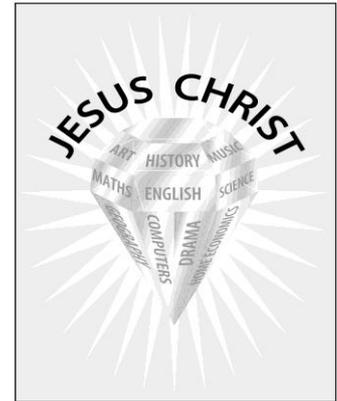


# A Christian Approach to Teaching National Curriculum Science in Primary Schools



## Who is this for?

This document is designed for primary teachers or student teachers who wish to understand more about the National Curriculum for Science (2000). This should help the reader to acknowledge potential bias towards secular objectives, and also highlight opportunities for teaching Christian principles, in the National Curriculum. I hope that it will also provide a basis upon which planning can be supported for anyone seeking to involve Christian principles in their teaching of National Curriculum Science.

## Science

I love Science. Why? Because the subject reveals so much about God. Simplistic, yes, but true nevertheless. Children can develop a love and worship of God through a love for Science.

On the introductory pages of the NC document for Science, is this quote by Colin Tudge:

‘Science does not tell us everything that we want to know about life. But it does provide us with the most robust information about the way the universe works that has so far become available to us.’

Here we find both a helpful admission and a profound omission of the ability that God has to inspire revelation and scientific thought. Science does not tell us everything, although some have deified science to a position of almost absolute authority. As Christians we must believe that understanding the ‘way the universe works’ is more than purely a scientific discipline, no matter how robust the information Science provides.

Johannes Kepler (1571-1630), who was one of the first to postulate laws that governed the motion of planets, stated:

‘Science is thinking God’s thoughts after Him.’

It is indeed the study of the lawfulness of creation and moreover of the Creator who faithfully upholds and governs His creation. He can and does ‘break the rules’ from time to time, with supernatural acts, to which cold Science can only offer a view of unbelief. Science can only ever be our best human effort to comprehend God’s creation and to articulate the current understanding in human language. Theories are always fallible and in need of correction. And yet we can, and do, engage with a real, knowable, universe, which can augment our worship, aid our ability to steward His creation and, hopefully, point us towards the Creator. A much fuller discussion of some of these issues can be found in Arthur Jones ‘Science and Faith’ and Bolton & Lord’s ‘Towards a Biblical Framework for Curriculum Development’ (Available from CST).

## **Worldviews**

All human beings have a worldview. This has a profound effect upon their ability to apply knowledge, skills and understanding to everyday life and work. The National Curriculum is based upon a secular humanistic worldview, which has many elements that are contrary to Christian teaching.

To a humanist there is no God, and therefore the universe exists in isolation. Human beings and rationality is what we should put our faith in (and even worship). The material, observable world is the only reality we can depend on. The reason why we exist on planet Earth is because of random events and chance. Therefore, each person is of relative insignificance. Our purpose is to understand and explore the world and the universe for the sake of our own progress and evolution. The belief is that all the problems of the world could eventually be solved through Science and Technology. This view of the world has a subtle yet powerful effect that often enters our understanding unconsciously and militates against a full acceptance of the truths of Christianity.

To a Christian, God is the creator of the universe and is intimately involved in every aspect of nature, especially people who are all made in His image. Human beings can know and put their faith in God, by trusting in Jesus Christ, and giving their lives to serve Him and His purposes. The reason we exist is to further His glory, kingdom and work on this Earth. Each person is therefore of infinite value. Because human beings have chosen to live without God, the creation is corrupted, including the humans themselves. Jesus can give new life to individuals, giving them motivation and ability to steward this world in the present, and hope that God Himself will in the future make everything new, perfecting the creation He has made. This godly view of the world can be seen in contrast to the lies of secular thinking, and therefore should encourage the teacher to find opportunities to discover the distinctive nature of Christian education.

### **Distinctives for a Christian Approach to Science Teaching**

Bolton and Lord have produced a comprehensive and well reasoned list of those aims which are distinctive from those of a secular education system. They have arrived at 14 areas for promotion and 10 areas to “combat, challenge or expose”. I would recommend a detailed study of their thought process before accepting these, but I do believe each one can be helpfully included in the teaching of the state NC and can help the Christian teacher to purify the aims of their Science lessons.

Fig. 1

## **Bolton and Lord's Distinctives**

### **To Promote:**

1. God as the **source** of all.
2. A sense of awe and **wonder**, which contributes to a **worship** of the Creator God.
3. An understanding of the **diversity** within the **unity** of creation.
4. An understanding of the **roles** of created things and their **interrelationships**.
5. An appreciation of the **order, design and purpose** in creation (including analogies).
6. An appreciation of the fact that scientific laws and theories are not human inventions but an expression of **God's faithfulness**.
7. A **top-down**, holistic approach to any topic studies (rather than a reductionist approach).
8. The role of humans as responsible **stewards** of God's creation.
9. Responsible technology and science which can be a means of **Christian service**.
10. An understanding that science can be performed in **obedience** or disobedience to God.
11. A **balanced use of faculties** in enquiry and response e.g. memory and intuition as well as rationality.
12. An awareness of how the **worldviews** of scientists affect their science.
13. Science that is **culturally sensitive** and relevant (this also affects question raising).
14. A **global** perspective on any given topic (e.g. relevance to the third world).

### **To Combat, Challenge or Expose:**

15. The **autonomy** of science- the idea that science is unrelated to a creator God and to any other areas of life such as politics, law and the arts.
16. The **deification** of science- the idea that science is the only way to true knowledge.
17. The idea that, given enough time and money, science can **solve all our problems**.
18. The supposed moral and spiritual **neutrality** of science- the idea that science does not convey any values, only facts.
19. The supposed **superiority** of western culture and rational thought.
20. The **hidden values** and worldviews implicit in the national curriculum and text books.
21. **Stereotyping** of race, sex, age, class and status.
22. Any **denigration of other subjects** or areas of life.
23. **Evolutionary ideas** and language.
24. A bottom-up (**reductionist**) approach to any topic.

