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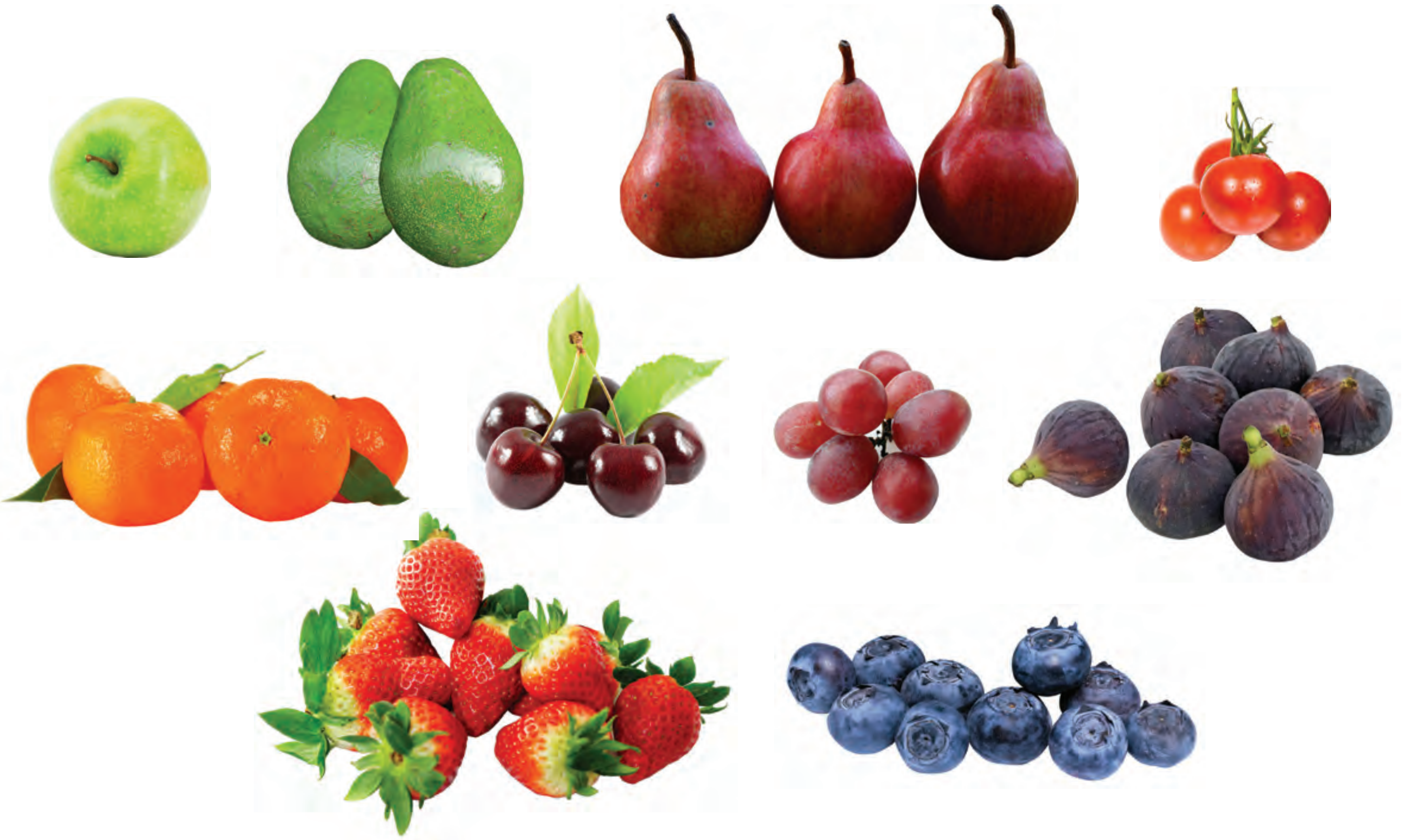

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Enhancing the development of statistical literacy through the Robot Bioglyph

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One way to heighten students' interest in the classroom is by personalising tasks. Through designing Robot Bioglyphs students are able to explore personalised data through a creative and engaging process. By understanding, producing and interpreting data, students are able to develop their statistical literacy, which is an essential skill in today's world.

