c for example.

Without using the brackets in the query – this would produce a very different result. You would be asking the computer for the records that have both ear rings and glasses, alternatively they could be female. Refer to Figure 8d for example.

### Venn diagram

Venn diagrams normally comprise of two or more overlapping circles. The interior of the overlapping circle represents the elements of the set, while the exterior parts of the circles represents elements that are not members of the set, see Figure 5 below:



**Figure 5: Example Venn diagram**

Image source: <http://en.wikipedia.org/wiki/File:Venn0001.svg>

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## Databases Unplugged: Updated Version

### How could I teach this in my classroom?

#### New vocabulary

- ✓ Boolean searches
- ✓ Wild cards
- ✓ Brackets
- ✓ Structure Query Language (SQL)
- ✓ Venn Diagram

#### Instructions

At the beginning of the lesson it is key to recap the learning and vocabulary from the previous lesson (Human Databases – Introduction).

#### Kinaesthetic learning

Repeat the process of asking all children to line up outside the classroom and then *importing* them into the classroom database. As the children re-enter the room, hand each child either a Top Trump or Detective Suspect card [9], see figure 6 below:

Suspect database		Suspect number:
First name:	Yuri	Photograph:
Last name:	Mehic	
Gender:	Male	Finger print:
Age:	55	
Occupation:	Sharpshooter	
Height:	Short	
Build:	Medium	
Shoe size:	11	
Glasses:	N	
Hair colour:	Dark	
Hair length:	Long	
Facial hair:	Moustache	
Eye colour:	Brown	
Ear rings:	Y	

Figure 6: Suspect card

Ask the children to identify the records (each card), fields (columns in the table on each card) and data (variables against each field). Place a sign at opposite ends of a classroom. On one sign place a “Yes” and the other a “No”.

Explain to the children that databases use Structured Query Language (SQL) to enable humans to ask questions of the data in the database. Show them an example of the syntax used to structure questions, and then repeat the activity described previously but this time displaying the questions using SQL syntax, as shown in Figure 7a below.

# Computing

## Databases Unplugged: Updated Version

### Introducing 'Where'

```
SELECT *
FROM Murder
WHERE ear ring='Y'
```

SELECT fields(s)  
FROM table name  
WHERE field operator value

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

### Introducing 'Where'

```
SELECT First Name,
Surname
FROM Murder
WHERE ear ring='Y'
```

SELECT fields(s)  
FROM table name  
WHERE field operator value

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

Figure 7a: Simple question in SQL using all the available fields

Figure 7b: Simple question in SQL with only selected fields.

The class teacher or children can lead this activity by reading out the questions. After each question structured using SQL syntax is read out, children then move around the classroom to stand in groups under the relevant sign, depending on the answer to the question. Figures 7c and 7d show the use of the wild card in the search criteria.

### Introducing 'Where' with Wild card

```
SELECT *
FROM Murder
WHERE First Name='B*'
```

SELECT fields(s)  
FROM table name  
WHERE field operator value

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

### Introducing 'Where' with Wild card

```
SELECT First Name,
Surname
FROM Murder
WHERE First Name='*k'
```

SELECT fields(s)  
FROM table name  
WHERE field operator value

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

Figure 7c: Simple question in SQL using all the available fields combined with a wildcard acting as a suffix

Figure 7d: Simple question in SQL with only selected fields combined with a wildcard acting as a prefix

This activity can be extended with the children creating questions (using the SQL syntax) based on what they would like to find out.

### Discussion

Ask the children what they think are the advantages of using a structure language to communicate with the database. If the children struggle with the concept, ask them to consider the problems that regional accents or problems they may have when visiting different (far away) countries that don't speak your language?

# Computing

## Databases Unplugged: Updated Version

### Kinaesthetic learning

Boolean searches can be integrated into the activity by asking the children how the database could make the process of doing multiple searches to then look for data that meets the criteria for each of the searches quicker and more efficient?

Children tend to refer back to the Human Branching Databases activity where only the data that meets the criteria from the first question gets asked the second question, this provides key questioning opportunities to identify connective words they use in Literacy e.g. AND, OR and NOT.

Continue the Human Database activity but this time extending the children by using the Boolean connectors in the SQL syntax to combine questions (see Figures 8a & 8b below).

**Introducing AND**

**SELECT \***  
**FROM Murder**  
**WHERE ear ring='Y'**  
**AND Glasses='Y'**

**SELECT fields(s)**  
**FROM table name**  
**WHERE field operator value**

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

**Introducing OR**

**SELECT \***  
**FROM Murder**  
**WHERE ear ring='Y'**  
**OR Glasses='Y'**

**SELECT fields(s)**  
**FROM table name**  
**WHERE field operator value**

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

Figures 8a & 8b: Boolean operators in SQL

To get children really thinking about the question being asked, present them with “*male AND female*”, which usually involves a few children standing in the wrong place, which provides an excellent discussion point!

To extend the more able or older children, the class teacher can combine Boolean operators (AND and OR) into the same query. It is possible to help them understand the purpose of the brackets in a query by asking looking at the results for the query in 8c and comparing them to the query results for 8d. From experience, with older children you can encourage them to relate the results to what they know about mathematics and use of brackets.

However, it is important to talk through the syntax through with them the first few times as this is where they tend to struggle, not on the logic. Refer to Figure 8c for an example.

# Computing

## Databases Unplugged: Updated Version

### Combing AND with OR

```
SELECT *
FROM Murder
WHERE ear ring='Y'
AND (Glasses='Y' OR
Gender='Female')
```

**SELECT** fields(s)  
**FROM** table name  
**WHERE** field operator value

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

### Combing AND with OR

```
SELECT *
FROM Murder
WHERE ear ring='Y'
AND Glasses='Y' OR
Gender='Female'
```

**SELECT** fields(s)  
**FROM** table name  
**WHERE** field operator value

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

Figures 8c: Combining Boolean operators with brackets in SQL

Figures 8d: Combining Boolean operators without brackets in SQL

### *Demonstration*

To conclude the learning on Boolean searches asks children to consider how the use of AND, OR and NOT affects the number of search results. If necessary, some of the kinaesthetic learning where children can count the number of “yes” and “no” answers for each question to reinforce their observations of:

- ✓ AND reduces number of children
- ✓ OR increases the number of children

### *Extension*

This activity can be extended to cover the study of Venn Diagrams. You can either base the development of the Venn Diagrams on the results from the questions asked in the Human Databases activity (Figure 9) where Boolean operators are used; or alternatively based on use of Boolean operators with a (recommended) maximum three search criteria on the internet using a search engine (Figure 10). The cross over between the circles represents the AND, with both the respective circles and the cross over representing the OR.