## The National Curriculum

Produced by a long process of review and discussion among secular educationalists, the National Curriculum has improved the content, continuity and quality of teaching across the country. Many see it as a positive step forward from the wide range of approaches to curriculum adopted previously. Much of the content seems at first glance to be sound, however the worldview behind the document is one of training children to be productive members of society who are self-sufficient, well educated, citizens, who will improve the status of our market run economy by their contribution. I have deliberately phrased the preceding sentence to stir a question or two. My experience of state schools has demonstrated to me that much more than this really occurs and that a love for children, and God, does play a vital role in many state learning communities. However, without God at the centre of curriculum, the teacher will always lack the most valuable purpose and inspiration.

The National Curriculum (NC) Science section is separated into *Key Stage 1* (YR-Y2) and *Key Stage 2* (Y3-Y6), with each section divided into Sc1- *Scientific enquiry*, Sc2- *Life processes and living things*, Sc3- *Materials and their properties* and Sc4- *Physical processes*. There is a list of learning targets under each heading, with a closing statement about *Breadth of Study*. Finally, there are a list of level statements (from 1-6) for the purpose of assessment. These will each be dealt with separately.

One of the distinctives alluded to by Bolton and Lord is that a Christian view of education should be truly holistic. Science itself has become a segment of necessary learning, and each aspect of scientific study is further reduced to more manageable parts. However, this has arisen from a reductionist approach which says that the best learning comes through understanding the smaller parts first. The whole is merely the sum of its parts. A truly godly holistic view addresses the interrelated parts of a topic and holds them in balance together, through keeping God at the centre of the learning. Wider applications of learning, and relevant application to the learner's world are therefore an essential part of the teaching rather than an added extra.

An example could be seen in learning about the names of the parts of a flower. Learning which part of the stamen is the anther, is a small piece of information. Seen in the context of understanding how God's created world has plants which have wonderfully intricate processes of reproduction, can bring much more meaning and wider learning. The reduced level of merely learning scientific vocabulary can be broadened into greater understanding of God and His world.

The way that subjects themselves have been separated from one another is another example of how the reductionist approach has dissected learning into individual segments. Care should be taken to combine and integrate teaching across conventional subject areas, to ensure that broader more holistic learning takes place. Studies on 'water' for example can encompass far more than Science and Geography alone. Measuring water, writing about water, artistic uses of water and depicting water are all potential ways of making the study more holistic. Teaching of topics and themes should be encouraged, even if it can be harder to link together the targets which need to be taught, from a subject partitioned set of aims. Timetables, teachers and curriculum are usually divided into subjects for ease and manageability; however, awareness of the importance of holistic teaching can prevent us from falling into the dangers of reductionism.

## Critiquing the National Curriculum

Every Christian who comes to look at how they can effectively teach about God, will see different opportunities in any given situation. Such is the richness of God's diverse family. As each teacher prayerfully looks at the subject matter of their teaching, a variety of methods and angles of approach will become apparent. I believe strongly that each teacher needs to prayerfully engage in planning before commencing teaching. Using many of the ideas shown in Figure 1. I will endeavour to highlight some opportunities for Christian content, and where there seem to be opportunities for the seeds of secular thinking to take root.

This is *by no means exhaustive* and is merely an initial attempt to stimulate thinking about how you could handle the NC objectives. Each teacher, class, school and Christian denomination has its own distinctive emphases, which are important to hold on to, and therefore each need to prayerfully consider how to use the document.

## KS1 Sc1-Scientific Enquiry

*Comment: The ability to think in a particular way is what is being taught through Sc1. It is important to recognize at the outset that this ability to think scientifically can be useful, however even if I, "can fathom all mysteries and knowledge" If I have not love I am nothing. (1 Corinthians 13 v 2). The book of Ecclesiastes is full of observations, tests and results, but its final conclusion is "Fear God" (Ecclesiastes 12 v 13).*

## Ideas and Evidence in Science

- 1) Pupils should be taught that it is important to collect evidence by making observations and measurements when trying to answer a question.

*Comment: For younger children, God's ability to help should be encouraged to avoid the independence and pride that could be engendered at an early stage. One could highlight the limitations of science against the unlimited God we worship e.g. We can't measure God's love for us. Passages that encourage people to look/observe the world can be used to keep a godly perspective on observation and evidence itself e.g. **Matthew 6 v 26;** **Proverbs 26 v 20***

## Investigative Skills

- 2) Pupils should be taught to:

### Planning

*Comment: All planning should be subject to God and His wisdom. (Proverbs 16 v 9; 12 v 5) As we are created in His image we do have this ability ourselves, at a level greater than that of animals.*

- a) Ask questions [for example, 'How?', 'Why?', 'What will happen if ... ?] and decide how they might find answers to them.

*Comment: Children need to be encouraged to ask questions as part of the learning process as a disciple or student. Linking 'asking' with prayer and communication with God is helpful here, to avoid the emphasis on independence in finding answers. (Genesis 3 v 6)*

b) Use firsthand experience and simple information sources to answer questions.

*Comment: Testimony and experience help us answer questions, however the Word of God governs what is learnt through such experience. (2 Timothy 3 v 16)*

c) Think about what might happen before deciding what to do.

*Comment: Much of the Created world is predictable, but not all that exists! God is also mysterious, and infinitely so. (Isaiah 40 v 28) Consequential thinking is an aspect of wisdom and is godly, but decision making without God is ultimately relying on yourself.*

d) Recognize when a test or comparison is unfair.

*Comment: God is just and righteous. In scientific work children (and teachers) should be honest in testing fairly in seeking to answer a question. This can lead into considering good discernment.*

## **Obtaining and Presenting Evidence**

e) Follow simple instructions to control the risks to themselves and to others.

*Comment: The concept of obedience is important here. Younger children will need to obey for reasons both understood and unknown, as they will have to in the Christian life in relationship to Father God. This is important for safety of themselves and others. (Deuteronomy 28)*

f) Explore, using the senses of sight, hearing, smell, touch and taste as appropriate, and make and record observations and measurements.