Personalising classroom tasks is one way to tap into children's interests and make the development of statistical literacy skills more engaging and meaningful. In this paper, we detail the importance of being statistically literate and share our experience of creating a purposefully designed Robot Bioglyph with primary school children from Foundation to Year 6. We observed that the children were engaged, motivated and excited by the prospect of creating their Robot Bioglyph with personalised data. Bioglyphs offer teachers an avenue to broaden children's statistical literacy through a fun and educational task.

Introduction

The Organisation for Economic Co-operation and Development [OECD] propose three key competencies individuals should possess to contribute to a well-functioning society and enjoy a successful life—using tools interactively, interacting in heterogeneous groups, and acting autonomously (Rychen & Salganik, 2003). Statistical literacy is evident in 'using tools interactively' as its competencies include:

> Identify, locate and access appropriate information sources…; Evaluate the quality, appropriateness and value of that information, as well as its sources; and Organise knowledge and information (p. 11).

Further, the connection between statistical literacy and the OECD's key competencies supports English and Watson's (2016) position that, "Preparing our students to be statistically literate in today's world is paramount" (p. 3). The need to have statistical understanding is becoming more evident in everyday life and participants in Australian society must be able to make sensible decisions from the proliferation of data we experience (Trewin, 2005).

The Australian Bureau of Statistics (2009) defined and summarised the importance of statistical literacy:

> Statistics tell interesting stories and enable us to make sense of the world. They are indicators of change and allow meaningful comparisons to be made. …While it may be the issues rather than the statistics that grab people's attention, it should be recognised that it is the statistics that inform the issues. Statistical literacy, then, is the ability to accurately understand, interpret and evaluate the data that inform these issues (para. 3).

To assist children in developing these key statistical literacy capabilities of understanding, interpreting and evaluating data, a personalised Robot Bioglyph task was born. Personalising the data supports Marshall and Swan's (2006) experience of making meaning from statistics through children collecting the data themselves. In this article we describe a series of tasks that utilise the Robot Bioglyph and share the implementation of these tasks with primary children from Foundation to Year 6.

The tasks described in this paper have strong links to the *Australian Curriculum: Mathematics* (Australian Curriculum Assessment and Reporting Authority [ACARA], 2016) across all primary levels. Children in the Foundation Year will "Answer yes/no questions to collect information and make simple inferences (ACMSP011)" when describing the data from the

Robot Bioglyphs. Exploring the Year 2 content description of, "Collect, check and classify data (ACMSP049)" is evident in the "Who am I?" activity as the children use a key to decode, check and classify the gathered data. The Venn diagrams task develops the Year 3 content description of, "Interpret and compare data displays (ACMSP070)" through the children comparing and contrasting the Robot Bioglyphs of two students. Year 6 children have an opportunity to "Interpret secondary data presented…elsewhere (ACMSP148)" through exploring the data collated by the class, developing a picture of the 'typical' student, and writing a story which features their interpretation of these secondary data, thus demonstrating their statistical literacy skills.

What is a bioglyph?

A bioglyph (bio = life + glyphe = carving) is a picture that shares elements of someone's life through symbols. The symbols might depict physical features, such as hair or eye colour; family background, such as birth order or number of siblings; and personal preferences, such as favourite season or ice-cream flavour. After experiencing the motivating effects of a bioglyph created for North American children in our classes, the authors endeavoured to create a Robot Bioglyph and instruction key that would have more general appeal and be better suited for our Australian context (see Appendices 1 and 2). Additionally, the robot form is non-binary and does not emphasis a particular body shape. The choice of the symbols' representations can be determined by a classroom teacher, or a pre-existing bioglyph might be employed. Below we describe the initial task for introducing the Robot Bioglyph through data collection, presentation and summation, with the inclusion of adaptions for younger children.

