Year 10 ACARA – Science B Unit 2: ENERGY AND SUSTAINABLE SYSTEMS

The program includes the SCSA (School Curriculum and Standards Authority) content, 21CLD elements (self-regulation, knowledge construction, ICT and skillful communication), study skills and 'Habits of Mind' skills

Science Content Descriptions

Science Understanding

Earth and Space Sciences/Biological Sciences

Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere (ACSSU189)

1. Investigating how human activity affects global systems
2. Modelling a cycle, such as the water, carbon, nitrogen or phosphorus cycle within the biosphere
3. Explaining the causes and effects of the greenhouse effect
4. Investigating the effect of climate change on sea levels and biodiversity
5. Considering the long-term effects of loss of biodiversity
6. Investigating currently occurring changes to permafrost and sea ice and the impacts of these changes
7. Examining the factors that drive the deep ocean currents, their role in regulating global climate, and their effects on marine life

Chemical Sciences

Different types of chemical reactions are used to produce a range of products and can occur at different rates (ACSSU187)

1. investigating how chemistry can be used to produce a range of useful substances such as fuels, metals and pharmaceuticals
2. predicting the products of different types of simple chemical reactions
3. using word or symbol equations to represent chemical reactions
4. investigating the effect of a range of factors, such as temperature and catalysts, on the rate of chemical reactions

Physical Sciences

Energy conservation in a system can be explained by describing energy transfers and transformations (ACSSU190)

1. Recognising that the Law of Conservation of Energy explains that total energy is maintained in energy transfer and transformation
2. Recognising that in energy transfer and transformation, a variety of processes can occur, so that the usable energy is reduced and the system is not 100% efficient
3. Using models to describe how energy is transferred and transformed within systems

Science as a Human Endeavour

The nature and development of Science

Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community (ACSHE191)

1. Considering the role of science in identifying and explaining the causes of climate change

Use and influence of science

People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions (ACSHE194)

1. Describing how science is used in the media to explain a natural event or justify people's actions.
2. Considering the scientific knowledge used in discussions relating to climate change.
3. Evaluating claims relating to environmental footprints.

Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities (ACSHE195)

1. Recognising that scientific developments in areas such as sustainable transport and low-emissions electrical generation require people working in a range of fields of science, engineering and technology.

The values and needs of contemporary society can influence the focus of scientific research (ACSHE230)

1. Investigating technologies associated with the reduction of carbon pollution, such as carbon capture.
2. Considering innovative energy transfer devices, including those used in transport and communication.
3. Investigating the use and control of CFCs based on scientific studies of atmospheric ozone.
4. Recognising that financial backing from governments or commercial organisations is required for scientific developments and that this can determine what research is carried out.

Science Inquiry Skills

Questioning and predicting

Formulate questions or hypotheses that can be investigated scientifically (ACSIS198)

1. Developing hypotheses based on well-developed models and theories.
2. Using internet research to identify problems that can be investigated.

3. Formulating questions that can be investigated within the scope of the classroom or field with available resources.
4. Developing ideas from students own or others' investigations and experiences to investigate further.
5. Evaluating information from secondary sources as part of the research process

Planning and conducting

Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS199)

1. Using modelling and simulations, including using digital technology, to investigate situations and events.
2. Deciding how much data are needed to produce reliable measurements.

Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (ACSIS200)

1. Identifying where human error can influence the reliability of data.

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS203)

1. Using spreadsheets to present data in tables and graphical forms and to carry out mathematical analyses on data.
2. Describing sample properties (such as mean, median, range, large gaps visible on a graph) to predict characteristics of the larger population, acknowledging uncertainties and the effects of outliers.
3. Exploring relationships between variables using spreadsheets, databases, tables, charts, graphs and statistics

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS204)

1. Constructing a scientific argument showing how their evidence supports their claim.

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS205)

1. Identifying alternative explanations that are also consistent with the evidence.

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS208)

1. Constructing evidence based arguments and engaging in debate about scientific ideas.
2. constructing evidence based arguments and engaging in debate about scientific ideas
3. presenting results and ideas using formal experimental reports, oral presentations, slide shows, poster presentations and contributing to group discussions
4. Using a range of representations, including mathematical and symbolic forms, to communicate science ideas

