**Levels 9/10 Design and Technologies Activity**

**Our Local Area**

**Introduction to Numeracy in Design and Technologies**

In the Victorian Curriculum area of Design and Technologies, there are several outcomes for which students are required to have both numeracy and mathematical skills. Numeracy is evident in all three sub-strands in Design and Technologies, which are:

* Technologies and Society
* Technologies Contexts
* Creating Designed Solutions

In Design and Technology learning, students need numeracy skills to be able to engage in exploring, creating, and evaluating designs in which technology is incorporated.

In each of these three sub-strands, students employ sophisticated numeracy skills in order to interrogate technology-enhanced designs and create their own data-informed designs. Students engage in real-world scenarios and explore data sets such as, user numbers or frequency of access to physical or virtual spaces. Strong numeracy skills are required for students to make informed decisions about the effectiveness of designs.

**Technologies and Society**

In this sub-strand, students explore factors that influence how technologies meet the needs of various demographic groups. In achieving these learning outcomes, students will need to draw on numeracy skills to find and explore data to answer their questions. Students then need to be able to use their knowledge of statistics to decide whether the proposed design has met the needs of the intended audience. Students also need to be able to explore different ways that data are presented.

For example, in reviewing the design of a website for an audience of visually impaired learners, students may discover that the ‘website map’ page is comparatively under-used.
A closer inspection of the data might reveal that the text is presented in a difficult-to-read font. If students compare the usage statistics for different pages, they may discover a clear preference for a design that better meets the needs of visually impaired learners. Students might use numeracy skills to question the reliability of this type of data, and look at the amount of time spent in each area of the website. Students need to demonstrate a flexible
and informed approach to working with data.

**Technologies Contexts**

In this sub-strand, students analyse designs and processes within the contexts of food and fibre production, engineering systems, and materials specialities. As the term ‘analyse’ implies, students are asked to make sense of complex systems and data sets in order to demonstrate their understanding of data. To be successful in the learning outcomes for this sub-strand, students need to be able to interpret a wide range of graphs, charts, and diagrams that represent abstract concepts, such as computer networks or manufacturing cycles.

**Creating Designed Solutions**

In this sub-strand, students investigate, generate, produce, evaluate, and create solutions to complex problems. In designing these solutions, technology is used to frame, design, and/or implement the strategies. Key skills for students to achieve these outcomes include the ability to make sense of statistics and data, find locations, and interpret and create maps and plans. Finally, students need to seek feedback on their designs.

Hence, strong numeracy skills, underpinned by well-developed mathematical understandings, are inextricably linked to Design and Technologies in the Victorian Curriculum.

**Developing Numeracy Understanding in Design and Technologies**

In the Victorian Curriculum: Design and Technologies, teachers are required to provide students with a range of learning experiences in which students demonstrate design processes, use technologies, and employ numeracy skills. Location and position are crucial numeracy skills that are used to make sense of design and technologies in a range of settings, such as understanding the location of factories near the required primary resources (geographic location) or designing a mobile app for users with physical limitations (the positioning of buttons on the screen).

In order to support students’ numeracy development in design and technologies, it is important to:

* *Expose students to a range of learning contexts in which students engage with technological and design challenges.* Teachers should expose students to a range of physical and virtual contexts to ensure that students can transfer their understanding between these different spaces. In these contexts, numerical data will be presented various ways. Hence, students need to be able to make sense of these presentations of data. Teachers should dedicate time to exploring the relative benefits and challenges of different types of data and when and how they might be best used.
* *Clearly elucidate the numeracy skills that are required to make sense of data and statistics.* Interpreting statistics requires students to demonstrate specific numeracy skills that students may not be confident applying to real-world problems. Teachers need to provide examples of how data might be interpreted or used to justify a claim. In co-creating and evaluating technology-enabled designs, teachers can develop students’ ability to analyse and evaluate their design proposals.
* *Explain key mathematical terminology.* There may be terms that students are unfamiliar using outside the mathematics classroom. The teacher should seek to normalise the use of terms such as statistics, mean, median, and mode, so that students are confident in their ability to apply mathematical skills and understandings in the Design and Technology classroom. Teachers should consider engaging students in the development of a glossary of key terms for use in the classroom.
* *Provide access to design and technology challenges in which students are engaged in authentic problem-solving*. Teachers are guided by the curriculum documents to bridge the gap between abstract design concepts and numeracy skills. This means that teachers need to provide engaging and complex learning activities (Schooner et al., 2017). Ensuring that design challenges and examples are authentically linked to students’ experiences beyond school can support deeper engagement and learning (Brookes, 2017).