*Comment: We use our senses to 'know' however some things may not be wise to explore (the occult, human embryos, tasting bleach!). We are called to be innocent about some things. (Romans 16 v 19) All exploration should be with God and with godly motivation, therefore using our faculties in wise ways. Using our senses is an opportunity for developing gratitude, wonder and worship of God. (Psalm 139 v 14) Beyond this it is important to understand that some aspects of creation are mostly unobservable e.g. spiritual realms. (Revelation 4)*

g) Communicate what happened in a variety of ways, including using ICT [for example, in speech and writing, by drawings, tables, block graphs and pictograms].

*Comment: God wants to communicate with people in a variety of ways, and this target for children can reflect His desire.*

## Considering Evidence and Evaluating

*Comment: Evaluating should be encouraged as an important thinking and learning process as a disciple. Comparing the outcomes of activities can help children to be spiritually contemplative. (Hebrews 13 v 7)*

h) Make simple comparisons [for example, hand span, shoe size] and identify simple patterns or associations.

*Comment: Comparing is a godly thought process, an aspect of wisdom. It helps us not only to understand the lawfulness of Creation, but godly and ungodly actions. (Luke 13 v 20; Isaiah 40 v 18)*

i) Compare what happened with what they expected would happen, and try to explain it, drawing on their knowledge and understanding.

*Comment: The value of teachers and scientists who have already discovered scientific facts, and that we can trust others, could be included here so that reliance on self alone is not encouraged. Knowing that you can trust others even when what is observed seems to contradict a learning target is better than fudging experiments to prove a point. Finding reasons for mistakes and learning from them is also an important aspect of the discipling process.*

j) Review their work and explain what they did to others.

*Comment: As in other areas of the curriculum, the ability to communicate effectively with others, as God can, could be considered here. Reviewing is important with the purpose to remind children of what has been learnt, confirm facts to long-term memory and to find ways to improve testing. (Luke 10 v 17-21)*

## Sc2- Life Processes and Living Things

### Life Processes

*Comment: God is the source of life and this needs to be included for a fully Christian perspective to be brought to bear here. (Genesis 1 v1) The belief that there is also soul/spiritual life for humans and that this comes from God who is also alive and is Spirit. (2 Corinthians 3 v 17)*

1) Pupils should be taught:

a) The differences between things that are living and things that have never been alive.

*Comment: God's breath is what has given human beings life. (Genesis 2 v 7) There are also other spiritual beings that exist but are usually invisible. (Hebrews 12 v 22)*

b) That animals, including humans, move, feed, grow, use their senses and reproduce.

*Comment: The spiritual life that is invisible also has the opportunity to demonstrate that it is alive, with God's power, resulting in 'movement', 'growth', 'reproducing life in others' etc... (Romans 8 v10)*

c) To relate life processes to animals and plants found in the local environment.

*Comment: Younger children need to have this opportunity to wonder and worship in God's creation, and to see it where they are. (Jeremiah 1 v 11; Job 39)*

## **Humans and Other Animals**

2) Pupils should be taught:

a) To recognize and compare the main external parts of the bodies of humans and other animals.

*Comment: The similarities between humans and other living things should not lead the child to a belief that we are the same as animals. Human beings have a higher role, ability to choose and opportunity to relate to God, as they are made in His image. The uniqueness of human beings may need to be covered as a separate topic. (Genesis 1 v 27-30)*

b) That humans and other animals need food and water to stay alive.

*Comment: There is a link here between the Word and the Spirit as food and water for our spiritual life. (John 6 v 51) Life for humans is more than just the body.*

c) That taking exercise and eating the right types and amounts of food help humans to keep healthy.

*Comment: Being a good steward involves us looking after our bodies and our spirit, so we are completely healthy. (1 Timothy 4 v 8) God is the one who allows us to be healed miraculously and has made our bodies in amazing ways so that it can heal itself.*

d) About the role of drugs as medicines.

*Comment: Wisdom in knowing what to explore, as seen in Sc1 (2e), comes in here, along with the wonder of God having given wisdom to those who have developed medicines.*

e) How to treat animals with care and sensitivity.

*Comment: Stewarding God's world well is important as part of God's plan for creation. (Genesis 2 v 15) The topic of pets can be integrated at this point. (Proverbs 12 v 10)*

f) That humans and other animals can produce offspring and that these offspring grow into adults.

*Comment: God's plan for creation has always been multiplication. (Genesis 1 v22) He also desires for us to mature in our spiritual growth. (Hebrews 5 v 12-14)*

About the senses that enable humans and other animals to be aware of the world around them.

*Comment: Using our senses is an opportunity for developing gratitude, wonder and worship of God. (Psalm 139 v 14) However, there is also more to the world than what we can sense with our body, i.e. the spiritual dimension.*

## Green Plants

3) Pupils should be taught:

a) To recognize that plants need light and water to grow.

*Comment: God has made aspects of creation in interdependent relationships. The Sun is needed for life. Analogies with spiritual life can be made here. (Psalm 1)*

b) To recognise and name the leaf, flower, stem and root of flowering plants.

*Comment: Knowledge of language so we can communicate and understand, is part of God's plan for us to mature.*

c) That seeds grow into flowering plants.

*Comment: Many biblical passages use seeds to describe a Christian principle. (Mark 4; John 12 v 24; 1 Corinthians 9 v 11) Understanding and appreciating creation helps us to understand and worship God. (Romans 1 v 20)*

## Variation and Classification

4) Pupils should be taught to:

a) Recognise similarities and differences between themselves and others, and to treat others with sensitivity.

*Comment: God has created a world of variety. Diversity and the interrelationship between the living things, is part of God's plan. This has many implications for classroom conduct. We need to learn to accept and value difference.*

b) Group living things according to observable similarities and differences.

*Comment: Being able to group and sort is a valuable skill that can be used to serve God and others and reflects God's original classification in creation. (1 Kings 4 v 33)*

## Living Things in Their Environment

5) Pupils should be taught to:

a) Find out about the different kinds of plants and animals in the local environment.

*Comment: Younger children need to have this opportunity to wonder and worship in God's creation, and to see it where they live and learn. (Jeremiah 1 v 11; Job 39)*

b) Identify similarities and differences between local environments and ways in which these affect animals and plants that are found there.

