Science Teachers Association NSW Position Paper on ACARA Curriculum version 9.0

Executive Summary

The Science Teachers Association of NSW (STANSW) seeks to advance science education in NSW through the provision of quality professional development, information and advocacy for primary and secondary science educators. A strong science education is essential so that every school student has an understanding of the core concepts and the nature and practice of science, particularly the ability to think scientifically. We aspire to a society founded on the development of scientific language, logic and problem solving producing scientifically literate adults.

In May 2022, Education Ministers endorsed Version 9.0 of the F-10 Australian Curriculum, updated as a result of the review undertaken by ACARA in 2020-2022. The review sought to improve the curriculum from Foundation to Year 10 by refining, realigning and decluttering the content of the Australian Curriculum. The Science Teachers Association NSW believes this is commendable and we acknowledge the various considerations in undertaking this review.

This paper was developed by a STANSW Think Tank comprising classroom teachers and academics, established to review the curriculum, identify strengths and areas of concern, and provide recommendations to NESA for the new NSW syllabus.

Priority areas of concern identified by the Think Tank include:

- There is a trend of content being introduced prior to appropriate scaffolding of concepts. Well-established empirical evidence demonstrates that building conceptual understanding at developmentally appropriate stages is foundational to sound understanding. We have tried to address this in the tables below.
- There is a trend of content being introduced at earlier ages, prior to the stage at which students are developmentally capable of understanding the concepts. For example, particle theory has been introduced in year 5, and while research supports this, teaching particle theory to students of this age will not be effective without appropriate conceptual depth. In addition, the Solar System is introduced in Year 2 where students lack understanding of large distances and required spatial concepts.
- Evidence indicates that developing an understanding of the concept of energy is not linear, rather it develops interconnectedly. Thus, there needs to be a level of increasing complexity and sophistication from primary through to senior school. Primary teachers need to focus on phenomenological ideas about a wide range of energy concepts that exist in their lives. Middle school then build on these basics with links between these concepts and real-world phenomenon and the abstract energy concepts including atomic and molecular explanation saved for senior students. **Source: Journal of Research in Science Teaching, LEARNING PROGRESSION FOR ENERGY IDEAS 91.**

1 Primary Science

Vision

To develop students who question the world around them, observe things happen, and find out why.

Feedback regarding the ACARA 9.0 curriculum Primary

Primary school science is about inspiring students' interest and excitement in the world around them through careful observation, collecting data, testing ideas and so on. The curriculum needs to provide opportunities for many hands-on investigations related to local scenarios.

Overall, Primary Science in the ACARA Curriculum v9.0 does not have enough opportunity to build scientific conceptual understanding. Students will progress into high school without the foundational science vocabulary and skills necessary to be successful.

ACARA curriculum V9.0	**Comments**	**Suggestions for wording or Recommendations**
Year 2 Earth and Space Recognise Earth is a planet in the solar system and identify patterns in the changing position of the sun, moon, planets and stars in the sky (AC9S2U01)	Make it an observational activity.	Recognise Earth is a planet and identify patterns in the changing position of the sun, moon, planets and stars in the sky (AC9S2U01)
Year 2 Physical Science Explore different actions to make sounds and how to make a variety of sounds, and recognise that sound energy causes objects to vibrate (AC9S2U02)	Sound energy is a vibration.	Explore different actions to make sounds and how to make a variety of sounds, and recognise that sound energy is a vibration and may cause objects to vibrate (AC9S2U02)
Year 3 Biology Compare characteristics of living and non-living things and examine the differences between the life cycles of plants and animals (AC9S3U01)	Emphasise basic needs (air, water, energy source, warmth) then movement (currently stage 2 NSW) then life cycle Do not include the mechanics of reproduction (e.g. fertilisation, pollination)	Examine features of living things and how they grow and change over time through life cycles.