# Computing

## Databases Unplugged: Updated Version

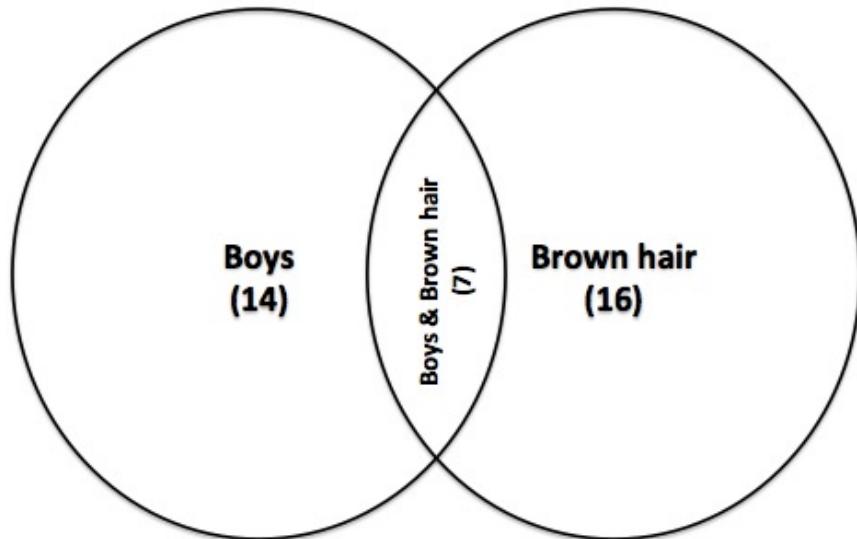


Figure 9: Venn diagram for a human database

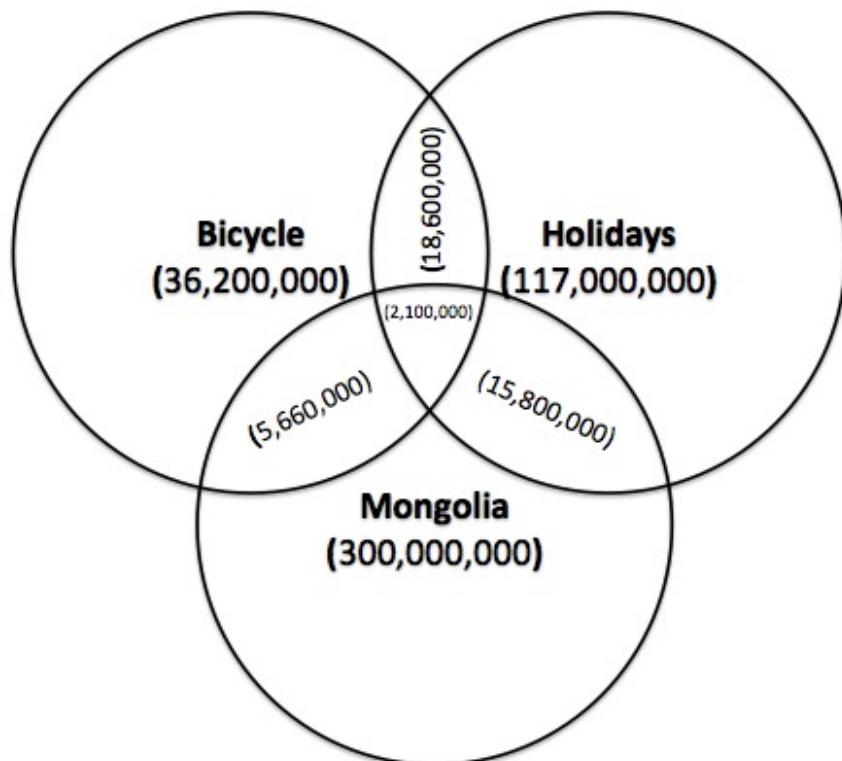


Figure 10: Venn diagram for an internet search

# Computing

## Databases Unplugged: Updated Version

### Human Databases: Advanced Summary

- ✓ A kinaesthetic learning activity where the children integrate Comparison Operators and Data Sorting into the “Human Databases” Kinaesthetic learning activities.

#### Curriculum links

- ✓ Mathematics
- ✓ Literacy

#### Age group

- ✓ 9 and up

#### Materials

- ✓ A large classroom, school hall or playing field
- ✓ Two large signs, one with the word “yes” and the other with the word “no”.
- ✓ Flip chart, projector or interactive whiteboard to display the SQL questions
- ✓ A pack of Top Trump cards or Digital Schoolhouse suspect profile cards
- ✓ Pack of playing cards

### Introduction

#### What is a query?

The word “Query” or “Interrogate” is a technical term used in databases to ask a question about something. The query includes the details about what fields or expressions and operators are to be used to identify the information that is sought.

#### What is a Comparison Operator?

Comparison operators allow you to compare two values against each other. They are used in logical statements such as queries using SQL syntax to identify if values are equal or if there is a difference between the values. There are six Comparison Operators, see Table 5 below:

Symbol	Name
=	Equal to
<	Less than
>	More than
<=	Less than or Equal to
>=	Greater than or Equal to

Table 5: Comparison operators

#### What is data sorting?

Data sorting is the process of arranging the data into a meaningful order to enable the viewer to analyse the information more effectively. The choice of data sorting is selected as part of the query. There are two methods of data sorting available:

- Data (numbers or characters) sorted into ascending order is when they are arranged from the smallest to the largest number e.g. 7, 12, 19, 23 and 37 or A, C, E, H, M, X, and Z.

# Computing

## Databases Unplugged: Updated Version

- Data (numbers or characters) sorted into descending order is when they are arranged from the largest to the smallest number e.g. 37, 23, 19, 12 and 7 or Z, X, M, H, E, C, and A.

### How does the computer perform the sort?

The computer sorts the elements of a list into the desired order using a Sorting Algorithm. There are many different types of sorting algorithm, some more or less efficient than others but the most commonly taught in schools are the Bubble, Insertion and Merge sorts.

### What is a report?

A database report is the answer to a query (question) that is presented in a viewer friendly layout and is printable.