**Lesson Plan: Our Local Area**

The following lesson is designed as part of a larger unit of work, modelling the problem-based learning approach often taken in Design and Technologies teaching. This lesson is the first lesson in a series of six. Students will draw on numeracy and mathematical skills and concepts, including problem-solving, physical and digital representations, location, relative position, and measurement between locations.

In this unit, students engage in high-level design thinking, beginning with an analysis of existing city plans. Then, students explore an innovative design concept, the 20-minute neighbourhood, where all major facilities are located within a 20-minute walk of home (Victoria State Government, 2020). Finally, students are asked to reflect on how technology may impact future city designs, with particular emphasis on the ways that the COVID-19 pandemic has changed how people work, study, and socialise.

By the end of the first lesson (which is the focus of this detailed lesson plan), students will be able to read, interpret, and create clear and detailed design plans and maps of their local area.

The unit outline for the six lessons is as follows:

1. Students explore local area maps and are introduced to the notion of a [20-minute neighbourhood](https://www.planning.vic.gov.au/policy-and-strategy/planning-for-melbourne/plan-melbourne/20-minute-neighbourhoods) as an emerging, futuristic design concept.
2. Students identify planning strategies and documents relevant to the local area. For example, students might discover the rate of population growth, land parcel sizes, types of recent building projects, and/or infrastructure facilities.
3. Students use maps, data, and visualisations to claim that their area is, or is not, a 20-minute neighbourhood.
4. Students use Google Sketch Up software to create a 3D visualization and plan of changes needed to make their area a 20-minute neighbourhood, following the [Stanford School Design Thinking Process](http://web.stanford.edu/~mshanks/MichaelShanks/files/509554.pdf).
5. Students present their designs (on a website or private blog) and provide feedback on their peers’ designs. Students use the feedback to improve and revise their designs.
6. Students identify key people involved in either the local council planning department or the Victorian 20-minute neighbourhood scheme. Students identify the most effective plan from their class and invite a local councillor to review the design and plan.

**Prerequisite/Corequisite Knowledge: Design and Technologies**

* Familiarity with the geographic concept of interconnection between humans and physical locations
* Ability to read maps and diagrams, including interpreting scales and symbols

**Background Mathematical Skills and Understandings**

Teachers of Design and Technologies are not expected to teach the mathematical knowledge and skills that students will draw on when engaging with this activity. The students will have learnt, and should be adept with, the required mathematical knowledge and skills to complete the activity. According to the Victorian Curriculum: Mathematics, the required mathematical knowledge and skills should have been developed in earlier years of schooling, that is, by the end of Level 8.

For this activity, the background mathematical skills and knowledge are:

* Knowledge of measurement and time units, as well as units of speed
* Calculating (average) speed when distance and time are known, that is, applying the formula: (average) speed = distance/time; expressing speed in appropriate units

N.B. Students may need some assistance in converting speed units (e.g., from metres/minute to kilometres/hour)

* Calculating time when speed and distance are known, that is, manipulating the formula relating (average) speed, distance, and time
* Using scales, legends, and directions to interpret information contained in (analogue and digital) maps
* Finding distance on a map – manually and with digital technology (e.g., Google Maps) – based on the route taken; estimating distance when relevant (e.g., a winding path/road on an analogue map)

**Lesson Description**

In this lesson, students will explore town planning and design through maps, plans, design strategies, and the concept of a 20-minute neighbourhood.