Introducing the Robot Bioglyph

Prior to the lesson the teacher prepares a completed Robot Bioglyph about themselves. The teacher's Robot Bioglyph can then be displayed for students to view and discuss. Begin this task by introducing students to the teacher's Robot Bioglyph and Instruction Key (Figure 1). Ask the following questions to assist children in reading the symbols, and interpreting and analysing the data contained within the teacher's Robot Bioglyph: "Share what we know about this Robot Bioglyph." "How do we know if this person is left- or right-handed?" "Tell me two facts about their family." Clarifying the meaning of the symbols in the Robot Bioglyph will establish the necessary foundation for the following activities.

Students may quickly notice that the Robot Bioglyph has been created by the teacher or they may need further time to unpack the information to discover the mystery person.

Figure 1. Child review Robot Bioglyph instruction key.

Personalising your Robot Bioglyph

Students are provided with the Robot Bioglyph template and instruction key, and use the appropriate symbols to create their Robot Bioglyph based on personalised facts and interests (Figures 2 and 3), for example, hair colour, family background and favourite fruit. Once created, the students work in pairs to review each other's data. Encourage the articulation and the meaning of the symbol in the response. For example, "I see from your rectangular space boots that your favourite season is spring." Reading aloud the information on their partner's Robot Bioglyph serves the dual function of ensuring that the children can describe as well as record the symbols accurately. This review of their partner's data offers children an opportunity to read the data and amend errors if any inconsistencies arise with the accuracy of the provided information. For example, to the comment above a child might respond, "No, I like summer more than spring," and the datum is reviewed and revised to reflect this fact.

Figure 2. Children personalising Robot Bioglyphs.

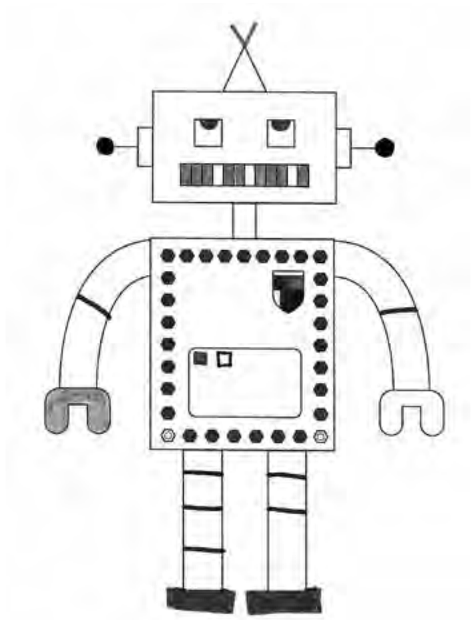

Figure 3. Robot Bioglyph completed by teacher in advance of class.

Who am I? Investigating the Robot Bioglyph data

The teacher organises the students' Robot Bioglyphs randomly in an array on a wall (see Figure 4) in the classroom and secretly selects a Robot Bioglyph for the whole class to find in the task "Who am I?" The teacher does not reveal the location of the selected Robot Bioglyph and makes statements such as: "I have one sibling," "I have two pets," or "I have brown hair." As the teacher makes these statements the students use a process of elimination by interpreting the key and removing the Robot Bioglyphs that do not fit the description until they are left with the final Robot Bioglyph. During a trial with Year 2 children, a student highlighted that: "We only have one person in Year 2 with red hair so the second one on the left must be Lisa's (pseudonym) Robot Bioglyph!"

Further, this activity offers students an opportunity to develop their statistical literacy skills of understanding and interpreting data through questioning. The "Who am I?" task is repeated with the class, however this time the students must discover who the mystery Robot Bioglyph is by posing questions to the teacher, who can only respond with "yes" or "no." Questions such as, "Was the mystery Robot Bioglyph born overseas?", "Does the mystery Robot Bioglyph have green eyes?", "Do they have a sister?" The teacher facilitates a discussion on the helpfulness or unhelpfulness of the questions to assist in eliminating the Robot Bioglyphs. The teacher asks, "What is a helpful question to ask to narrow the number of Robot Bioglyphs?" or "What is an unhelpful question to ask?" For example, if all remaining Robot Bioglyphs have pets, then asking the question, "Do they have a pet?" will not refine the search for the mystery Robot Bioglyph. It is important that the teacher models this skill of asking helpful questions as it encourages children to pay careful attention to commonalities and differences in these data.