### How could I teach this in my classroom?

#### New vocabulary

- ✓ Query or Interrogate
- ✓ Operators (Equal to, Greater than, and Less than)
- ✓ Sorting
- ✓ Reports
- ✓ Ascending and Descending

#### Instructions

At the beginning of the lesson it is key to recap the learning and vocabulary from the previous lessons (Human Databases Introduction and Intermediate).

Ask the children to research another word for question. You could use the Internet or a dictionary. Alternatively, explain to the children what the word “query” means.

#### Discussion

The class teacher should start the discussion by either reminding the children of the learning point from the first Human Databases lesson where the children had tried to ask a question of the database using a measure i.e. height, which it would not have been possible to answer. If the children did not complete this learning then it is essential for the class teacher to ask this question of the Human Database to enable this discussion to take place.

Encourage pupils to consider what language they use during numeracy lessons or games of Top Trumps where they compare two values i.e. Greater than and less than.

#### Kinaesthetic learning

Begin this activity by asking the children a question that involves them measuring something as part of the query, for example:

- I want to find all the children in the class with Shoe Size (field) Greater than (Operator) Size 2 (criteria).
- I want to find all the children in the class that are Height (field) Less than (Operator) a particular child in the class (criteria).

Re-hand each child either a Top Trump or Detective Suspect card. Ask the children to compare the values in the various fields to be able to create queries for the database i.e. the value of the data in

# Computing

## Databases Unplugged: Updated Version

one field is greater than or equal to a particular value. When the children think they have a question which has been correctly written down using the SQL syntax, the children should be given the opportunity to test the question, see Figure 11 below:

The screenshot shows a yellow-tinted window titled "Comparison Operators". Inside, there is a sample SQL query:

```
SELECT *
FROM Murder
WHERE Shoe size >='8'
```

Below the query, there is a legend table:

=	Equal
<>	Not equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
*	Wild cards

Figure 11: Example comparison operators in SQL

### Extension

Replacing the murder suspect profiles with a Geography topic (stats about countries) or Literacy topic (Harry Potter) based on the Top Trumps playing cards. Alternatively, you could work with your English department to create your own fictional superhero Figure 12 with the pupils deciding the qualities required to be a Superhero and agreeing on the minimum and maximum values for each category.



Figure 12: Example Top trumps super heroes card created by a child

### Discussion

The class teacher should lead a discussion around the sorting of data. Begin by asking them if they can think of a list that places them into a particular order. The obvious answer is the register. Develop the discussion by asking the children to consider how to resolve issues such as:

- Where two or more children share the same family name e.g. Smith, Singh or Khan.
- Where two or more children share the same family, first and middle names.

# Computing

## Databases Unplugged: Updated Version

Encourage the pupils to think of other fields in which the data in the Human Database could be sorted into a particular order:

- Date of birth
- Measurements e.g. Height, Shoe size

### Kinaesthetic learning

The human database activity is concluded with the children developing an understanding how reports work by sorting themselves into an order based on any of the fields identified in the previous activity. This activity starts by asking children to sort themselves into register, then first name order, followed by date of birth, etc. in ascending (A – Z) order, see Figure 13a for examples of data sorting.

Introduction ORDERS

```
SELECT *
FROM Murder
ORDER BY last name ASC
```

**SELECT fields(s)**  
**FROM table name**  
**WHERE field operator value**  
**ORDER BY fields(s) ASC|DESC**

= Equal
<> Not equal
> Greater than
< Less than
>= Greater than or equal
<= Less than or equal
* Wild cards

Combining WHERE with ORDER

```
SELECT *
FROM Murder
WHERE ear ring='Y'
ORDER BY last name DESC
```

**SELECT fields(s)**  
**FROM table name**  
**WHERE field operator value**  
**ORDER BY fields(s) ASC|DESC**

= Equal
<> Not equal
> Greater than
< Less than
>= Greater than or equal
<= Less than or equal
* Wild cards

Figures 13a and 13b: Data sorting with SQL

Encourage the children to consider how they could sort the data into a different order without changing the field i.e. into descending order. Encourage the children to observe the children they are standing next to do not change, they simply swapped sides.

### Discussion

Encourage the children to consider how the sorting of the data based on the different fields will produce different orders. Continue the discussion to cover the use of ascending and descending, and how this could be used in every day life i.e. by the class teacher during school productions to position the children on the stage.

### Activity

It is possible to ask simple and complex queries on the human database to group children e.g. gender, before repeating the sorting activity within the smaller groups, refer to Figure 13b for an example.

### Extension

To extend the children's learning, older children can combine this activity of sorting data with either previous learning about Sorting Algorithms or use this as opportunity to spend time learning about Sorting Algorithms.

# Computing

## Databases Unplugged: Updated Version

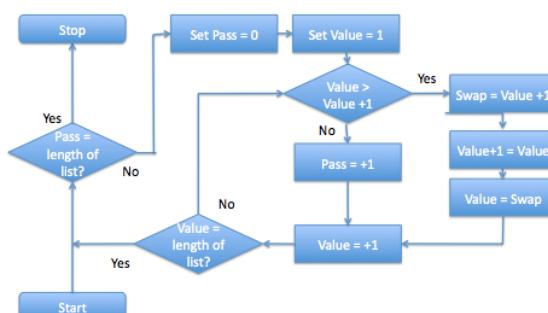
It is the experience of the DSH teacher that it is best for children to identify the rules of how a particular sorting algorithm works. The preference of the DSH teacher is to use a video of [Hungarian Folk Dancers](#) [23] and encourage the children to discuss in small groups.



Figures 29: Hungarian Folk Dancer

Then provide each child with a pack of playing cards, encourage them to use the playing card to model what they have watched in the video, it is important that the numbers of the playing cards are in the same places as the video. When the children understand how the particular sorting algorithm works, they should then work repeat the playing card activity but this time the card numbers should be in a different order. This provides the DSH teacher with an opportunity to assess learning of the children. Then each child (with the support of the teacher and peers) should model the sorting algorithm using a flow diagram, see figure 30.

Bubble sort: Flow diagram



Figures 30: Example Bubble Sort Algorithm as a Flow Diagram

At this point, depending upon your time constraints, the DSH teacher will either model the algorithms using a software called Scratch [24]. This work can also be extended so that they apply their chosen Sorting Algorithm to a list in a game they create i.e. highest scoreboard [25], see figures 31 and 32.

