CHOOSE YOUR OWN ADVENTURE AT THE AUSTRALIAN SCIENCE & MATHEMATICS SCHOOL

Reshaping STEM Assessment Methodologies

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Government of South Australia
Department for Education and Child Development

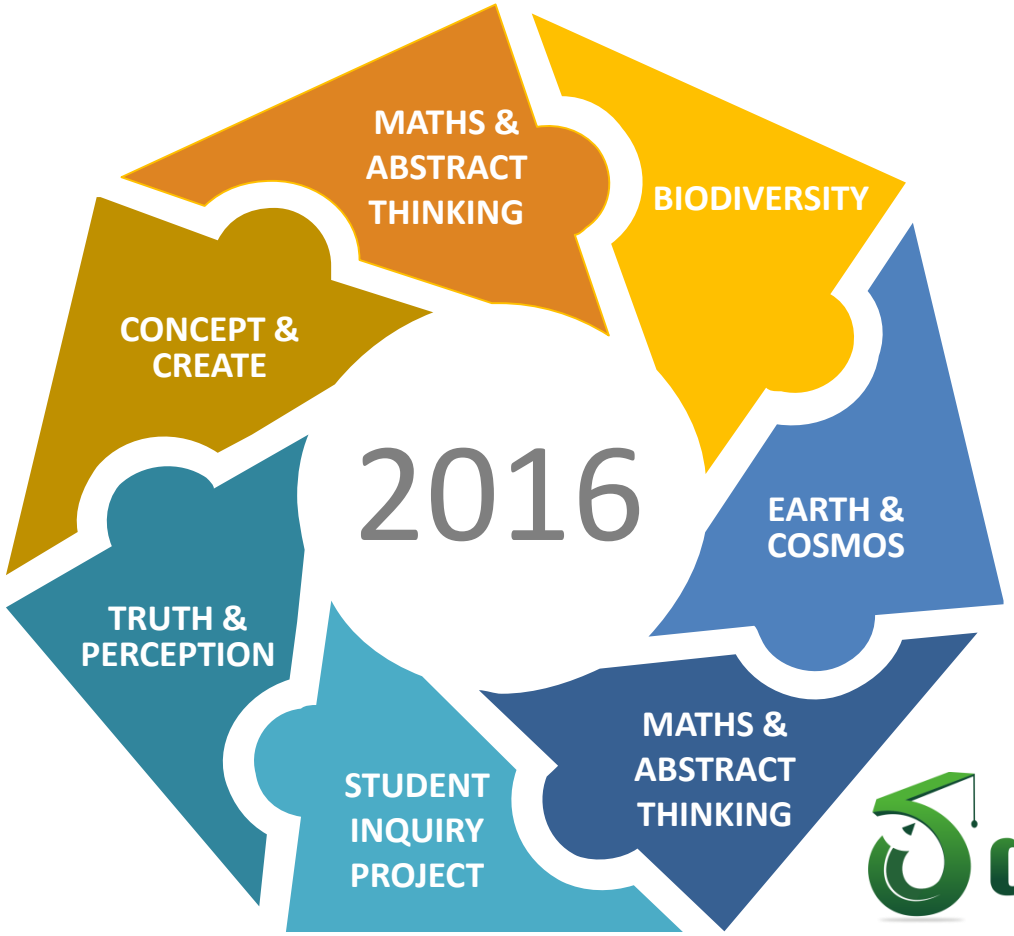
Flinders University

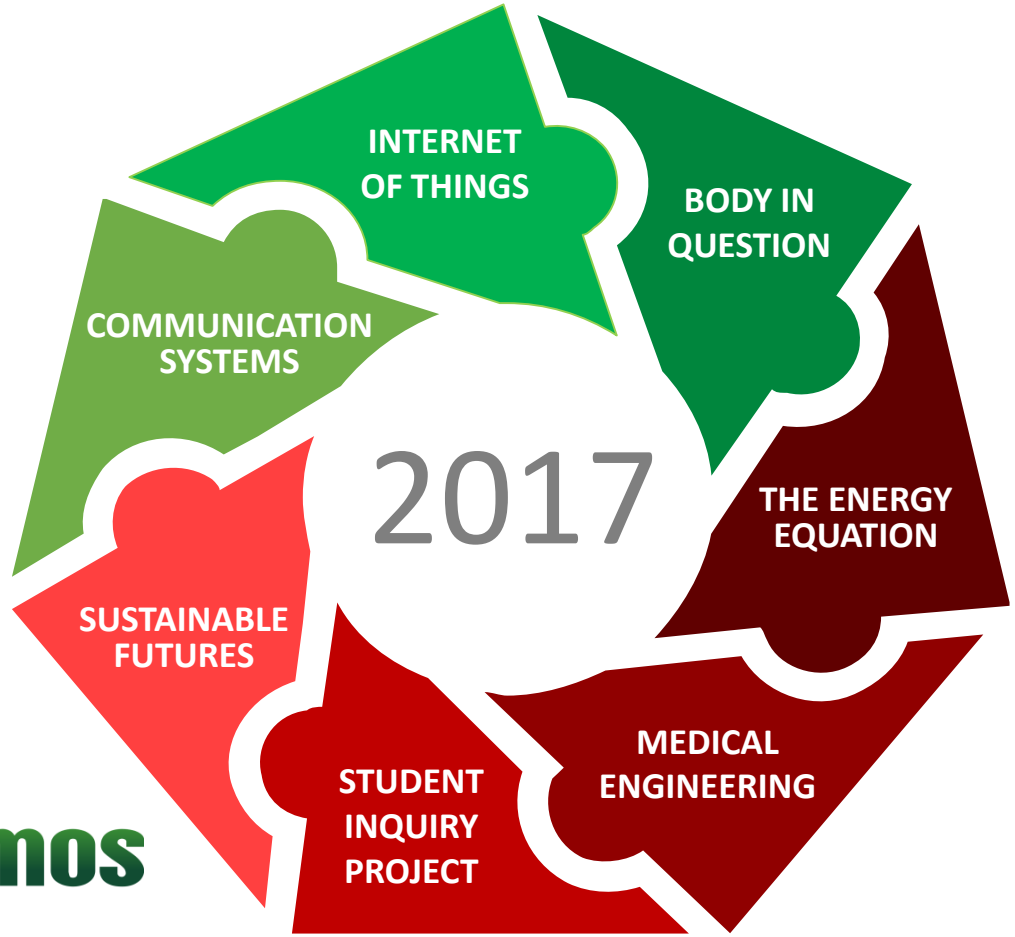
ASMS is…..