*Comment: Here are the seeds of evolutionary thinking and that species can be changed due to the environmental conditions. The belief that God has designed creation, by whatever means, should be encouraged even at this early stage. The environment's effects must be seen as part of God's working. (Jeremiah 8 v 7)*

c) Care for the environment.

*Comment: Stewarding God's world well is important as part of God's plan for creation. (Genesis 2 v 15)*

### **Sc3- Materials and Their Properties**

#### **Grouping Materials**

1) Pupils should be taught to:

a) Use their senses to explore and recognise the similarities and differences between materials.

*Comment: A clear opportunity to worship as a result of what we sense. The unity and diversity in non-living things can be highlighted.*

b) Sort objects into groups on the basis of simple material properties [for example, roughness, hardness, shininess, ability to float, transparency and whether they are magnetic or nonmagnetic].

*Comment: Being able to group and sort is a valuable skill that can be used to serve God and others (1 Kings 4 v 33)*

c) Recognise and name common types of material [for example, metal, plastic, wood, paper, rock] and recognise that some of them are found naturally.

*Comment: It is good to emphasize here that God is the provider, who has given all we need in His creation. (1 Timothy 6 v17)*

d) Find out about the uses of a variety of materials [for example, glass, wood, wool] and how these are chosen for specific uses on the basis of their simple properties.

*Comment: God uses the characteristics of creation to bring glory to Himself. Man can use the properties and characteristics of the created materials, to work as a craftsman/creator in His image. God guides us with His Spirit in the use of His materials. (Exodus 35 v 31-35) Understanding these materials help us to understand analogies e.g. the wise man built his house upon the rock!*

#### **Changing Materials**

2) Pupils should be taught to:

a) Find out how the shapes of objects made from some materials can be changed by some processes, including squashing, bending, twisting and stretching.

b) Explore and describe the way some everyday materials [for example, water, chocolate, bread, clay] change when they are heated or cooled.

*Comment: As temperature and movement change materials, so can God change our lives as He wishes. (Jeremiah 18 v 5; Isaiah 64 v 8) **Emphasis should be given to the fact that God has given man the creative intelligence to make new materials (man-made).***

## Sc4- Physical Processes

### Electricity

1) Pupils should be taught:

- a) About everyday appliances that use electricity.
- b) About simple series circuits involving batteries, wires, bulbs and other components [for example, buzzers, motors].
- c) How a switch can be used to break a circuit.

*Comment: The wonder of the power of electricity can be linked to the power of God (e.g. lightning). The ability to create light can be seen as a way to reflect our creator's creativity. Some materials are able to resist and some conduct the power; this can be used as an analogy for letting God's power work in us. (Job 38 v 35; Revelation 4 v 5; Luke 5 v 17)*

### Forces and Motion

2) Pupils should be taught:

- a) To find out about, and describe the movement of, familiar things [for example, cars going faster, slowing down, changing direction].
- b) That both pushes and pulls are examples of forces.
- c) To recognise that when things speed up, slow down or change direction, there is a cause [for example, a push or a pull].

*Comment: The forces of good and evil in the world can be discussed here and the ability to overcome evil with good, as one force in nature overcomes another. The consequential thinking about cause and effect will develop children's thinking skills in ways that are helpful for future discipleship. The invisible forces of the wind, gravity and magnetism could be used to describe the invisible God. (Romans 12 v 21; Jonah 1 v 4)*

### Light and Sound

3) Pupils should be taught:

#### Light and Dark

- a) To identify different light sources, including the Sun.
- b) That darkness is the absence of light.

*Comment: God created light in all its beauty. Many obvious scriptural analogies can be found to link in here, especially that light always overcomes darkness. (John 1; John 8 v 12) God creating the Sun should be introduced to young children (Genesis 1 v 14)*

## Making and Detecting Sounds

- c) That there are many kinds of sound and sources of sound.
- d) That sounds travel away from sources, getting fainter as they do so, and that they are heard when they enter the ear.

*Comment: When we 'hear from' or 'listen to' God, there are a variety of ways for this to happen. Explanation that helps children avoid confusion about audibility of actually heard sounds, is helpful for younger children. God is the one who gives us the ability to make sounds and to listen. These abilities need to be governed with self-control. Classroom conduct can be discussed here. (Psalm 71 v 23; Ecclesiastes 9 v 17).*

## KS2

### Sc1- Scientific Enquiry

Please read and consider the comments additional to the KS1 points for Sc1. This will help you see the progressive thinking in the NC, in teaching children towards a secular scientific thinking process as they mature.

*Comment: The ability to think in a particular way is what is being taught through Sc1. It is important to recognise at the outset that this ability to think scientifically can be useful, however even if I, 'can fathom all mysteries and knowledge' If I have not love I am nothing. (1 Corinthians 13 v 2). The book of Ecclesiastes is full of observations, tests and results, but its final conclusion is 'Fear God' (Ecclesiastes 12 v 13).*

### Ideas and Evidence in Science

- 1) Pupils should be taught:
  - a) That science is about thinking creatively to try to explain how living and non-living things work, and to establish links between causes and effects [for example, Jenner's vaccination work].

*Comment: It is good to make the link between creativity and scientific thinking. The Creator wants man to rule creation and man has creative ability because he is made in the image of the Creator. (Genesis 2 v 15) Seeking to understand cause and effect will help to develop consequential thinking. (Proverbs 6 v 6) God does inspire and give revelation through the Holy Spirit (John 16 v 13), and God-fearing scientists can be used as example here e.g. Newton. There are also worldviews that shape secular scientists' approaches e.g. the assumption that there is no God, and these should be recognised.*

- b) That it is important to test ideas using evidence from observation and measurement.

*Comment: A suitable scepticism and discernment of information, with the help of the Holy Spirit is key here. Honesty in looking at results and accuracy in measuring are godly principles (Deuteronomy 25 v 15). Without putting God 'to the test' we are still told to 'Test me in this,' with regards to tithing! (Malachi 3 v 10) Man's testing is of some value, but not every idea can be completely tested scientifically and responsible interpretation of scripture is of greater value for Christians. There is a place for faith! (Hebrews 11 v 6)*

## Investigative Skills

2) Pupils should be taught to:

### Planning

*Comment: All planning should be subject to God and His wisdom. (Proverbs 16 v 9; 12 v 5) As we are created in His image we do have this ability ourselves, at a level greater than that of animals. Planning is a godly activity! (Isaiah 46 v 10)*

a) Ask questions that can be investigated scientifically and decide how to find answers.