Year 3 Chemical A change of state between solid and liquid can be caused by adding or removing heat (ACSSU046)	Only use liquid water and solid water (ice). Need to include L<->G if doing water cycle in year 4	Year 3 Chemical A change of state between solid, liquid and gas can be caused by adding or removing heat for water (ACSSU046)
Year 4 Biology Explain the roles and interactions of consumers, producers and decomposers within a habitat and how food chains represent feeding relationships (AC9S4U01)	Food chains do not show feeding relationships (energy flow will cause confusion with physics)	Year 4 Biology Explain the roles and interactions of consumers, producers and decomposers within a habitat and how food chains represent the flow of energy (AC9S4U01)
Year 4 E&S Identify sources of water and describe key processes in the water cycle, including movement of water through the sky, landscape and ocean; precipitation; evaporation; and condensation (AC9S4U02)	There has been no content on change of state from liquid to gas. Add gas to year 3 chemical	
Year 5 Biology Examine how particular structural features and behaviours of living things enable their survival in specific habitats (AC9S5U01)	Avoid any reference to adaptations and evolution.	Examine how a range of living things have structural features and behaviours that help them to survive in local Australian and global habitats.

Year 5 Earth and Space Describe how weathering, erosion, transportation and deposition cause slow or rapid change to Earth's surface (AC9S5U02)	Remove weathering because it's too confusing (physical, biological and chemical aspects) ...	Describe how erosion (including transportation and deposition) cause slow or rapid change to Earth's surface (AC9S5U02)
Year 6 Biology Investigate the physical conditions of a habitat and analyse how the growth and survival of living things is affected by changing physical conditions (AC9S6U01)	Include elaborations that link to socio-scientific issues such as impact of drought, fire on human health or rural regional issues.	Identify the physical conditions of an outdoor ecosystem and investigate how the growth and survival of living things is affected by changing physical conditions (AC9S6U01)
Year 6 Chemical Compare reversible changes, including dissolving and changes of state, and irreversible changes, including cooking and rusting that produce new substances (AC9S6U04)	Cooking is very ambiguous. Where would mixing fit? It would be good to see clear distinction between change of state and a physical change and the production of a new substance. E.g. Melting chocolate is a physical change not a change of state. Whipping cream is a new substance, melting ice cream cannot be reversed.	Compare reversible changes, including dissolving, and change of state; and irreversible changes that produce new substances including rusting and cooking (AC9S6U04)

Feedback regarding the NSW K-6 Syllabus

1. **Physical world** – regarding forces in stage 2-3, clarification is needed regarding what should be done in each stage and the details in stage 3 (i.e. types of forces is more appropriate for stage 2. Stage 3 is more about increasing or decreasing forces - possibly simple machines). Both Early Stage 1 and Stage 1 contain information about push and pull; further clarity is needed on how they differ.
2. **Physical world** - renewable and non-renewable energy sources could be linked to electrical energy generation as a natural opportunity for students to debate ethical issues of electrical energy sources (e.g. coal and gas versus renewable energy). This would be an authentic opportunity to look at real science implications.
3. **Physics** – There is an opportunity for teachers to relate force and energy; for example, through the inclusion of a statement such as "all things have energy'.
4. Continued use of the terms 'energy of movement' and 'stored energy' in primary, and avoidance of complex scientific terminology, is appropriate.
5. **Chemistry** - Stages 2-3 could be clearer on which content is and is not appropriate around properties of L,S,G. We recommend keeping changes of state in Stage 3, so gases can then be introduced.
6. **Chemistry** – We recommend changing the term 'properties of materials' to 'characteristics of materials'. This is because 'properties' requires a deep understanding of atoms.
7. We recommend separate the ideas of physical change versus a new substance being produced and change of state.
8. **Living World** – We recommend changing the term 'adaptations' to 'features', in order to remove the link of adaptations to an individual.

2 Year 7-10 Biology

Vision

To prepare students to become scientifically literate adults who can respond to societal and environmental concerns with a critical scientific viewpoint. To be a solid science foundation for

students as they enter stage 6 elective sciences for either a tertiary science career or for personal interest and awareness in science.