# Computing

## Databases Unplugged: Updated Version



Figures 31 and 32: Example Bubble Sort Algorithm modelled in Scratch

Alternatively, the children perform the studied algorithm as a whole class activity using the data from the suspect cards, essentially re-enacting the Hungarian Folk Dance video described previously. It is the experience of the DSH Teacher that this is an excellent opportunity to assess individual children's learning and progress during a whole class activity.

# Computing

## Databases Unplugged: Updated Version

### Databases: Plugged-in Summary

The series of Database Detective lessons produced by Digital Schoolhouse (DSH) and its educational partners, the Royal Holloway, University of London and Jungle Fortress Animal Sanctuary based on a range of murder mysteries.

Before completing the database lessons, the class teacher is encouraged to either read a book (except the last chapter) called Certain Death by Tanya Landman [10], or complete a series of CSI investigations, experience a hands on animal workshop, or numeracy puzzles e.g. cryptography, the answers providing pupils with the clues to question the database and identify the murderer.

Pupils then use cloud computing technology e.g. Google Documents: Spreadsheets, to collaboratively input data about the suspects from profile cards based on the book. Pupils then perform verification on their neighbour's data entry before downloading the spreadsheet and importing it into Microsoft Access.

After importing the data, pupils first use the filter tool to solve the murder using the answers from the numeracy challenges, then create a report for the Court based on a query identifying the murderer [11].

#### Curriculum links

- ✓ Mathematics
- ✓ Literacy

#### Age group

- ✓ 9 and up

#### Materials

- ✓ What is cloud computing?
  - [How it works](#) [12]
  - [Top cloud applications](#) [13]
  - [Google docs in plain English](#) [14]
- ✓ Computers with a internet connection for Google Docs
  - [Example Google Docs Spreadsheet](#) [15]
- ✓ Computers with a internet connection for Independent Learning Videos
  - [Creating a database](#) [16]
  - [Importing Google Docs data into the database](#) [17]
  - [Filtering the suspects to solve the murder](#) [18]
  - [Creating a query](#) [19]
- ✓ Computers with a Relational Database software
- ✓ Interactive White Board or Projector

# Computing

## Databases Unplugged: Updated Version

### Introduction

#### What is Cloud Computing?

Watch the videos for what is cloud computing.

#### Quality of data and information

The quality of the information in a database is only as good as the data that you put in. There is a acronym that for this called: GIGO which stands for “Garbage In, Garbage Out”. Therefore, a database must be regularly maintained if it is to maintain its integrity i.e. if the data in the real world changes then it needs to be updated in the database.

#### What is data verification?

Data verification is a process of checking the data entered for accuracy and inconsistencies i.e. that the data being entered exactly matches the original source i.e. the suspect cards. Data Verification can be either entering the data twice and then compare the copies, and/or Proofreading data after entry.

#### What is an Independent Learning Video?

An Independent Learning Video is a screen capture recording of what the class teacher has done to complete the task. It provides the children with a step-by-step learning video created by a class teacher to support the children to learn at their own pace.

# Computing

## Databases Unplugged: Updated Version

### How could I teach this in my classroom?

#### New vocabulary

- ✓ Cloud computing
- ✓ Relational Database Software
- ✓ Data verification

#### Instructions

To get pupils up to speed on the benefits of cloud computing technology and how it works, show the pupils a short video clip which uses simple language to explain how cloud computing works.

Pupils are given a suspect profile card based on the characters in the book. Each suspect profile card has a unique identifier i.e. suspect id with pupils being briefly question about the benefits of using a suspect id.

Pupils then select the row number in the spreadsheet that matches their suspect id. Pupils then begin collaboratively inputting data about the suspects from profile cards into a Google Docs: Spreadsheet.

The Digital Schoolhouse teacher always tell the pupils at the start of the day that “good computing should appear as though it is magic” and the pupils are never disappointed to see this technology in action e.g. watching their entries and the entries of their colleagues magically appearing on the Interactive White Board, see Figure 14 below:

	A	B	C	D	E	F	G	H	I	J
	Yuri	Mehic	Male	56 Sharpshooter	Occupation					
1		Belini	Female	26 Acrobat						
2	Marco		Male	29 Acrobat						
3	Carlotta	Mancini	Female	24 Circus Artiste						
4	brady	sparkle	Male	59 ringmaster	short	fat	9 N	bald	n	
5	lara flying	Belini	Male	27 Acrobat	tall	slim	10 Y	dark	long	
6	lara	Belini	Male	22 Acrobat	tall	slim	8 N	dark	short	
7	Draco	Blade	male	59 knife thrower	short	fat	8 Y	dark	long	
8	Ruby	Diamond	Female	34 assistant	short	medium	4 Y	dark	long	
9	Majestic	Whizzbang	Male	62 Magician	tall	fat	12 Y	Light	short	
10	Zeppe	Max	Male	62 Roller skating						
11	Alfonso "The brave"	Romero	Male	47 Lion tamer	Med	Athletic	i	Rad	short	
12				Lion Tamer's	Med	Medium	Athletic	10 Y	Rad	
13										
14	Alissa	Romero	Female	41 Assistant	Short	Slim	5 N	Light	Shoulder	
15	Emilia	Trapeze	Female	19 highwire artiste	tall	slim	8 none	dark	long	
16	Emilie	Perfume	male	32 Clown	tall	athletic	11 N	red	short	
17	Columbine	Petroska	Female	32 Clown	tall	Medium	10 Y	Dark	long	
18	Rudi	Petrova	Male	27 Clown	short	fat	6 Y	bald	N	
19										

Figure 14: Google Documents in action

#### Activity

When this is completed many of the children acknowledge that they have made a mistake in entering the data so the class teacher should get the children to play a short game to illustrate the importance of data verification.

# Computing

## Databases Unplugged: Updated Version

Present the children with some example data from the suspect cards. The data has been replaced with data that contains errors e.g. rather than using the number 27 it is replaced with the words “Twenty Seven”, see Figure 15. This highlights that as computing specialists they need to use what they know about the “real” world when verifying data in a database.

Name	Gender	Eye colour	Hair colour	Shoe size
Mark	Male	Blue	Bron	7
Priscila	Female	Brown	Blonde	6
Hassan	Male	Brown	Brown	Four
Iman	F	Brown	Brown	5
Demi	Female	Blue	Blonde	3

Figure 15: Data verification game

Children need to own the data so they should perform data verification on their neighbour’s data entry by swapping profile cards and correcting any data incorrectly entered before downloading the spreadsheet into their user area to use in the database software.

### Combining the cloud with de-facto software

The class teacher can either model the import process in Microsoft Access or use the Independent Learning Videos.