*Comment: The scientific investigator can discover much, but without God the answers have less meaning. Asking questions should be encouraged, but knowledge without God should not. (Genesis 3 v 6) Interest in creation and the wonder of it can be encouraged through questioning. This can then lead to worship.*

b) Consider what sources of information, including first-hand experience and a range of other sources, they will use to answer questions.

*Comment: As a source of information, the Bible is fundamental to a Christian. Faith in others as well as in God can be considered here. The thinking process in having a rational faith involves a range of sources (scripture, those we trust, faith) of which firsthand experience is important. (1 Timothy 3 v 16; 1 Timothy 2 v 7)*

c) Think about what might happen or try things out when deciding what to do, what kind of evidence to collect, and what equipment and materials to use.

*Comment: Children should be encouraged to investigate and experiment for themselves, so long as this does not lead to the assumption that everything can be tested and proved in this way. Many good thinking skills are included in this target which are good for discipling as well as good science. The use of personal gifting as part of their equipment is possible here, developing concepts of our interdependence. (1 Corinthians 12)*

d) Make a fair test or comparison by changing one factor and observing or measuring the effect while keeping other factors the same.

*Comment: The justice and fairness of God can be highlighted here, in considering the 'fair test'. Again, the ability to discover through fair testing, balanced with an understanding of the limitations of such discovery, can maintain an attitude of humility and wonder before the infinite God, rather than pride in the scientific process.*

### Obtaining and Presenting Evidence

e) Use simple equipment and materials appropriately and take action to control risks.

*Comment: Responsible, faithful, careful use of equipment is part of good stewardship of what God has given us to use. Being faithful and safe with the small and simple equipment can be linked to the use of talents. (Matthew 25 v 21)*

f) Make systematic observations and measurements, including the use of ICT for datalogging.

*Comment: Again, it is important to do this without losing the wonder of the things being studied. Also, the teacher should counteract the belief that this work can result in all questions being answered. Using the best methods is about using the best tools for the job. (Ephesians 6 v 10-18) Also we can develop from this target the understanding that God purposefully records some things and others He 'forgets'. (Revelation 20 v 12) Furthermore, detailed observations can lead us to a greater understanding of God. (Psalm 37 v 25)*

g) Check observations and measurements by repeating them where appropriate.

*Comment: The lawful universe God has created does have predictability, which can lead us to understand His unchanging nature. However, in this fallen world there are flaws, as there can be in our own imperfect science work. Careful repetition can also be seen as part of learning good discipline.*

h) Use a wide range of methods, including diagrams, drawings, tables, bar charts, line graphs and ICT, to communicate data in an appropriate and systematic manner.

*Comment: God is a communicator and we too must learn to communicate effectively in a variety of ways (1 Corinthians 9 v 20). This can serve others well in their work and communicate to those with many different learning styles and preferences. (Matthew 23 v 11)*

## **Considering Evidence and Evaluating**

i) Make comparisons and identify simple patterns or associations in their own observations and measurements or other data.

*Comment: Interpreting data can be a very subjective process even for the rational scientist and worldviews often give a bias to these interpretations. Involving honest, humble, prayerful consideration of data will help to reveal unbiased knowledge about Creation. (Colossians 2 v 3)*

j) Use observations, measurements or other data to draw conclusions

*Comment: Reaching conclusions is important to give practical use to knowledge, but some may be wrong. The limitations and value of human rationality can be highlighted here. (Ecclesiastes 12 v 13) Some conclusions about life and creation may come from unobservable truths.*

k) Decide whether these conclusions agree with any prediction made and/or whether they enable further predictions to be made.

*Comment: The value of teachers and scientists who have already discovered scientific facts, and that we can trust others, could be included here so that reliance on self alone is not encouraged. Knowing that you can trust others even when what is observed seems to contradict a learning target is better than fudging experiments to prove a point. Finding reasons for mistakes and learning from them is also an important aspect of the discipling process.*

l) Use their scientific knowledge and understanding to explain observations, measurements or other data or conclusions.

*Comment: Not everything is explainable through scientific knowledge, which can be deified in western society. The place of faith and revelation from the Holy Spirit, alongside rational thought is important in coming to any conclusions.*

m) Review their work and the work of others and describe its significance and limitations.

*Comment: The belief that all problems can be solved eventually through science is a myth. Science and rational thought is valuable but limited. The significance of any work in Science should be reviewed from a prayerfully godly perspective. Faith in others' findings is part of life as well as science and the review process may lead to asking further questions. This should be approached not with frustration, but with wonder and worship in the infinite Creator God.*

## **Sc2- Life Processes and Living Things**

Please read and consider the comments additional to the KS1 points for Sc2. This will help you see the progressive thinking in the NC, in teaching children towards a secular scientific thinking process as they mature.

### **Life Processes**

*Comment: In KS2 as well as KS1, it should be regularly highlighted that God is the source of all life (Genesis 1 v 1). There are many opportunities throughout this work for worship to be integrated.*

1) Pupils should be taught:

a) That the life processes common to humans and other animals include nutrition, movement, growth and reproduction.

*Comment: All living things are God's creatures, but man's role is significantly different, as is his spiritual ability to relate to God. The practical outworking of this, need to be integrated, for this to be seen in reality for older children. Man is made in the image of God, and therefore has special worth (**Genesis 1 v 26**). The uniqueness of human beings may need to be covered as a separate topic.*

b) That the life processes common to plants include growth, nutrition and reproduction.

*Comment: Links between biblical principles taught through parables about plants can be included here, as with subsequent objectives. The similarities between plants, may have first been written down by Solomon. (**1 Kings 4 v 33**) There is unity in the diversity.*

c) To make links between life processes in familiar animals and plants and the environments in which they are found.

