Ozobot City

Over 8 billion people live on Earth with around 56% of the world's population (that's 4.4 billion inhabitants!) living in cities. It is estimated that by 2050 nearly 7 of 10 people will live in cities. This significant growth means that sustainable cities will play a crucial role in our future. Technology is driving the design and redesign of our future cities. Smart cities have no clear definition but are evolving. They fuse technology and urban living, creating efficient, sustainable, safer, and connected communities while reducing our human impact and improving services to people who live in them.

In this activity, students will work in small teams to plan and design a sustainable city using Ozobot robots to simulate autonomous vehicles. This lesson could be achieved in a double lesson or workshop or run as part of a longer sequence of lessons that incorporate student research into smart cities and sustainable design ideas.

This lesson plan has been based on an activity designed and run for Curious Minds.

Required resources

- OzoBot robots and textas
- Butchers paper
- Pen and paper for planning
- Access to OzoBot free form simulator: https://www.ozoblockly.com/simulator
- PC/Tablet if coding using OzoBlockly with Access to OzoBlockly editor: https://www.ozoblockly.com/editor
- Access to computer/tablet and Internet if students will be undertaking research (optional)

Required learning

Ensure students are familiar with Ozobots, particularly with calibrating, drawing lines and programming using Ozoblockly. Ozobot Classroom has a series of video lessons available on the Ozobot website https://ozobot.com/create/

Pre-learning or an introduction could include discussing and brainstorming responses to a question: what makes a city sustainable? What examples of sustainable solutions have you seen or heard about?

Discuss city planning and why it's essential to consider various factors when designing a city. We have provided a list of suggested city requirements below as a guide, which can be customised to suit the students in the class.

- Residential Zones:
    - Low-Density Housing: Suburban areas with spacious homes and green lawns.
    - Medium-Density Housing: Residential areas with townhouses or apartments.
    - High-Density Housing: Urban areas with high-rise apartment buildings
- Commercial and Business Districts:

    - Central Business District (CBD): The city's economic and commercial hub with offices, shops, and restaurants.
    - Technology Hub: An area focused on technology companies, startups, and innovation.
- Entertainment and Cultural:
    - Arts and Culture: An area featuring museums, galleries and cultural centres.
    - Entertainment: An area with theatres, cinemas, nightclubs, and music venues
- Transportation and Infrastructure:
    - Public Transport: An airport, bus stops, bike paths and pedestrian or walking tracks.
- Industrial and Manufacturing Zones:
- Areas for factories, warehouses, and manufacturing facilities.
- Public Services and Safety:
    - Safety Services: Locations for fire stations, police stations, and emergency services.
    - Community Services: Facilities like community centres, libraries, and healthcare centres.
- Sustainability and Environmental Zones:
    - Renewable Energy: Areas with wind farms, solar installations, and sustainable energy sources.
    - Green Infrastructure: Zones with eco-friendly architecture, green roofs, and urban gardens.
    - Natural Reserves: Preserving natural landscapes and biodiversity.
    - Green Belts: Areas for hiking, nature trails, and conservation efforts.
- Shopping and Retail Districts:
    - Shopping Malls: Modern shopping centres with a variety of retail stores.
    - Local Markets: Areas for local markets and street vendors.
- Tourist Attractions:
    - Landmarks: Sections with iconic landmarks or tourist destinations.

Suggested steps

Scenario

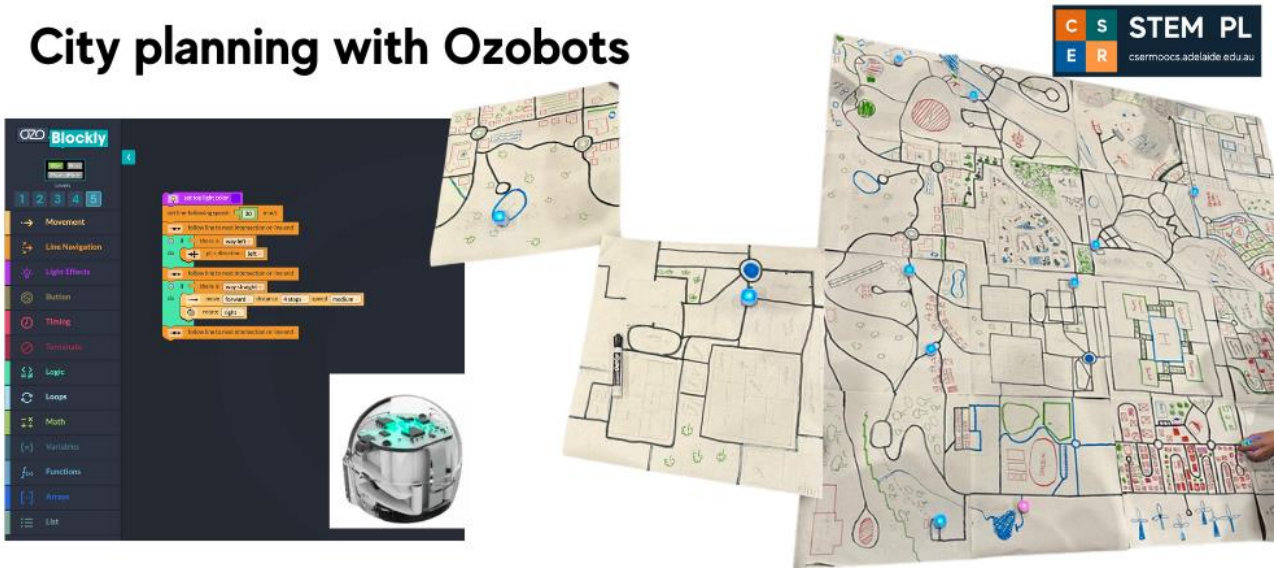
Introduce the scenario: "Your company has been commissioned to plan a new settlement where automated vehicles will be the only means of transport within the city." As a class, create a user story for this challenge and develop design criteria.