If the class teacher is going to encourage independent learning, the teacher should show the children how to use pre-prepared Independent Learning Videos Figure 16 e.g. play, pause, rewind and fast forward.

After successfully importing the data, the class teacher should lead the class discussion to use the clues from the book, science experiments and numeracy challenges with the filter tool to identify the murderer.

The class teacher can either model the creation of queries and then develop reports based on a query.

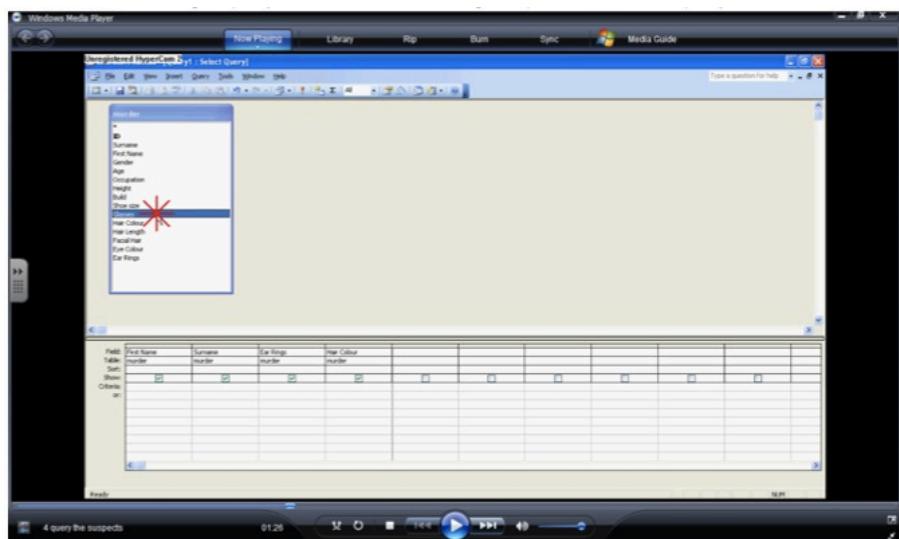


Figure 16: Screen shot of an Independent Learning Video

# Computing

## Databases Unplugged: Updated Version

When the children have finished the database work, the class can read the last chapter of the book or watch the suspect videos to see if their database work has led them to correctly solving the murder.

### ***Extension***

At Langley Grammar School the year 6 pupils are introduced to cloud computing on their year 7 induction day as a tool to help them to get to know their new classmates. Essentially, pupils enter non personal or sensitive data into the online spreadsheet e.g. first name, tutor group, hobby, favourite subject and colour etc. As soon as the data entry task is complete and it has been downloaded by pupils to their user area, the class teacher deletes it from the cloud. By using the spreadsheet filter tool, pupils play an electronic game of Guess Who to identify the children with similar interests.

# Computing

## Databases Unplugged: Updated Version

### Relational Databases: Introduction

#### Summary

- ✓ A paper based activity using the cloud computing activity as a stimulus to help children develop an understanding of what a relational database is and why we use them i.e. the aim to reduce the number of errors, increase the speed of entry, and amount of space used by the database.

#### Age group

- ✓ 11 and up

#### Materials

- ✓ Computers with a internet connection for Google Docs
- ✓ One centimetre squared paper and a pencil for each child
- ✓ A pack of Top Trump cards or Digital Schoolhouse suspect profile cards

### Introduction

#### What is data validation?

Data validation is a tool that helps control the input/changes someone can make in a database. The computer automatically checks or comparing the data being entered to a set of requirements. If the data does not meet the requirements then the data is rejected. Data validation does not check the accuracy of the data, the process of data verification performs this task.

The data validation we will be concentrating on in this lesson is Lookup table as it allows the children to develop an understanding of relational databases. The Lookup table validation checks the data being entered to ensure that it is one of the accepted values in the table e.g. Gender is equal to Male or Female. Other types of data validation include:

Type:	
Existence check	Checks that the data being entered exists in the database i.e. suspect id.
Format check	Checks that the correct format has been used e.g. a mail post or zip code, or email address i.e. contains an @ sign.
Length check	Check the text entered is not greater or less than a certain length e.g. a mail post or zip code.
Presence check	Checks that it has not been left blank and something has been entered.
Range check	Check that a number of date is within a certain range.
Type check	Checks that the data is the right type e.g. integer, currency etc.

Table 5: Types of validation

#### What is a relational database?

A relational database persistently stores and organises data in separate (lookup) tables instead of placing all data in one large (flat file) table.

#### How does this relates to how a computer works?

The term persistent refers to the data being stored on non-volatile storage i.e. a hard disk. The database only exists in volatile memory i.e. Random Access Memory, when the program is running.

# Computing

## Databases Unplugged: Updated Version

### What are the advantages of using a relational database?

The three advantage of using a relational database we will be focusing on are:

- Reduces duplication of data because the user enters codes that will match a code in the corresponding lookup table e.g. M equal Male, therefore saving 3 characters for every time the word Male is replaced by a M.
- By replacing codes for words it saves the person time because they don't have to duplicate the data the full details every time e.g. M equal Male.
- By using codes and lookup list, it improve the accuracy of data (reducing data inconsistency) being entered because it gives the user less opportunity to make mistakes.

### What is a Primary Key

A primary key (PK) is a single field or (sometimes) combination of fields in a table that is used to uniquely identify a unique record in a database table. It is used to ensure that no two records can be exactly the same i.e. auto number in a database e.g. customer id, or car registration plates refer to table 6 below.

Suspect id (PK)	First name	Family name	Gender
1	John	Smith	Male
2	John	Smith	Male

Table 6: Example table with Primary key

### What is a Foreign key?

The foreign key in a relational database acts as the cross reference between two tables. This field will appear in both the parent (main) and child (lookup) tables, view Figure 17 below.