Figure 4. Children playing Who am I?

What do we have in common? Using Venn diagrams with the Robot Bioglyph

A Venn diagram was used with Year 2 and Year 6 children to compare and contrast the Robot Bioglyphs of two students (Figure 5). The student pairs placed their Robot Bioglyphs side by side and used the instruction key as a checklist to compare each component. Next, they documented the differences and similarities between them on a shared Venn diagram. Students were encouraged to start with the antenna, and move all the way down to the space boots to ensure they compare all of the characteristics of the Robot Bioglyph. The Venn diagram can be displayed on paper, using a Venn diagram app <www.readwritethink.org/>, in chalk outside on the courtyard, or with hula hoops on the floor. The task can be extended further by comparing three Robot Bioglyphs and creating a Venn diagram with three circles (Figure 6). Class discussion questions to explore the data from the Venn diagram are: "What was a similarity between you and your partner?" and "What is something new that you learnt about your partner from the Robot Bioglyph?" "How might knowing this information help you plan for an activity you both might enjoy together?" Although the primary focus of this task is on representing relationships between two sets of data, it can be employed with students to better understand about representing, analysing, and using data to make decisions.

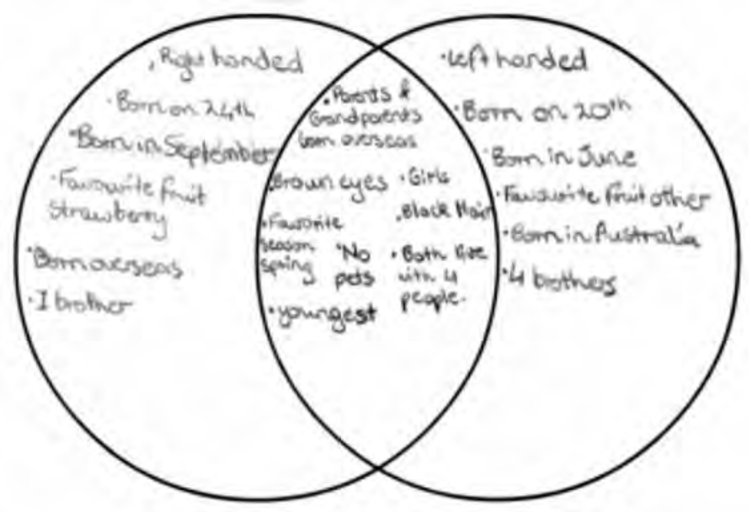

Figure 5. Hand drawn Venn diagram illustrating the commonalities and differences between two Robot Bioglyphs.

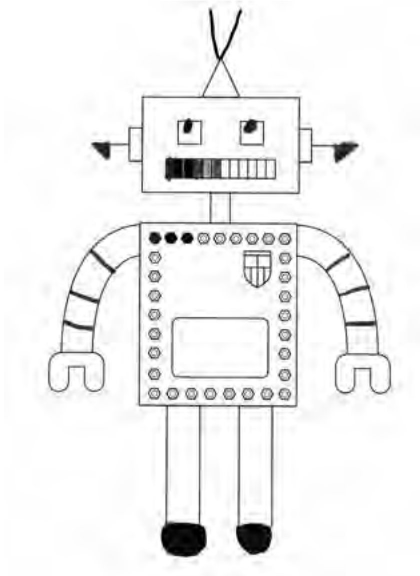

Figure 7. Adapted Robot Bioglyph completed by Foundation child.