Feedback regarding ACARA 9.0 curriculum

ACARA curriculum V9.0 Biology	**Comments**	**Suggestions or recommendations**
Year 7 use models, including food webs, to represent matter and energy flow in ecosystems and predict the impact of changing abiotic and biotic factors on populations	Food chains will have to be introduced again (covered in primary) to allow students to create food webs from first hand data. Students incorrectly believe all animals placed higher in a food chain is a predator of all others placed below it so adding the food chain at the same time as building the food web will help alleviate this problem (Allen, 2010)	use models, including food chains and food webs, to represent matter and energy flow in ecosystems and predict the impact of changing abiotic and biotic factors on populations
Year 8 analyse the relationship between structure and function of cells, tissues and organs in a plant and an animal organ system and explain how these systems enable survival of the individual	The organ systems that need to be covered could be split up between years 8 and 9. Refer to endocrine and nervous system specifically in year 9.	Describe the relationship between structure and function of cells, tissues and organs in a plant and an animal organ system and explain how these systems enable survival of the individual AC9S8U02

	Analysing the structure and function of cells in year 8 is what we do in year 11 Biology. The verb should be describe, not analyse.	
Yer 9 compare the role of body systems in regulating and coordinating the body's response to a stimulus, and describe the operation of a negative feedback mechanism	Instead of negative feedback focus on the students' understanding the concept of balance.	compare the role of body systems, including nervous and endocrine, in regulating and coordinating the body's response to a stimulus, and describe the that a balance needs to be maintained.
Year 10 explain the role of meiosis and mitosis and the function of chromosomes, DNA and genes in heredity and predict patterns of Mendelian inheritance	The latest thinking is that Mendelian thinking is problematic and that the only monogenic trait is ear wax. Punnet squares are to be used as a tool for predicting inheritance patterns and most traits are polygenic so leave Punnet squares for year 12.	explain the role of meiosis and mitosis in plant and animal lifecycles and the function of chromosomes, DNA and genes in heredity.
	Ecosystems is missing, and it is unclear whether this is now covered in geography	Introduce in year 6

	Diseases have been removed	Include socio-scientific issues as possibilities to introduce disease.

3 Year 7-10 Physics

Vision

To enable students to understand physical phenomena in the world around us.

Feedback regarding ACARA 9.0 curriculum

ACARA curriculum V9.0 Physics	**Comments**	**Suggestions or recommendations**
Year 7 investigate and represent balanced and unbalanced forces, including gravitational force, acting on objects, and relate changes in an object's motion to its mass and the magnitude and direction of forces acting on it AC9S7U04	If this refers to newton's third law, this is not appropriate for year 7, as it's conceptually demanding and quantitative. Direction of forces is also already in K-6, so if vectors are not introduced, this is a repetition.	
	Year 9 is very content heavy, particularly as sound and	Possibility that AC9S8U05 could go to year 7, then AC9S9U04 in year 8

	heat are two distinct concepts.	*or* move AC9S9U05 to year 8, to allow for the time for sound and heat to be sufficiently addressed
	Language change is recommended to prevent overdoing a concept.	Specifically, 'transfer' and 'transformation' that refer to different things (sound, heat, electrical circuits, etc.). E.g., simple 'mechanical' systems. Energy transfer = transfer of energy through waves or heat transfer

4 Year 7-10 Chemistry

Vision

For students to develop an appreciation and understanding of chemistry for their life experiences.

Feedback regarding ACARA 9.0 curriculum

ACARA curriculum V9.0 Chemistry	**Comments**	**Suggestions or recommendations**
Year 7 use particle theory to describe the arrangement of	Include the word force to refer to the attraction between particles.	use particle theory to describe the arrangement of particles in a substance, including the

particles in a substance, including the motion of and attraction between particles, and relate this to the properties of the substance AC9S7U05		motion of and forces of attraction between particles, and relate this to the properties of the substance AC9S7U05
Year 7 use a particle model to describe differences between pure substances and mixtures and apply understanding of properties of substances to separate mixtures	Further clarity is required. Does this mean properties of the elements or characteristics of the compounds?	
Year 8 classify matter as elements, compounds or mixtures and compare different representations of these, including 2-dimensional and 3-dimensional models, symbols for elements and formulas for molecules and compounds AC9S8U06	Include the word common and give some examples to prevent too much depth. e.g. water, salt, carbon dioxide, oxygen.	classify matter as elements, common compounds or mixtures and compare different representations of these, including 2-dimensional and 3-dimensional models, symbols for elements and formulas for common molecules and compounds AC9S8U06
Year 8 compare physical and chemical changes and	What does this mean? Does it mean indicators of the chemical change occurring?	compare physical and chemical changes and identify