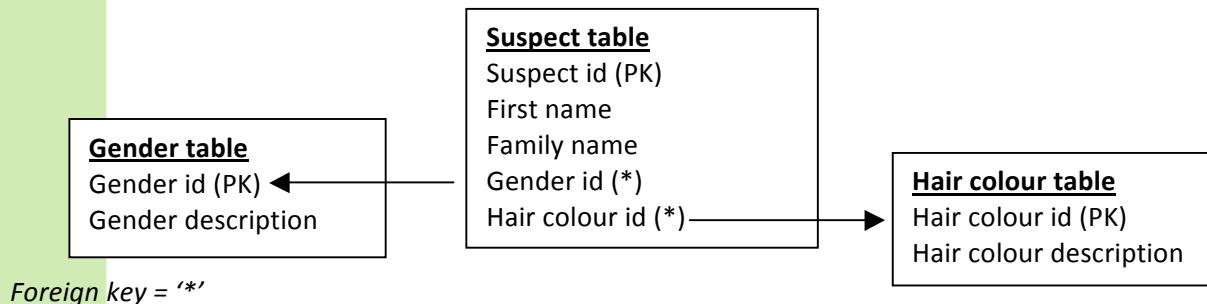


Figure 17: Lookup tables using foreign keys

### Referential integrity

Once you've added a foriegn key to a table and linked to another table, you can then create a database constraint which allows you to enforce something called the "referential integrity" between the two tables.

### So what does the referential integrity do?

Essentially, you can not add a new record to Suspects with a value in a field that contains a foreign key unless there is a corresponding record in the linked table i.e. if the Hair Colour table only has Black, Brown, Brown and Blonde. You could not enter a record in the Suspects table with the field value 'Red' because it is not in the Hair Colour table. You would need to create a record in the Hair colour table before creating the record in the Suspect table.

# Computing

## Databases Unplugged: Updated Version

### Relationships

The links between tables are called the relationships. There are three types of relationships:

- One to One
- One to Many
- Many to Many

#### One to Many

The relationships you will create in this activity will always be One to Many i.e. The Gender field in Suspect Table may have many linked records in Gender Table i.e. Male or Female, but only one corresponding record in the suspect table.

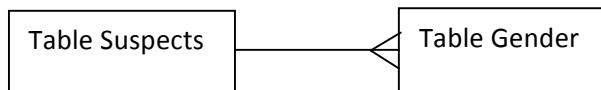


Figure 19: Entity Relationship Model - One to Many relationship

#### One to One

One to One relationships exist when there is only one record in Table A that corresponds to only one record in the related table, Table B. If you have a One to One relationship then is it worth having the additional related table?

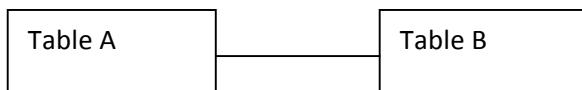


Figure 20: Entity Relationship Model - One to One relationship

#### Many to Many

Many to Many relationships exist when each record in Table A may have many linked records in Table B and vice-versa. For example, a Teacher may teach many students and a Student will have many teachers.

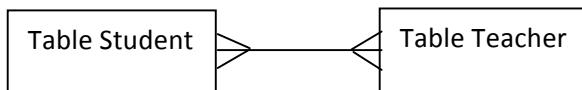


Figure 21: Entity Relationship Model - Many to Many relationship

However database management systems can only handle One to Many relationships so it is necessary to introduce a third table to handle an instance of that many relationship called Class Table. Both the relationships from this Table Class will be One to Many i.e. A Class will have one or more Students and the class will have one or more Teachers.

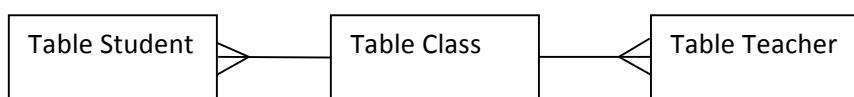


Figure 22: Entity Relationship Model - Third instance table called Class

### Database Management System

The Database Management System is the software that separates the applications from the data. The purpose of the Management System is to control the creation, maintenance, and use of a database. Therefore, changes can be made to one application without affecting another application or the data in the database. This separation is often called Program-data independence.

# Computing

## Databases Unplugged: Updated Version

### How could I teach this in my classroom?

#### New vocabulary

- ✓ Data validation
- ✓ Relational database
- ✓ Referential integrity
- ✓ Primary key
- ✓ Foreign key
- ✓ Database Management Systems

#### Instructions

Begin by asking the children to think back to the last lesson where they performed data verification on their neighbours work. Now ask the children to imagine that they are computing specialists working for a large company with thousands of records. What are the problems of data verification by proof reading thousands of records? The children will tell you that:

- It is time consuming and therefore costly to employ lots of people do the task.
- People doing this task might find it boring and when people get bored they make mistakes.

Now ask the children to think creatively about how we could solve this problem. Many children will identify that the computer should do the checking process as the data is entered. Ask the children to think about how the computer can check that the data being entered is correct. They usually come up with the idea of the computer having some sort of lookup list so that it can check the data being entered against the correct answers.

If the children struggle to identify way they could get the computer to check for errors on entry, ask them to look through the suspect cards to see if the detectives have used any abbreviations in the cards i.e. replacing 'no' for 'n'. Ask the children what the 'n' stands for? How would a computer know? What might a computer use to remember this abbreviation?

You can then tell the children that this is the process called validation. To help the children understand what the word validation means, ask them to find the longest word they can in the word validation i.e. valid. The children should have an idea of what the word valid means to them. Ask them to be human dictionaries by sharing their definitions with the class.

#### Activity

Split the class into two equal sized groups. Hand every child in the class an A4 sheet of squared paper. Explain to the class that you are going to test their idea of using a lookup list for the computer to check the answers against. Tell them that they are going to play the role of the computer performing the data validation and the other is going to do it the original way. Explain that they are going to be given a time limit to complete the task.

Group A is going to start copying the data from the Google Docs Spreadsheet into the square paper. One character should go in each square, refer to Table 7 for details. To help the pupils with reading the data after the game you can allow them to use one square as a break between fields. When the child reaches the end of the line of squares they should continue on the next line. The children should not use line breaks between each record.