*Comment: Knowing your local area, helps man to steward it effectively. This can also help children to look and meditate on creation around them, leading them to worship. This can be included as part of planned worship opportunities. **Psalms 104** is a good example of such worship.*

## Humans and Other Animals

2) Pupils should be taught:

### Nutrition

- a) About the functions and care of teeth.
- b) About the need for food for activity and growth, and about the importance of an adequate and varied diet for health.

*Comment: Being wise with our bodies is part of stewarding ourselves well. Good health is not a concept that can be rightly understood, without understanding that the purpose of our life is to serve, and therefore glorify God. God's glory, rather than our own bodily glory, is the focus. We will however, be given perfected bodies in eternity.*

**(1 Corinthians 15)** The link between food and scripture can also be made here. (See KS1)

### Circulation

- c) That the heart acts as a pump to circulate the blood through vessels around the body, including through the lungs.
- d) About the effect of exercise and rest on pulse rate.

*Comment: The biblical use of the word 'heart' (a place of desire, a frequently used concept) should be contrasted with the physiological, to help avoid confusion. (Ezekiel 36 v 26; Romans 10 v 1) Helpful analogies can also be made, in line with health.*

**(Proverbs 4 v 23)** The increase in pulse rate due to emotions as well as exercise is also worth integrating. **(Job 37 v 1; Jeremiah 4 v 19)**

### Movement

- e) That humans and some other animals have skeletons and muscles to support and protect their bodies and to help them to move.

*Comment: Links with the interdependence of parts of the body and the 'body of Christ' are apparent here. (Ephesians 4 v 16; Colossians 2 v 14; 1 Corinthians 12)*

### Growth and Reproduction

- f) About the main stages of the human life cycle.

*Comment: The Christian belief that life is more than our observable existence, needs to be covered here. Development and maturity are God's plan for us, spiritually as well as bodily (Hebrews 5 v 12-14). Childlikeness, however, is to be commended!*

**(Matthew 18 v 3)** God is also positively involved in our life right from conception, and even before. **(Psalm 139 v 13; Ephesians 1 v 4-5)**

## Health

- g) About the effects on the human body of tobacco, alcohol and other drugs, and how these relate to their personal health.
- h) About the importance of exercise for good health.

*Comment: Good health is linked to good stewardship of our bodies. (1 Corinthians 6 v 19-20; 1 Timothy 4 v 8). This honours God. (Also see comments on **Nutrition**)*

## Green Plants

- 3) Pupils should be taught:

### Growth and Nutrition

- a) The effect of light, air, water and temperature on plant growth.
- b) The role of the leaf in producing new material for growth.

*Comment: Factors that affect growth can be linked with spiritual growth easily. (Revelation 22 v 1-2) The interdependence of animals on plants is worth inclusion, to maintain a holistic perspective. (Genesis 1 v 29-30)*

- c) That the root anchors the plant, and that water and minerals are taken in through the root and transported through the stem to other parts of the plant.

*Comment: Roots are often spoken of symbolically, and are seen as a life source, in many passages. (Job 18 v 16; Hosea 14 v 5-6)*

### Reproduction

- d) About the parts of the flower [for example, stigma, stamen, petal, sepal] and their role in the life cycle of flowering plants, including pollination, seed formation, seed dispersal and germination.

*Comment: The wonder and miracle of reproduction in plants and animals reflects God's desire for multiplication. (Genesis 1 v 11-12) Understanding the vocabulary helps us to communicate about the detail of God's creation. Human reproduction is not mentioned in Sc2, but KS2 children will already have some knowledge of this. Therefore, it is important to consider carefully who will address this and when during the KS2 years. (1 Timothy 4 v 7; Proverbs 22 v 6; Ephesians 6 v 4)*

## Variation and Classification

4) Pupils should be taught:

- a) To make and use keys.
- b) How locally occurring animals and plants can be identified and assigned to groups.
- c) That the variety of plants and animals makes it important to identify them and assign them to groups.

*Comment: Being able to group and sort is a valuable skill that can be used to serve God and others. (1 Kings 4 v 33; Judges 7 v 4) God's mandate to rule over creation is supported through being able to name the various plants and animals. We are still attempting to name and discover species, and this truth can lead us toward humility, worship, and an appreciation of God's infinitely creative power.*

## Living Things in Their Environment

5) Pupils should be taught:

- a) About ways in which living things and the environment need protection.

*Comment: Almost any aspect of stewardship, servanthood or interdependence can be covered through this objective. A local and global perspective is most beneficial.*

## Adaptation

- b) About the different plants and animals found in different habitats.
- c) How animals and plants in two different habitats are suited to their environment.

*Comment: Here are the seeds of evolutionary thinking and that species can be changed due to the environmental conditions. The belief that God has designed creation, by whatever means, should be encouraged especially at KS2. The environment's effects must be seen as part of God's ordered, not random, working. (Jeremiah 8 v 7) God has assigned places for his creatures. (Acts 17 v 26) As the topic of dinosaurs is of such interest to KS2 children, is strongly present in contemporary culture, and as the existence of dinosaurs is used as an argument for refuting scripture, a full understanding of theories about this issue need to be considered by the teacher. The choice to avoid or deal with this should be made consciously. I would suggest it should be dealt with within Sc2 or history work in KS2.*

## Feeding Relationships

- d) To use food chains to show feeding relationships in a habitat.
- e) About how nearly all food chains start with a green plant.

*Comment: The interdependence of God's creation as part of God's order could be covered here. The concept of the fall could be linked in where it is noted that the feeding relationships have resulted in death/extinction or pollution has resulted in take up of toxins by plants and animals.*

## Micro-organisms

- f) That micro-organisms are living organisms that are often too small to be seen, and that they may be beneficial [for example, in the breakdown of waste, in making bread] or harmful [for example, in causing disease, in causing food to go mouldy].

*Comment: Some things are small but have great power! Analogies with faith, words and sin are all possible here. Biblical references to yeast are also valuable.*

**(Luke 12 v 1; Luke 13 v 18-20; 1 Corinthians 5 v 6-8)**

## Sc3- Materials and Their Properties

Please read and consider the comments additional to the KS1 points for Sc3. This will help you see the progressive thinking in the NC, in teaching children towards a secular scientific thinking process as they mature. Much of this work is best taught in KS2 through investigations.