LINKS TO SENIOR EARTH AND ENVIRONMENTAL SCIENCE /BIOLOGICAL / CHEMICAL /PHYSICAL SCIENCE COURSES

Earth and Environmental Science

1. Understand how theories and models have developed based on evidence from multiple disciplines; and the uses and limitations of Earth and environmental science knowledge in a range of contexts
2. Use science inquiry skills to collect, analyse and communicate primary and secondary data on Earth and environmental phenomena; and use these as analogues to deduce and analyse events that occurred in the past.
3. Communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres.
4. Understand how energy is transferred and transformed in Earth systems, the factors that influence these processes, and the dynamics of energy loss and gain.
5. Understand how energy transfers and transformations influence oceanic, atmospheric and biogeochemical cycling.
6. Understand how theories and models have developed based on evidence from multiple disciplines; and the uses and limitations of Earth and environmental science knowledge in a range of contexts.
7. Evaluate, with reference to empirical evidence, claims about energy transfers and transformations between and within Earth systems.
8. Understand the difference between renewable and non-renewable Earth resources and how their extraction, use, consumption and disposal impact Earth systems.
9. Understand how renewable resources can be sustainably extracted, used and consumed at local, regional and global scales.
10. Understand how models and theories have developed over time; and the ways in which Earth and environmental science knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts.
11. Understand the causes of Earth hazards and the ways in which they impact, and are impacted by, Earth systems
12. Understand how environmental change is modelled, and how the reliability of these models influences predictions of future events and changes

13. Understand how models and theories have developed over time; and the ways in which Earth and environmental science knowledge interacts with social, economic, cultural and ethical considerations in a range of contexts
14. Evaluate, with reference to empirical evidence, claims about Earth hazards and related impacts on Earth systems and justify evaluations
15. Communicate Earth and environmental understanding using qualitative and quantitative representations in appropriate modes and genres.

Biology

1. Understand that the structure and function of cells and their components are related to the need to exchange matter and energy with their immediate environment
2. Understand that multicellular organisms consist of multiple interdependent and hierarchically-organised systems that enable exchange of matter and energy with their immediate environment
3. Understand how the structure and function of the human body maintain homoeostasis.

Chemistry

1. Understand the concept of enthalpy, and apply this to qualitatively and quantitatively describe and explain energy changes in chemical reactions
2. Understand how the presence of functional groups and the molecular structure of organic compounds are related to their properties
3. Understand addition, condensation and oxidation reactions, and predict the products of these reactions
4. Understand how knowledge of chemical systems is used to design synthesis processes, and how data from analytical techniques provides information about chemical structure

Physics

1. Understand how the nuclear model of the atom explains radioactivity, fission, fusion and the properties of radioactive nuclides
2. Use algebraic and graphical representations to calculate, analyse and predict measurable quantities associated with heating processes, nuclear reactions and electrical circuits
3. Evaluate, with reference to empirical evidence, claims about heating processes, nuclear reactions and electrical technologies
4. Communicate physics understanding using qualitative and quantitative representations in appropriate modes and genres.

2020 Year 10 ACARA Science B: Sustainable Systems of Energy Module Two: Chemistry (Part One), Physics (Part Two), Earth and Space Science / Biology (Part Three)

Big Picture:

Modern Humans have been on the planet for a significant amount of time. They have learnt how to use energy and they have modified their environment to sustain their increasingly complex lives. The need and use of energy brings its own complexities, so an understanding is needed to formulate reasoned positions for the production and consumption of energy. Students need to understand how energy is used in everyday life, how it is consumed both directly and indirectly. They will explore how energy flows through a system and how the resources are recycled and the processes involved. They will assess and evaluate the impact of chemical weathering and deposition, as well as ocean acidification. How sustainable are the systems we use to harness energy? What are the alternatives?