1. Begin by displaying a map of a city or town (or local area) with which students are familiar. Lead a discussion to help students to identify where diverse facilities, such as basketball courts, supermarkets, and doctors’ surgeries, are located on the map. Highlight places that students know or with which they are familiar. Identify the school’s location in relation to other identified locations.
2. Ask students how they think the town was designed or laid out. Are there obvious thoroughfares or types of businesses located together?
3. Once you feel that the students have engaged in the idea of city design and planning, introduce the idea of 20-minute neighbourhoods as a futuristic design concept.
4. Next, identify students’ most visited locations on the map and ask students to calculate the time that it would take to walk to each location from the school. Students will use Google Maps to plan routes and to calculate how long each route might take to walk.
5. Compare estimates between students. Why might there be a disparity? (routes taken, speed of walking, traffic at road crossings, time of day, etc.) Develop an agreed-upon approach to estimating the time taken to walk to locations (e.g., all estimates are based on 9:30 a.m. on a weekday, taking the most direct route on pedestrian-friendly pathways).
6. Explore the idea that all main infrastructure should be located within a 20-minute walk from home. Begin by looking at the school. How long would it take to walk to a supermarket, a doctors’ surgery, a chemist, or a playground?
7. Ask students to identify the most central area for the school to be located, based on these routes. Ensure that students take into account the agreed-upon parameters for the students’ estimates (see Step 5). Students use the built-in route calculators in Google Maps and modify the variables to find the best routes to school (considering the time of day, following footpaths or roads, avoiding major intersections or freeways, etc.).

**Table 1: Links to the Victorian Curriculum – Design and Technologies**

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| Strand and Sub-Strand (if applicable) | Content Description (Code) | Elaboration(s) |
| Design and Technologies* Technologies and Society
 | Critically analyse factors, including social, ethical and sustainability considerations, that impact on designed solutions for global preferred futures and the complex design and production processes involved(VCDSTS054) | Recognising the impact of past designed solutions and possible future decisions in relation to creating preferred futures |
| Design and Technologies* Technologies and Society
 | Explain how designed solutions evolve with consideration of preferred futures and the impact of emerging technologies on design decisions(VCDSTS055) |  |
| Creating Designed SolutionsGenerating | Apply design thinking, creativity, and innovation and enterprise skills to develop, modify and communicate design ideas of increasing sophistication(VCDSCD061) | Using techniques including combining and modifying ideas and exploring functionality to generate solution concepts |

**Table 2: Links to the 21st Century Numeracy Model (Goos et al., 2014)**

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| Aspect of the Model |  How This Aspect is Addressed by the Lesson |
| Attention to Real-Life Contexts* Citizenship
* Work
* Personal and Social Life
 | The real-life context of this lesson is the neighbourhood in which the school is located. Specifically, students will explore the need for clear, informed, and person-centred design for their local area, making considerations of work, personal life, and social life. Students will analyse maps from their local area.  |
| Application of Mathematical Knowledge* Problem Solving
* Estimation
* Concepts
* Skills
 | Students will calculate distances and check routes from the school to local facilities, such as supermarkets and chemists. Students will solve problems that involve time, speed, and distance to make informed decisions about the fastest routes to take. |
| Use of Tools* Physical
* Representational
* Digital
 | Students will use Google Maps, a digital tool, to identify and compare routes from the school to facilities in the local area. More generally, maps are representational tools. |
| Promotion of Positive Dispositions* Confidence
* Flexibility
* Initiative
* Risk
 | In this lesson, students estimate and compare distances and times to walk between the school and another local facility. Due to their familiarity with the data (since it is a local area), students will be more confident and willing to take risks to solve the problems. |
| Critical Orientation* Interpreting Mathematical Results
* Making Evidence-Based Judgements
 | Throughout the design process, students will critically evaluate distance and time data to make decisions and judgments about routes they could take. They will also make informed judgments about whether or not their school is in a 20-minute neighborhood. |

**References**

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Victoria State Government. (2020). *20-minute neighbourhoods.* <https://www.planning.vic.gov.au/policy-and-strategy/planning-for-melbourne/plan-melbourne/20-minute-neighbourhoods>

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<https://victoriancurriculum.vcaa.vic.edu.au/technologies/design-and-technologies/curriculum/f-10#level=7-8>