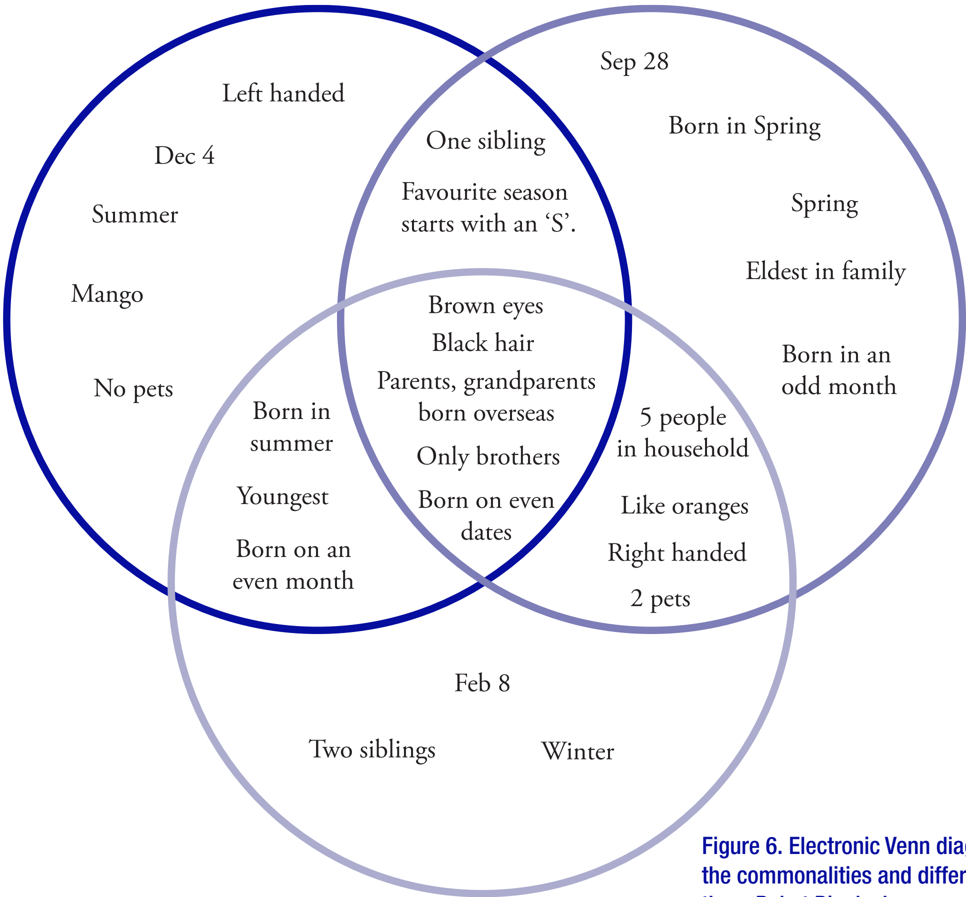

Figure 6. Electronic Venn diagram illustrating the commonalities and differences between three Robot Bioglyphs.

Story writing with the Robot Bioglyph

In this task, a set of six Robot Bioglyphs is used as a writing stimulus with a focus on interpreting data to create a story of the "typical" student in their set. The Robot Bioglyphs set can be made by reducing the size of the Robot Bioglyphs completed by children onto an A3 piece of paper. Six bioglyphs fit comfortably to a page. The teacher distributes a Robot Bioglyphs set to pairs or small groups of students. Students spend time decoding the data with assistance from the key, to gather and record information about their assigned Robot Bioglyphs set. They develop a written summary of the characteristics of their typical student from the set. This information is then referred to whilst writing their story. The typical student from the Robot Bioglyph set becomes the main character in this narrative writing task and direction may be offered to incorporate suggestions about possible conflicts, settings, or contexts based on the collated data. The students are instructed to return to their recorded summary and the Robot Bioglyph set to check their interpretation of these data within the story is accurate. This is a highly engaging task for students, as well as insightful for teachers when assessing students' capability in determining the information gleaned from the Robot Bioglyph set and how these data are interpreted and incorporated into story writing. Collating these stories into a class book provides opportunities for students to enjoy reading other's stories and determining if their characteristics are featured within the stories. This task may be simplified through the use of the Venn diagrams produced earlier to make a composite of the commonalities of two or three children in the class to determine the 'typical' student.

Adaptation for younger grades

The Robot Bioglyph is a flexible task that can be modified easily for younger year levels. The task can be simplified by altering the attributes, symbols, number of attributes, or the addition of specific colours used when drawing symbols. The key information can be displayed on the interactive whiteboard, which enables the teacher to highlight the relevant sections and check for understanding through questioning. During a trial in a Foundation class, a decreased number of attributes were selected. The attributes were; eye colour, hair colour, birth month, number of pets, favourite season and favourite fruit (Figure 7). These attributes were chosen based on the students' prior knowledge and developmental level. To assist students in reading the information on the Robot Bioglyphs, they were instructed to use specific associated colours. For example, they used the same colour as their hair and eyes when drawing the symbol. When drawing the symbol for favourite season they used colours that were associated with the season; for example, yellow to represent summer.