Wk	Theme	Concepts / Content	Student objectives	Skills T = taught for 1st time R = reinforced	RESOURCES / ASSESSMENT/ PRACTICALS iSc10 = iScience Book 3, Ch 6 & 8
1 - 2	**Term 3 Weeks 1 & 2** Energy Consumption & Fossil Fuels	1. Introduction to the use of energy in everyday life. 2. Use of energy directly. 3. Use of energy indirectly. 4. Fossil fuels 5. Combustion of oil, gas and coal. 6. Changes in energy release. 7. Changing carbon concentrations. 8. Atmospheric changes leading to global warming.	1. State what energy is. 2. Describe what is meant by energy consumption. 3. Explain how energy is used in everyday life. 4. Describe the direct use of energy in everyday life, e.g. lighting heating, fuel for transport etc. 5. Describe how energy is consumed indirectly. 6. Explain how indirect consumption of energy is associated with the production of consumer goods, energy required to build homes and infrastructure, energy for transporting goods and growing food etc. 7. Compare direct and indirect use of energy in everyday life. 8. Review what is meant by a fossil fuel (coal, crude oil, natural gas). 9. Explain what happens to the concentration of CO_2 in the atmosphere with the burning of fossil fuels. 10. Describe the greenhouse effect using ideas about energy and radiation: ○ Earth's surface absorbs visible light from sun, temp increases, emits infrared radiation. ○ Greenhouse gases (including CO_2) absorb infrared and gain vibrational energy which	Study skills: Research and referencing. (Using APA style) (R) 21CLD: Self-regulation (*component for this is under construction and may include knowledge construction as well.)* *ICT Simulation Greenhouse effect https://phet.colorado.edu/sims/cheerpj/greenhouse/l*	RESOURCES • Notes in Energy Consumption folder on Connect. • Watch the documentary Crude: https://www.youtube.com/watch?v=e44ydPIQGSc (1:29:30). If low on time, use as homework task. ALSO FOUND in M drive! • iSci10, Chapt. 6 • http://needtoknow.nas.edu/energy/energy-use/ • http://needtoknow.nas.edu/energy/energy-use/home-work/ • http://www.energykids.eu/ • Simulator to show interaction of radiation and different molecules: https://phet.colorado.edu/sims/html/molecules-and-light/latest/molecules-and-light_en.html

			increases kinetic energy therefore temp of atmosphere. 11. Name common greenhouse gases (CO_2, CH_4, N_2O, CFCs & HFCs) 12. Describe some effects of the greenhouse effect (local and global). **Extension** 13. Reflect on the efficiency of energy use directly and indirectly. 14. Theorise about some of the problems we face in the future if we don't use energy more efficiently. 15. Study the graphs on this site: http://www.skepticalscience.com/global-cooling-january-2007-to-january-2008-intermediate.htm ○ What do you think the graphs mean? ○ DO they present evidence of climate change? If so, how? What other conclusions could be drawn. **Enrichment** 16. Describe what carbon capture is and how it could reduce atmospheric carbon dioxide. 17. Conduct an energy survey to identify how much energy you or your household use. 18. Reflect on some of the practices you could do to use less energy. 19. Construct a consequences wheel for global warming. Put the phrase "global warming" in the centre of the middle circle of the wheel. In the next circle out, write "rise in average world temperature." Consider the impact of this and write them down in the second layer of circles. Fill in other ideas that result from "global warming" in the inner circles leading to the outer circles.	*atest/greenhouse.html?simulation=greenhouse* 21CLD/ICT: Students use an online game resource for construction of knowledge.	ASSESSMENT • Worksheets and homework as part of teacher mark. (5%) PRACTICALS • https://fuse.education.vic.gov.au/pages/View.aspx?id=694b44cb-955f-4da0-9d31-359310622bea (Interactive energy game with tasks)