### Grouping and Classifying Materials

- 1) Pupils should be taught:
- To compare everyday materials and objects on the basis of their material properties, including hardness, strength, flexibility and magnetic behaviour, and to relate these properties to everyday uses of the materials.
  - That some materials are better thermal insulators than others.
  - That some materials are better electrical conductors than others.
  - To describe and group rocks and soils on the basis of their characteristics, including appearance, texture and permeability.
  - To recognise differences between solids, liquids and gases, in terms of ease of flow and maintenance of shape and volume.

*Comment: This is basically sound knowledge teaching. Variety in properties and uses of materials, highlight the variety in God's creation and also His provision for us.*

**(1 Timothy 6 v 17)** Understanding of conduction and insulation can help us to be good stewards of resources (heating) and conscious of safety (electrical dangers). A variety of soils are described in the parable of the sower, where the good soil is that which is fruitful. **(Luke 8)** Some have used the states of matter to help describe the Trinity.

### Changing Materials

- 2) Pupils should be taught:
- To describe changes that occur when materials are mixed [for example, adding salt to water].

*Comment: Links with God's desire to keep His people pure and the pollution that comes from 'the world' may be alluded to here. (Hosea 7 v8; James 1 v 27)*

- To describe changes that occur when materials [for example, water, clay, dough] are heated or cooled.

- c) That temperature is a measure of how hot or cold things are.
- d) About reversible changes, including dissolving, melting, boiling, condensing, freezing and evaporating.

*Comment: The fact that temperature causes changes is spoken of in scriptural analogies. (Psalm 66 v 10; Revelation 3 v 18; Psalm 97 v 5) The changing nature of creation glorifies God in its ordered processes, but God Himself is 'unchanging'.*

- d) The part played by evaporation and condensation in the water cycle.

*Comment: God's provision of water through this cycle can lead into worship. Around the world a lack of water is a problem contributed to by the greed of developed nations. Our love for our neighbour in being good stewards of world resources could be referred to. (Mark 12 v 31)*

- f) That non-reversible changes [for example, vinegar reacting with bicarbonate of soda, plaster of Paris with water] result in the formation of new materials that may be useful.
- g) That burning materials [for example, wood, wax, natural gas] results in the formation of new materials and that this change is not usually reversible.

*Comment: The fact that God's promises are non-reversible can be demonstrated here. Adoption into God's family, death and the new creation are also non-reversible changes. (Romans 8 v 23; Hebrews 9 v 27; Revelation 21 v 5)*

## **Separating Mixtures of Materials**

3) Pupils should be taught:

- a) How to separate solid particles of different sizes by sieving [for example, those in soil].
- b) That some solids [for example, salt, sugar] dissolve in water to give solutions but some [for example, sand, chalk] do not.
- c) How to separate insoluble solids from liquids by filtering.
- d) How to recover dissolved solids by evaporating the liquid from the solution.
- e) To use knowledge of solids, liquids and gases to decide how mixtures might be separated.

*Comment: The skill and knowledge of how to separate can be both positive and negative. The motivation behind science can be discussed here along with issues related to investigating in Sc1. Separating can be linked to good stewardship and servanthood; cooking provides good practical opportunities for many of the aims to be addressed.*

## Sc4- Physical Processes

### Electricity

1) Pupils should be taught:

#### Simple Circuits

- a) To construct circuits, incorporating a battery or power supply and a range of switches, to make electrical devices work [for example, buzzers, motors].
- b) How changing the number or type of components [for example, batteries, bulbs, wires] in a series circuit can make bulbs brighter or dimmer.
- c) How to represent series circuits by drawings and conventional symbols, and how to construct series circuits on the basis of drawings and diagrams using conventional symbols.

*Comment: All energy, as well as all matter, originates in God. (**Genesis 1 v 3**) The responsible and safe use of such energy is part of good stewardship of creation. Analogies can be readily drawn from this topic, such as how we can allow God's power to flow through us. (**1 Kings 18 v 46; Mark 5 v 30**) Electricity can also be seen as a wonderful gift, leading us to worship. The ability to communicate through diagrams is part of investigative skills 2h.*

### Forces and Motion

2) Pupils should be taught:

#### Types of Force

- a) About the forces of attraction and repulsion between magnets, and about the forces of attraction between magnets and magnetic materials.

*Comment: This can demonstrate well the invisibility of some forces and can lead to worship and understanding of the invisible God. (**Colossians 1 v 15-16; Romans 1 v 20**) Spiritual analogies of attraction and repulsion can also be drawn on here e.g. temptation, spiritual 'sensing' etc...*

- b) That objects are pulled downwards because of the gravitational attraction between them and the Earth.

*Comment: The example of Isaac Newton's theories as a God-fearing scientist, fit in well here. Gravity is very hard to understand scientifically and so can be another opportunity to be in wonder at God's universe. (**Job 11 v 7**)*

- c) About friction, including air resistance, as a force that slows moving objects and may prevent objects from starting to move.
- d) That when objects [for example, a spring, a table] are pushed or pulled, an opposing pull or push can be felt.

*Comment: Overcoming forces in order to move, can lead to discussions and analogies of the hindering nature of sin, spiritual battle and the power of prayer. (**Daniel 9, 10; Hebrews 12v 1**)*

f) How to measure forces and identify the direction in which they act.

*Comment: Honesty in measuring can be encouraged here (**Proverbs 12 v 17**) Detailed observations can lead us to a greater understanding of God and His leading (**Psalms 37 v 25**). Understanding the direction and strength of forces can help us to be good stewards of creation and to act safely e.g. safe carrying of weight.*

## Light and Sound

3) Pupils should be taught:

### Everyday Effects of Light

- a) That light travels from a source.
- b) That light cannot pass through some materials, and how this leads to the formation of shadows.
- c) That light is reflected from surfaces [for example, mirrors, polished metals].