Following on from this task, the Robot Bioglyphs can be displayed to offer students an opportunity to compare and makes sense of their data. During the trial, Foundation students were able to conclude "most of the students like strawberries", "no one in our class likes winter" and "three students are left-handed". Students may also consider gathering data from other classrooms. The teacher could pose questions such as, "If we collected data from the class next door, would it tell us the same things?", "Would strawberries still be their favourite fruit?"or "Would the same number of students be left-handed?"

The class share and discuss the following questions, "Why is the data different in both classes?", "What would happen if every class-room completed a Robot Bioglyph?" and "Why would this happen?" This deeper questioning can initiate the development of understanding that there is variation within a data set as well as variation among different data sets.

Conclusion

The Robot Bioglyph presented in this article offers primary aged children an opportunity to explore personalised data through a creative, novel and engaging approach. The versatility of the resources to be adapted to students' interests and environments allows for a nuanced personalisation of the Robot Bioglyph and enhanced connection between mathematics and the children's lived experiences. Understanding, producing and interpreting data supports the development of children's statistical literacy, which in turn assists children in making sense of their world.

Acknowledgement

We acknowledge the work of Kim-Janina Koch, the graphic designer of the Robot Bioglyph and the instruction key that was adapted from a bioglyph of an unknown source.

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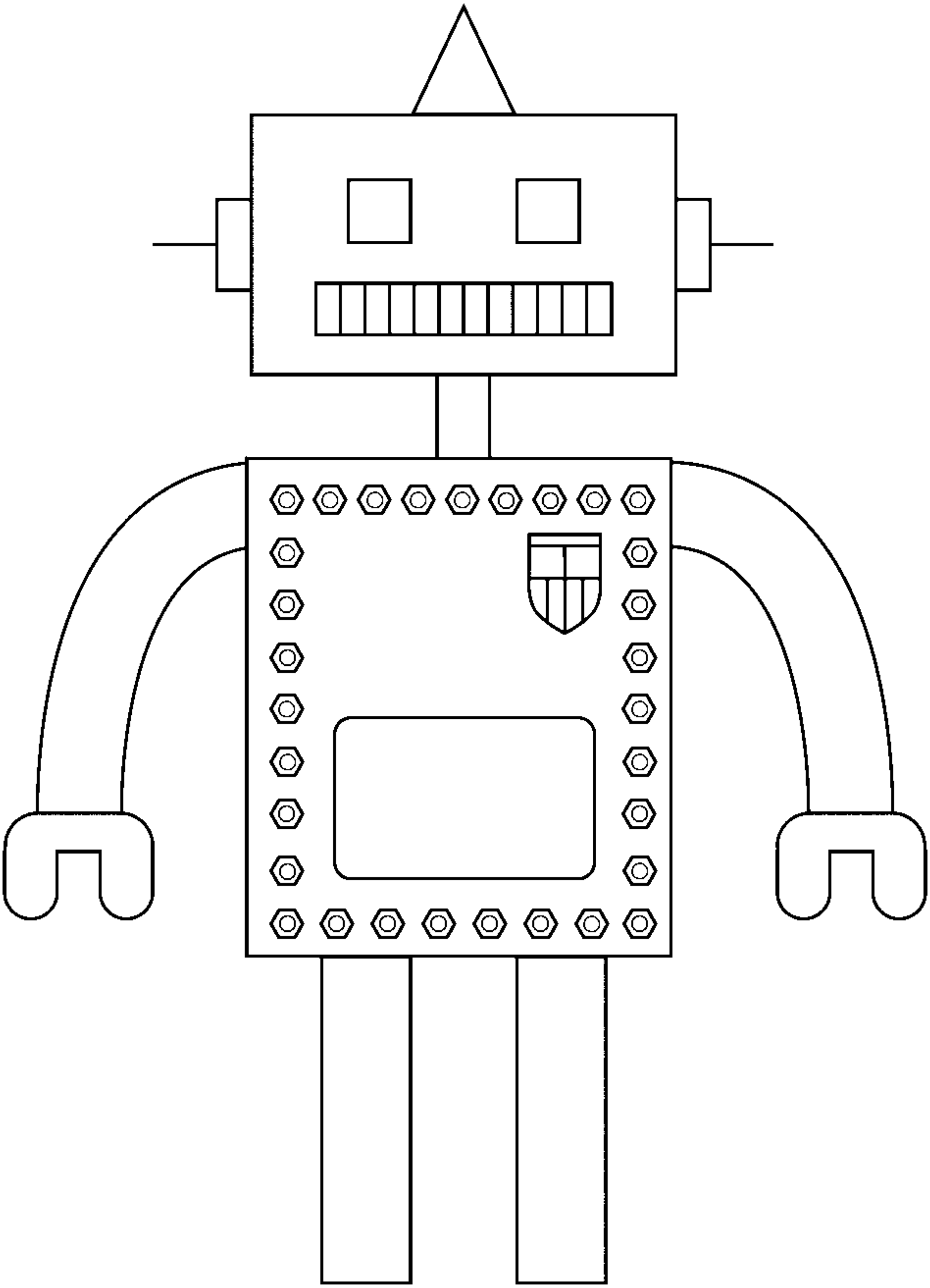
Appendix 1: Robot Bioglyph template