3	**<u>Term 3 Weeks 3 & 4 (part of week 4 only)</u>** Organic Chemistry	• Carbon bonding. • Alkanes, alkenes, alkynes, cyclic hydrocarbons. • Naming of hydrocarbons using IUPAC • Isomerism • General equations for combustion.	1. State what organic chemistry is. 2. Explain how fractional distillation works and describe how it is used to separate different substances within crude oil based on their boiling points, using ideas about evaporation and condensation. 3. Recognise homologous series of hydrocarbons: alkanes, alkenes, alkynes, cycloalkanes, cycloalkenes. 4. State what a functional group is and recognise functional groups of the homologous series listed above. 5. Use general formulae to recognise members of homologous series. 6. State what a saturated hydrocarbon is. 7. State what an unsaturated hydrocarbon is. 8. Write the names of hydrocarbons using the IUPAC naming system for substances with up to 8 carbons in the parent chain (straight and branched alkanes and alkenes, *simple only (no branches): cycloalkanes, cycloalkenes, alkynes*) 9. Describe the molecular, condensed and structural formulae of hydrocarbons with up to 8 carbons in the parent chain. 10. Use given information to predict names of hydrocarbons and infer molecular, condensed and structural formulae. 11. Draw and identify structural isomers for hydrocarbons, including chain isomers and position isomers. 12. Use IUPAC naming system to write names for structural isomers, using naming convention for alkyl groups and numbering system for position of substituents. 13. Define terms viscosity, volatility and flammability in relation to hydrocarbons. 14. Describe the trends in physical properties of hydrocarbons (melting point and boiling point, viscosity, volatility, flammability). 15. Predict the outcome of combustion reactions of hydrocarbons (complete and incomplete). 16. Write and balance molecular equations for complete combustion reactions of hydrocarbons.	21CLD/ICT – Use an online resource to visualise organic molecules in 3D. *molview.org*	<u>RESOURCES</u> • Notes in Organic Chemistry folder on Connect. • SPICE Organic Chemistry • SPICE molecule formation. • Fractional distillation video: http://splash.abc.net.au/home#!/media/106300/?source=secondary-science <u>ASSESSMENT</u> • Worksheets and homework as part of teacher mark. (5%) <u>PRACTICALS</u> • Distillation DEMO: Distil mixture of coloured water and ethanol (See technicians for support) • Fractions from crude oil DEMO: Test properties of “fractions” – colour, viscosity, ease of lighting, smokiness of flame (See sheet in resources folder, and technicians for support) • Molymod to support understanding of hydrocarbons.

			Extension 17. Describe and give examples of functional group isomers as a category of structural isomers. 18. Describe geometric isomers and give examples of them. How do they differ from structural isomers? How does the geometry affect the properties of hydrocarbons? **Enrichment** 19. Research the aromatic hydrocarbons and how they are used in industry.		
4 - 5	**<u>Term 3 Weeks 4 (part) & 5</u>** Energy Changes	• Energy changes in reactions. • Energy profile diagrams. • Catalysts.	1. State what is meant by endothermic and exothermic reactions. 2. Describe the energy changes (ΔH) that occur during endothermic and exothermic reactions using +/-. 3. Use the terms systems and surroundings to relate the energy transfer during a reaction. 4. Contrast the differences between endothermic and exothermic reactions, in terms of temperature change and energy transfer. 5. Define and describe activation energy (E_A) as the energy required for reactants to be able to react. 6. State the key features of a catalyst (increases rate of reaction, takes part in reaction but not consumed so can be reused) 7. Describe how a catalyst speeds up a chemical reaction (reduction of E_A so greater proportion of reactants can react). 8. Draw and analyse energy profile diagrams, including use of: reactants and products, ΔH positive or negative, E_a forward and reverse, transition state, with and without a catalyst. 9. Write equations for reactions that involve energy changes. 10. Identify exothermic and endothermic reactions from quantitative experimental data.	Science skills: Observation skills in practicals. Understand the difference between theory, inference & observation through practical work. Graph skills (A key Chemistry SIS skill, and the other Sciences) (R)	<u>RESOURCES</u> • Notes in Energy Changes folder on Connect. <u>ASSESSMENT</u> • Worksheets and homework as part of teacher mark. (5%) • Test on Organic Chemistry (80%) <u>PRACTICALS</u> • Exothermic and Endothermic reactions (See sheet in resources folder, and technicians for support) • **CAT: Energy released from fuels (15%) – Term 3 Week 5 (approx.) 2 periods** ○ **Students work in groups to collect experimental data from combustion reaction of fuel** ○ **Students complete short validation test assessing relevant SIS skills:** ▪ **Hypothesis and**