*Comment: God created light in all its beauty, and He is the source of all energy. Many obvious scriptural analogies can be found to link in here, especially that light always overcomes darkness. (**John 1; John 8 v 12**) Shadows can be used as a spiritual analogy of places 'hidden' from God. (**1 Corinthians 3 v 13; Luke 1 v 79**) Our ability to reflect God's glory (**2 Corinthians 3 v 18**) and consideration of poor reflections (**1 Corinthians 13 v 12**) are other possible links to spiritual principles.*

### Seeing

d) That we see things only when light from them enters our eyes.

*Comment: The wonder of the eye, its structure and function, is an excellent opportunity to lead into worship and to expose problems with an evolutionary view of origins; namely intermediate steps for eyes would be unusable.*

### Vibration and Sound

- e) That sounds are made when objects [for example, strings on musical instruments] vibrate but that vibrations are not always directly visible.
- f) How to change the pitch and loudness of sounds produced by some vibrating objects [for example, a drum skin, a plucked string].
- g) That vibrations from sound sources require a medium [for example, metal, wood, glass, air] through which to travel to the ear.

*Comment: God's invisibility can be linked with the predominantly invisible transfer of sound through waves. God's love for and creation of music and a variety of sounds is evident from scripture. This leads us to desire to use our ability in making sounds to glorify Him, and also guides us into ruling the kinds of things we listen to so that they are edifying (**1 Samuel 10 v 5; Revelation 5; Zephaniah 3 v 17**). The wide range of sounds, audible to humans and inaudible, can lead to discussions of God's love of variety.*

## The Earth and Beyond

4) Pupils should be taught:

### The Sun, Earth and Moon

a) That the Sun, Earth and Moon are approximately spherical.

### Periodic Changes

b) How the position of the Sun appears to change during the day, and how shadows change as this happens.

c) How day and night are related to the spin of the Earth on its own axis.

d) That the Earth orbits the Sun once each year, and that the Moon takes approximately 28 days to orbit the Earth.

*Comment: God as creator should be emphasised here (**Genesis 1 v 14-16; Job 9 v 8-10; Psalm 8 v3-4**). His sovereignty, faithfulness, power, provision and many other aspects of His character can be linked to this work. The patterns of time are ordained by God, yet He is able to overrule them (**Joshua 10 v 12-13**).*

## Breadth of Study

**The breadth of study statements for KS1 and KS2 are the same.**

Breadth of study

1) During the key stage, pupils should be taught the **Knowledge, skills and understanding** through:

a) A range of domestic and environmental contexts that are familiar and of interest to them.

b) Looking at the part science has played in the development of many useful things.

c) Using a range of sources of information and data, including ICT based sources.

d) Using first hand and secondary data to carry out a range of scientific investigations, including complete investigations.

2) During the key stage, pupils should be taught to:

### Communication

a) Use appropriate scientific language and terms, including SI units of measurement [ for example, metre, newton] , to communicate ideas and explain the behaviour of living things, materials, phenomena and processes.

## Health and Safety

- b) Recognise that there are hazards in living things, materials and physical processes, and assess risks and take action to reduce risks to themselves and others.

*Comment: All aspects of the breadth of study aims should be covered very naturally as part of the other areas of learning. This does attempt to bring more of a holistic view, yet without including the omnipresent God. Communication and the good stewardship considerations of health and safety are clearly applicable here, as has been mentioned in comments throughout. Using the knowledge, skills and understanding of Science in investigations, and environmental or domestic settings, is part of the Hebrew understanding of wisdom; godly knowledge, skills and understanding applied practically to life (**Proverbs 1-2**). However, Science has not only provided us with useful things (1b) but has also given us problems and side-effects due to the ungodliness of some of its application (pollution, global warming, abortion, money driven drug companies and health care, addictions). 'Knowledge apart from God' will often result in sinful, selfish actions.*

## Science Levels

The levels given at the back of the NC document are an attempt to provide guidance for looking at how well children are attaining, in terms of meeting the objectives concerned. By the end of KS1 it would be expected that the average child should achieve level 2. Level 4 should be reached, by the end of KS2. There should be roughly 1 level improvement every 2 years. Optional and end of Key Stage tests help to determine the level at which a child is working. As a Christian teacher of the NC in a state school, although other aims should be at the heart of the teaching, one would still need to demonstrate that the basic learning had been accomplished alongside the more godly principles. In Christian schools teaching the NC, decisions should be made as to how children should be assessed given that adjustments have been made in line with teaching Christian principles. The assessment of whether or not this additional knowledge and understanding has been learnt, is also important. A place to begin would be to ask the question, what would we expect an average child at the end of KS1 or KS2 to understand from our Science teaching, beyond that expected by the NC? This would then help clarify the Christian distinctiveness of the teaching in the school and encourage agreement between staff as to what would be achievable by the majority of the children as they mature.

## Ideas for planning

As a Christian teacher of the NC, any unit (group of lessons) of teaching on Science should be approached prayerfully and with biblical study. I would suggest some personal time reflecting on which aspects of godly wisdom the Holy Spirit would highlight to you. The next area would be to look at how these aims would be met progressively through the sequence of lessons, each lesson consolidating or building on the previous lesson. I would then decide how I, as the teacher, would be able to tell that the children had achieved these aims. Finally, the practicalities of the methods of teaching (investigation, demonstration, grouping, individual work, drama, story telling, resources) should be prayerfully chosen, in the expectancy that God will inspire creativity and life in what is planned. This would broadly follow the 'Way, Truth, Life' model; the Truth being the truth being taught (aims), the Life being the resulting achievement (target) and the Way being the methods chosen.

Each teacher needs to find an effective way of planning for themselves, that is easy to use by the teacher and clear enough for others to follow. All planning however should be subject to new inspiration from God and should never be seen as a rigid unchangeable structure.

## **Conclusion**

A godly teaching of Science must involve the creativity of the Creator. Planning, with whatever curriculum material, must be done with Him. Setting the aims for learning must be done with Him. The act of teaching itself must be done with Him, in Him and through Him. An increasing understanding of the confusion in fallen men's minds, can help us recognize where the enemy has sown his lies. But more importantly an increasing biblical understanding with the help of the Holy Spirit, should keep Christian teachers in the truth, so that their teaching reflects the Creator, bringing Him glory and guiding our learners to do the same.

**Stephen Beegoo 2004**