identify indicators of energy change in chemical reaction	Does it refer to take in or give out heat energy? What about the other indicators of a chemical change? It is too early for exothermic and endothermic or enthalpy. At this age students are still working concretely; indicators of a chemical change are enough.	indicators of change in chemical reactions
Year 9 model the rearrangement of atoms in chemical reactions using a range of representations, including word and simple balanced chemical equations, and use these to demonstrate the law of conservation of mass	Move to year 10 the part about simple balanced equations.	
Year 9 explain how the model of the atom changed following the discovery of electrons, protons and neutrons and describe how natural radioactive decay results in stable atoms	Best to link to year 10 study of the PT so the significance of the atomic structure can build into the concept of radioisotopes and radiation. Only do this at a basic level with limited need to venture into the types of radiation	

	unless as an elaboration or extension for students progressing to stage 6.	
	Year 10 need to study neutralisation to have an understanding for life.	
	Overall, there are concerns about the conceptual challenges of some of the work pulled from Year 11 (traditionally) to Year 9. The syllabus is very content heavy if done properly, with concepts that are very abstract and require reasoning across multiple modes of representation.	

5 Year 7-10 Earth and Space

Vision

To develop students' use of inquiry to learn about the world in which they live, to think scientifically, to question and to analyse.

Feedback regarding ACARA 9.0 curriculum

ACARA curriculum V9.0 Chemistry	Comments	Suggestions or recommendations
Year 7	Teaching the Solar system in year 2 and then jumping to day and night in year 6 is too big a gap. We suggest moving the solar system to year 7, as it is an abstract concept in time and space that is beyond year 2. Students need to be able to understand large numbers in order to understand the distances between planets. A model of the solar system without the relative distances is causing alternate conceptions.	
	Current links between year 6 space and 7 space is good.	
	There is a huge gap in astronomy from year 7 to year 10 and they are unrelated topics so there is no conceptual flow.	
Year 8 formation of geological features at divergent, convergent and transform	Year 8 are not ready to study plate tectonics and it is best left in year 9.	

plate boundaries and describe the scientific evidence for the theory of plate tectonics		
Year 8 describe the key processes of the rock cycle, including the timescales over which they occur, and examine how the properties of sedimentary, igneous and metamorphic rocks reflect their formation and influence their use	Does this mean properties or characteristics of rocks?	
Year 9 represent the carbon cycle and examine how key processes including combustion, photosynthesis and respiration rely on interactions between Earth's spheres (the geosphere, biosphere, hydrosphere and atmosphere)	This is too big for year 9. Combustion needs to be in chemistry and leave it to teachers to put into context. The point needs to be simplified.	
Year 10	There needs to be something about other astronomical features e.g. comets,	Add other astronomical features to year 9 as a continuum for space content.

	galaxies. Astronomy is often taught at the end of year 10.	
	Year 11 needs some preparation in year 10 in order to study parabolic motion, gravitational forces e.g. Newton's law of universal gravitation which is not in the physics year 10	Add Newtons law of universal gravitation

6 Year 7-10 Working Scientifically

Feedback regarding ACARA 9.0 curriculum

ACARA curriculum V9.0 WS	**Comments**	**Suggestions or recommendations**
The same outcome across all 4 years.	Will teachers have to develop their own continuum to encourage a building of complexity in scientific thinking?	
plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying variables and assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising	We suggest adding 'as appropriate'	plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying variables and assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising

key considerations regarding heritage sites and artefacts on Country/Place AC9S7I02		key considerations regarding heritage sites and artefacts on Country/Place as appropriate AC9S7I02

In conclusion

The Science Teachers Association of NSW welcomes the opportunity to work in partnership with NESA to further consult and optimise the new science syllabi. The Science Teachers Association NSW is a cross-sectoral organisation and is well-placed to support teachers in implementing the syllabus and advise on issues of concern.