			11. Use data from reactions to compare fuels. **Extension** 12. Describe and explain how catalytic cracking is used to convert long chain alkanes into a range of useful products. 13. Describe the difference between homogeneous and heterogeneous catalysis. **Enrichment** 14. Research how catalysts are used to reduce emissions from vehicle engines. 15. Research what a catalyst inhibitor is, and how it effects a catalysed reaction.		**variables** ▪ **Graphing** ▪ **Use of data to draw conclusions** ▪ **Identifying and evaluating sources of error**
6–7	**<u>Term 3</u>** **<u>Weeks 6 - 10</u>** Nuclear Energy	• Bohr model. • Strong nuclear force vs. electromagnetic repulsion. • Stability of nucleus, binding energy and BE/nucleon. • Radioactive decay	1. Recall Bohr's model of the atom with a focus on the nucleus (Year 9). 2. Recall what is meant by atomic number, atomic mass, protons, neutrons (Year 9) 3. State definitions of nucleons, strong nuclear force, electromagnetic force, radioactive decay 4. Relate knowledge of strong nuclear force and (counters) electromagnetic force to the stability of nucleus. Relate binding energy to stability of a nucleus and relate to nuclei becoming radioactive. 5. Describe the different types of radiation (alpha, beta, gamma) and explain the differences between them in terms of mass, charge, speed, ionising ability and penetrating power. 6. Identify specific materials that stop the different types of radiation. 7. Write and balance nuclear reactions for radioactive decay 8. State what a half-life is and explain that different isotopes have different levels of stability. 9. Interpret half-life graphs that measure mass, number of nuclei, percentage and activity (counts per	Study skills: Learning definitions (specific, not vague) (T) Study skill: Communication in different ways (T)	<u>RESOURCES</u> • SPICE UWA: <u>Year 11-12 : The University of Western Australia (uwa.edu.au)</u> • Notes in Nuclear Physics folder on Connect. • <u>http://www.bozemanscience.com/ap-phys-003-the-nucleus</u> • <u>http://www.bozemanscience.com/ap-phys-136-radioactive-decay</u> • <u>https://www.youtube.com/watch?v=KWAsz59F8gA</u> (Crash Course Nuclear Chemistry) <u>ASSESSMENT</u> • Worksheets and homework as part of teacher mark. (5%) • **CAT: Report on nuclear issue (15%) Can be peer marked in small groups to save time** • Test on nuclear physics (80%)

			sec/becquerels) 10. Draw decay graphs given data and use the graph to calculate half-life.		
8		• Fission and fusion reactions using conservation of nucleons and charge. • Mass defect and binding energy	11. Describe what fission and fusion are and explain the differences between them. 12. Predict energy changes as a result of fission and fusion reactions. 13. Write and balance nuclear reactions for fission and fusion reactions 14. State what is meant by mass defect in a fission/fusion reaction and how it relates to the energy released in the reaction 15. Describe the relationship between mass and energy using $E = mc^2$. 16. Describe mass defect and binding energy and their relationship.		PRACTICALS • SPICE Building Atoms (Worksheet 2.2 in Nuclear Energy folder) • SPICE Decay Chain Builder (Worksheets 4.1-5.3) • SPICE Fission and Fusion Learning Objects (Worksheets 6.1-6.3)
9-10		• Nuclear power stations. Basic structure and operation.	17. Describe the main components of nuclear power stations. In particular, reactor vessel (encases and prevents radiation from escaping), the control rods (function in controlling nuclear reactions), fuel rods, steam generator (heat exchanger + turbine + generator), moderator (slows neutrons eg graphite or heavy water). 18. Explain, in simple terms, how nuclear power stations work to generate electricity. A nuclear reactor is a device in which nuclear reactions are generated, and the chain reaction is controlled to release large amount of steady heat, thereby producing energy. 19. Describe an uncontrolled reaction in terms of neutrons escaping too quickly to maintain a chain reaction, resulting in the rapid release of nuclear energy, causing an explosion. Contrast this with a controlled reaction. 20. Analyse some advantages and disadvantages of using nuclear energy to generate electricity.		• SPICE Nuclear Reactor (Extension work and worksheets) • iScience10, Unit 8, pages 1275 • Nuclear Power station parts https://chem.libretexts.org/Courses/Los_Angeles_Trade_Technical_College/Foundations_of_Introductory_Chemistry-1/1.14%3A_Nuclear_Chemistry/19.08%3A_Nuclear_Reactors • Nuclear Power stations steps https://energyeducation.ca/encyclopedia/Nuclear_power_plant Practical: Model a controlled nuclear reaction with dominoes in straight line. Model an uncontrolled nuclear reaction with dominoes in a spreading fan shape.