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For example, the first and second record in the flat file suspects table (Figure 23) has been copied into to table 6 below:

◆	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Surname	First Name	Gender	Age	Occupation	Height	Build	Shoe size	Glasses	Hair Colour	Hair Length	Facial Hair	Eye Colour	Ear Rings
2	Mehic	Yuri	Male	55	Sharpshoot	Short	Medium	11	N	Dark	Long	Moustache	Brown	Y
3	Bellini	Francesca	Female	26	Acrobat	Short	Slim	5	n	Dark	Long	N	Hazel	N

Figure 23: Flat file suspects table

M	e	h	l	c	Y	u	r	I	M	a	l	e	5	5	S	h	A	r	p	e	S	H	o	o	t				
e	r		S	h	o	r	t		M	e	d	i	u	m	1	1		N		D	a	r	k		L	o	n	g	
	M	o	U	s	t	a	c	h	E		B	r	o	w	N		Y		B	e	L	l	l	n	I		F	r	a
n	c	e	S	c	a	2	6		A	c	r	o	B	A	t		S	H	o	R	t		S	L	I	m	5		
	N		D	a	r	k	L	O	n	g		N		H	a	z	e	l		N									

Table 7: Flat file database with no validation

Whilst Group A is starting the process of copying out the data, work with Group B to see if they can identify any abbreviations. Ask the children to work in pairs and for each pair to focus on a particular field e.g. Hair colour. Pass the suspect cards around the room so that each pair can build up a list of possible data values for their field in a table. When they have completed the list, ask them to assign abbreviated codes for each value e.g. Dark equals D, refer to table 8 below:

Hair colour	
D	Dark
L	Light
R	Red
G	Grey

Table 8: Hair colour lookup table.

Get each pair to share the details of their lookup table and record it on a white board, flip chart or interactive white board.

# Computing

## Databases Unplugged: Updated Version

Then ask Group B to perform the same task as Group A but where ever there is a lookup table for a table for a given value, they should replace it with the abbreviated code. Refer to Table 9 which shows the beginnings of a relational database.

M	e	h		c		Y	u	r	I	M		5	5		S	M	1	1	N		D	L	M		
B		Y		B	e	I	I	i	N	i		F	r	a	n	c	e	s	c	a	F		2	6	A
S	S	5		N		D		L	N		H	N													

Table 9: Flat file using lookup tables so the beginnings of a relational database

### Discussion

If either group managed to finish copying all the records on the sheet of A4 or the time allocated expires, ask the children to consider the following:

- Which group finished first, it was probably group B despite them giving Group A an head start.
- Which group has copied the data most accurately? The children could perform data verification on one another's groups to check.
- Explain to the children that the squares on the sheets of paper represent space in the hard disk in their computer. Each square is equal to one byte of data. Therefore, what Group has used the least amount of space i.e. bytes of data, and why?
- Ask the children to identify what other methods of data validation they could perform (thinking about there use of spreadsheets)?

Explain to the children that they have invented a concept widely used in industry called a Relational Database. Explain to the children that a relational database stores and organises data in separate tables instead of placing all data in one large (flat file) table.

Use this as an opportunity to introduce the concept of Foreign keys and referential integrity to demonstrate the example in Tables 7 and 8 combined with Figure 26.

### Extension

The discussion point relating to the amount of space saved through using a relational database thus preventing data duplication is an excellent opportunity to introduce older children how computer memory is measured i.e. bits, bytes, kilobytes, and data representation i.e. binary, American Standard Code for Information Interchange (ASCII)and error checking, and then relating this back to databases.

Essentially, binary is the language that computers understand. Computers only work with values of 1 and 0. The reason for this is computers work on circuit boards where there is either high voltage (1) or low voltage (0). The characters in ASCII characters are generated using binary. ASCII there are 128 characters that humans can use to represent numbers and letters.

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Each character e.g. the letter 'L' or number 9 in the database is equal to 7 bits (1, 2, 4, 8, 16, 32, 64) with one parity bit for error checking; totally one byte. Therefore, each letter or number the database is equal to one byte of data. See Figure 24 below:

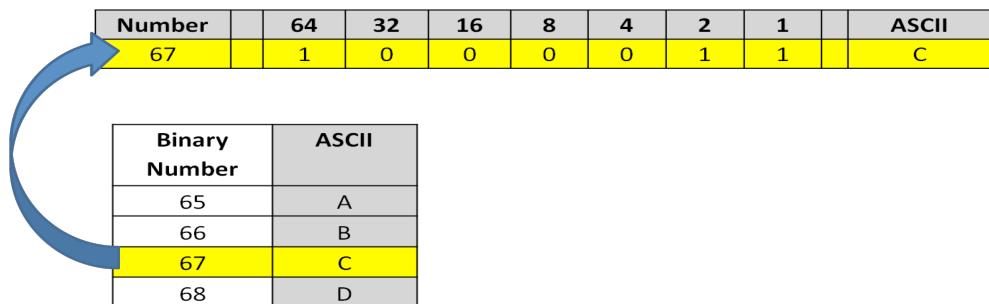


Figure 24: Generating ASCII using Binary

For more ideas on how to teach data representation to all ages of children, visit the [CS Unplugged](#) website or the resources for the collaboration between [The Digital Schoolhouse](#) and Thorpe Park theme park on making binary and data representation relevant to programming and roller coaster control [26].

### Activity

Now ask the children to summarise what the advantages of a relational database is.

For the more able or older children, you could ask the children to draw a diagram to map the lookup tables they have suggested to the suspect table, similar to Figure 25 below:

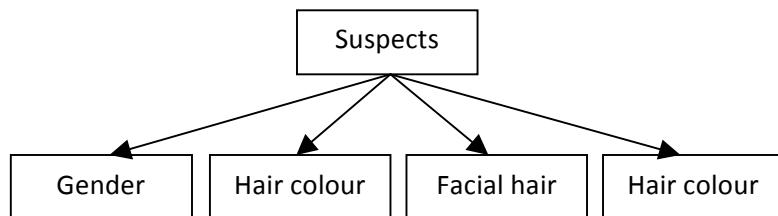


Figure 25: Modelling the relationship between tables step 1

To extend the older children you could ask them to turn the above diagram into an Entity Relationship Model using the correct symbols, refer to figure 26 below:

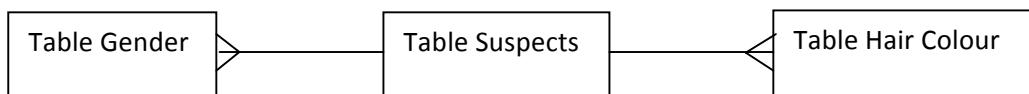


Figure 26: Entity Relationship Model - for the Suspects database

### Extension activity A

Introduce the children to the vocabulary Primary key. Ask the children why they think it is important to have different abbreviated codes for each of the options in the lookup table. They will tell you that it stops the computer and user from getting confused which option is which e.g. 'B' could equal blue or brown eyes. If they struggle, ask the children "is the problem with using single letters as abbreviated codes in a database?"

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They will probably tell you that you can only have 26 options – one for each letter of the alphabet. Then lead the questioning around ‘B’ could equal blue or brown eyes.