Sequence

Divide the class into small teams, and assign each team specific city requirements from the list (e.g., one group focuses on residential low density, another on entertainment, etc.). Each group should check the user story and design criteria and make any adapt needed to match their specific requirements. They will need to consider various city requirements, including residential and commercial areas, health and wellbeing, and sustainability features in city planning. All city sections must include sustainability elements in the design, and students should justify their choices.

Each group can work on their city section, designing roads, buildings, green spaces, public areas, restaurants, health and medical centres, sustainable waste management facilities, wind farms, communal gardens, tourist attractions, art galleries or museums, etc. Have the groups present their designs, evaluate them against the design criteria, and compare the sections as a city plan.

After feedback has been applied and changes made, provide each group of students with a 30 cm square of paper with the number of their city section marked on it, and have them collaborate with adjoining city sections to ensure that their roads align. Our example uses a grid of 16 sections with marked landforms, such as mountains and rivers. Alternatively, groups could work on one large sheet of paper with their areas marked out.



Have students develop an algorithm to reflect the pathway the Ozobot will take through the city and program their Ozobots to move along the roads of their city section, change colour as they progress through different areas to indicate a sustainable element, pause at intersections and choose to turn left or right or change speed depending on the surrounding areas. Students can also use the Ozobot colour codes on the roads to control the robot if OzoBlockly is unavailable. Each team can present their city section to the class, explaining their design choices and inclusion of sustainability features. You could invite a local urban planner to speak to the class about real-world city planning and sustainability efforts in your area.

Why is this relevant?

Computer science helps to create smart city solutions by using sensors, data analytics, and by creating interconnected systems to gather and process data from our city environments such as transportation, air quality, energy usage, movements, and public services. This data is then analysed using algorithms and even artificial intelligence to build digital tools, make informed decisions, automate processes, and create smart solutions for smart cities.

Assessment

Students can present their cities to the class, from design through to development. Students can cover topics such as:

- An overview of the design of the city – areas and features
- A demonstration of how the Ozobots move through the city
- Justify how the city design and movement of Ozobots are helping to achieve sustainable city goals and meet the user story.
- Any challenges in designing an Ozobot city

Students can also present their algorithms for review by the teacher. Identify whether students have included certain content descriptors from the Australian Curriculum: Digital Technologies (depending on your year level), e.g. use of variables, branching, iteration.

Australian Curriculum

Years 5 and 6 Digital Technologies

Students learn to:

- define problems with given or co-developed design criteria and by creating user stories (AC9TDI6P01)
- design algorithms involving multiple alternatives (branching) and iteration (AC9TDI6P02)
- generate, modify, communicate and evaluate designs (AC9TDI6P04)
- implement algorithms as visual programs involving control structures, variables and input (AC9TDI6P05)

Year 5 and 6 Mathematics

- use mathematical modelling to solve practical problems involving additive and multiplicative situations including financial contexts; formulate the problems, choosing operations and efficient calculation strategies, using digital tools where appropriate; interpret and communicate solutions in terms of the situation (AC9M5N09)
- create and use algorithms involving a sequence of steps and decisions and digital tools to experiment with factors, multiples and divisibility; identify, interpret and describe emerging patterns (AC9M5N010)
- use mathematical modelling to solve practical problems involving natural and rational numbers and percentages, including in financial contexts; formulate the problems, choosing operations and efficient calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation, justifying the choices made (AC9M6N09)
- create and use algorithms involving a sequence of steps and decisions that use rules to generate sets of numbers; identify, interpret and explain emerging patterns (AC9M6A03)

Cross-curriculum priorities

These content descriptions connect to the following Sustainability cross-curriculum organising idea:

- Sustainable design requires an awareness of place, past practices, research and technological developments, and balanced judgements based on projected environmental, social and economic impacts. (SD3)

General capabilities

These content descriptions connect to the following Critical and Creative Thinking (Level 4) general capability skills. We have identified relevant extracts from the elements and sub-elements of the general capability.

- create possibilities by changing, combining, or elaborating on new and known ideas in a variety of creative ways (Generating: Create possibilities)
- consider alternatives by challenging or creatively adjusting existing ideas in situations where current approaches do not work and recommend a preferred option (Generating: Consider alternatives)
- evaluate the effectiveness of a course of action or the outcome of a task, including using a given or co-developed set of criteria to support decisions (Analysing: Evaluate actions and outcomes)
- invite alternative perspectives or feedback in order to improve future outcomes (Reflecting: Thinking about thinking (metacognition)

Teacher professional learning resources

- CSER Digital Technologies + X MOOC 'Digital Technologies + Sustainability' module and 'Digital Technologies + Maths – Robotics and mapping sub-module
- Ozobot lessons and activities: https://ozobot.com/educate/lessons-and-activities/
- Getting started with Ozobot: https://ozobot.com/create/

For more information

Please visit our webpage https://csermoocs.adelaide.edu.au/lending-library
Email cser@adelaide.edu.au

We would like to thank the Australian Government Department of Education for funding our Lending Library and associated resource development.