		•	**Extension** • Discuss how radioisotopes are used in medicine. • Perform quantitative analysis of mass defect and binding energy • Evaluate, with reference to empirical evidence, claims about heating processes, nuclear reactions and electrical technologies **Enrichment** • Research the work of Niels Bohr. • Theorise about the impact of different sources of radiation used in everyday life. • Reflect on nuclear power as an alternative energy source. What considerations would need to be made?		
<u>Human Biology & Biology:</u> Health & Disease Topic – See separate program Term 4 Weeks 1 - 5					
	<u>Term 4 Weeks 6 & 7</u> EXAMS		Exam covers all content before this point, none of the later material.		
8	**<u>Term 4 Weeks 8 & 10</u>** The Carbon Cycle	• Photosynthesis ○ Where it occurs in plants. ○ The word and chemical equations. • Respiration. ○ The transfer of chemical potential	1. Define biogeochemical cycle as a concept describing how chemical elements (e.g., nitrogen, carbon) or molecules (e.g. water) are transformed and stored by both biological and geological components in the Earth's biosphere. 2. State the main forms of carbon in carbon cycle. 3. Describe the main processes in the carbon cycle (respiration, photosynthesis, weathering, erosion, dissolving, deposition, fossilisation, extraction, volcanic eruptions, carbon fixation into carbon sinks). 4. Explain how solar energy is transformed into chemical	Science study skills: Compare and contrast questions are common in extended response questions in Biology and Human Biology. Students need to	<u>RESOURCES</u> • https://www.youtube.com/watch?v=Bn41lXKyVWQ Bozeman science- Biogeochemical cycles <u>ACTIVITY</u> POSTER

		energy in food to ATP (the energy currency of the cell) ○ The word and chemical equations. ○ ATP/ADP and the roll this plays in energy transfer and ultimate release of this energy within the cell.	potential energy through the process of photosynthesis. 5. Explain how the structure of plants is adapted to the process of photosynthesis. 6. Explain how the structure of leaves are adapted to the process of photosynthesis. 7. State the word and chemical equation for photosynthesis. 8. State what respiration is. 9. Compare and contrast the similarities and differences between aerobic respiration and photosynthesis. 10. Organise the carbon cycle into a poster (electronic or paper). Emphasise the biological, chemical, geological or all three components of the carbon cycle. **Extension** 11. Explain the process light dependent and light independent stages of photosynthesis. 12. Hypothesise as to why intermittent light produces a greater rate of photosynthesis than continuous light. 13. Describe what photorespiration is and compare the differences between C3 and C4 plants. 14. Explain the processes of glycolysis, the Krebs Cycle and the electron transport chain in the generation of ATP during aerobic respiration. **Enrichment** 15. Reflect on the importance of plants for the survival of animals. 16. Hypothesise what will happen if plants are not managed well in Australia. Consider what may be done to preserve plants or increase productivity.	know how to answer these styles of questions. (T) Science skills: Observation v theory. Practical skills and safety in the lab. (Reinforced) Graphing (Reinforced)	

Reflection questions:

(a) Where would scaffolding be helpful for poor performing students?
(b) During which parts of the topic did students require more extension work?
(c) Could students benefit from more diagnostic or formative testing (particularly for carbon cycle which is not tested or in exam)?
(d) Based on cohort performance data, was the test degree of difficulty too high or too low?
(e) DO we need to shorten or lengthen the topic?