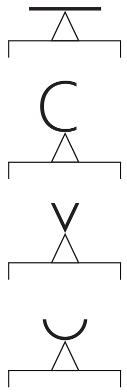
Source: Leicha A. Bragg, Jessica Koch, Ashley Willis

Appendix 2: Robot Bioglyph instruction key

Robot Bioglyph

Use these symbols to create your Robot Biogyph

Antenna (Hair Colour):



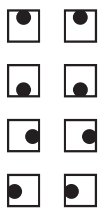
Brown

Blonde

Black

Red

Eyes (Eye Colour):



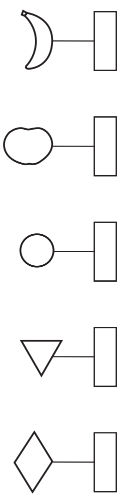
Brown

Hazel

Blue

Green

Ears (Favourite Fruit):



Banana

Apple

Orange

Strawberries

Other

Teeth:

The number of teeth coloured indicates the month of birth.

Bolts:

The number of bolts coloured indicates the day of birthdate.

Control Panel (Siblings):

Inside the control panel on your robot's chest draw in order the number of children in your family including you.

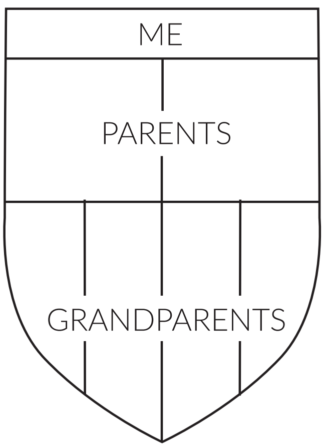
○ represents a sister

□ represents a brother

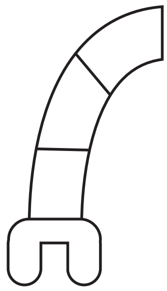
Colour in your symbol to represent you.

Crest (Family Background):

The sections for the crest coloured in indicates which family members were born in another country.



Arms (Pets):



Each stripe indicates a pet.

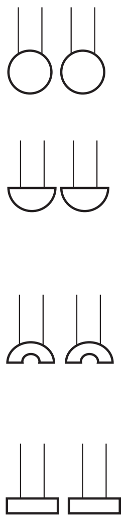
Hands:

A coloured hand indicates left or right handedness.

Legs (Household):

Each stripe drawn indicates a person with whom you live.

Space Boots (Favourite Season):



Summer

Autumn/Fall

Winter

Spring

Source: Leicha A. Bragg, Jessica Koch, Ashley Willis