Some of the children will suggest using number because then you can have a infinite number of records in the lookup table. Other children will suggest multiple letters as abbreviations. Ask the children to consider why this might be a good idea i.e. it keeps the codes meaningful.

You could ask the more able or older children to research which option would be seen as best practice in the IT word and why.

### ***Extension activity B***

For the older children, remind them of their definitions of ‘data’ and ‘base’. If they haven’t done this activity previously,

Now ask them what the word ‘management’ and ‘systems’ means mean to them. They could check these definitions against a dictionary. Play a game of Human Dictionary when to gain their ‘real word’ understanding of what the words mean. Use paired discussion combined with teacher lead class discussions. At the conclusion of this activity, children will combine their understanding of both words to develop a ‘real word’ understanding of what the word *database* means.

Usual explanations for what *data* are:

- ✓ Data is usually numbers like in maths
- ✓ Data is stuff that you collect in surveys and put in a graph

Use key questioning to steer the discussion to the graph being the thing that adds meaning to the data; therefore, *data is information without meaning*.

Usual explanations for the word *base* are:

- ✓ Base is at the bottom of something holding it up
- ✓ Base is a safe place in a playground game or game of Baseball
- ✓ Base is somewhere that everyone goes to in a game

Use the key questioning to get children to summarise the three main purposes of a base.

Once consolidation of the words ‘data’ and ‘base’ has taken place, ask the children to think about how these words ‘management’ and ‘systems’ could apply to a database. Repeat the process of getting the children to identify what the words mean to them.

They will usually say some thing along the lines of:

- Management means over seeing something so that it doesn’t go wrong but is not involved in actually doing it.
- System means a process or set of rules to be followed so that something doesn’t go wrong.

Then ask them to research what a database management system and ask them to draw comparisons between their definitions and what the stated purpose of a database management system. This provides the class teacher with an excellent opportunity to investigate and understand what is meant by the term program-data independence.

# Computing

## Databases Unplugged: Updated Version

### Philosophy of Computing: Introduction to databases

#### Summary

- ✓ A P4C discussion to get children considering some of the technical but mainly ethical considerations of organisations and Governments using database technology.

#### Age group

- ✓ 9 and up

#### Materials

- ✓ A Digital Schoolhouse [guide to Philosophy for Children](#) (P4C) [20]
- ✓ Computers with a internet connection for BBC News video clips
  - [UK police breaking the law on DNA database](#) [21]
  - [Innocent people are still criminals](#) [22]

### Introduction

#### What is Philosophy 4 Children (P4C)

P4C is teaching and learning using discussion based (Socratic) dialogue.

#### What's its aim?

It aims to engage pupils in asking questions to try to understand the world around them or the world they live in. It encourages the careful use of reasoning and justification in exploratory discussion.

#### What is the BANG for BUCK...

Helps pupils to:

- Become more involved in learning
- Become better at problem solving
- Improve their scores in tests of reasoning
- Improve reading comprehension
- Work with more confidence and with more analysis and justification across the curriculum.

#### What makes P4C different?

Teaching sessions will (usually) take the following format in figure 27 below:

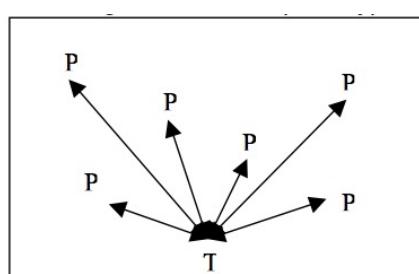


Figure 27: Usual teacher and childrens dialogue

After a few sessions of P4C, the enquiries should hopefully develop the interaction between pupils with the teacher only needed to monitor and scaffold the discussion, a shown in Figure 28 below:

# Computing

## Databases Unplugged: Updated Version

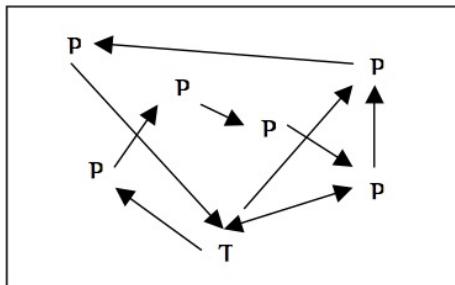


Figure 28: Teacher and childrens dialogue in P4C discussion

### Types of discussion

Disputation discussion encourages:

- Competitiveness
- Shallow listening
- Sticking to own point of view

Cumulative discussion encourages:

- Sharing ideas
- Agreeing with others
- Not critically evaluating others' ideas.

Benefits of exploratory (P4C enquiry) discussion:

- All actively participate
  - All ask questions
  - All actively listening
- All give reasons for their views...
- All develop critical but constructive attitudes...
- All try to reach some agreement...

# Computing

## Databases Unplugged: Updated Version

### How could I teach this in my classroom?

#### What is the structure of P4C enquiry?

1. Stimulus (proverb, pictures, video, reading (poems, plays, stories), actions, objects, sound, song lyrics, speeches , quotations, etc.).
2. Reflection (thinking time).
3. Discuss reflections in small groups.
4. Formulate a question(do not use this step if you are using a Thunk).
5. Groups present questions, and other groups clarify question and meaning (do not use this step if you are using a Thunk).
6. Loading of question (each individual gets to vote for a question).
7. Dialogue
8. Final thoughts (each individual gets to summarise their thoughts from the enquiry)

#### Rules of engagement

We don't put our hands up... we put our hand out with our palms up!

Whenever possible sentences should begin:

- I agree with what... said because...
- I disagree with what... said because...

Other general rules of thumb for P4C enquiries:

- All opinions are valued unless they cause offense.
- All pupils should have an equal opportunity to speak.
- The teacher should never agree or disagree, or show bias in any way.
- And remember, there is no definitive right or wrong answer with these questions.

#### Instructions

After explaining what a P4C discussion is, choose one of the two BBC News video clips to play to class and then follow the structure described above.

#### Note from the author

The children will discuss what ever they fill the need to discuss. You'll be amazed where the ensuing conversations may lead... From the authors experience, the discussions will usually include the following topics which provide excellent opportunities to introduce new topics of study:

- Technical considerations of can we build a computer that know everything due to the vast amounts of data that would need to be stored against each person
- Ethical issues of is it right to hold so much data about people in our community because can make the right choices as well as one off bad choices.
- Security issues and having to trust the Government with our personal and intimate data bearing in mind that they are under constant attack from hackers and lose memory sticks on trains.

# Computing

## Databases Unplugged: Updated Version

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