- A school for the renaissance of teaching and learning in science and mathematics
- A school to create learners who are critical thinkers, problem solvers, communicators, collaborative, creative and innovative
- A school for *all* South Australian students

ASMS Central Studies Sequence

This year the ASMS has embarked on a 2-year journey towards the full integration of mathematics.





desmos

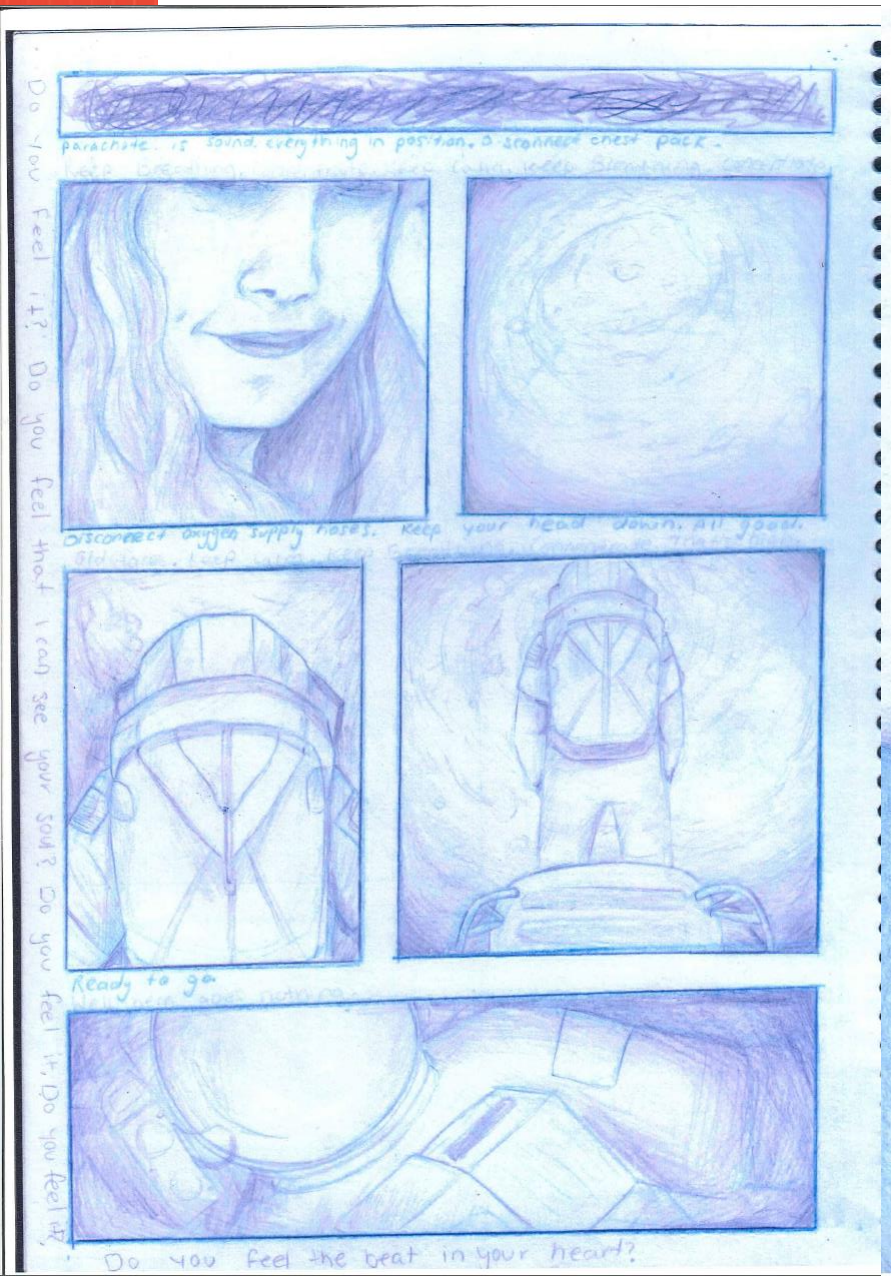
https://student.desmos.com/?prepopulateCode=etta8

Hey, students!

Go to student.desmos.com
and type in:

ETTA8

SAMPLE STUDENT WORK


parachute. is sound. everything in position. 3 scanners chest pack.
Disconnect oxygen supply hoses. Keep your head down. All good.
Ready to go.
Do you feel the beat in your heart?
Do you feel it? Do you feel that I can see your soul? Do you feel it, Do you feel it?


Do you feel it?
The fast beat of your heart?
Your heavy breath?
Tumble and turn towards me
Come Child
I will make or break you


Callisto
$F_g = F_d$
$m \times g = \frac{1}{2} \rho \times Cd \times A \times v^2$
$120 \times 1.236 = \frac{1}{2} \times 1.83 \times 0.75 \times 20 \times v^2$
$148.32 = 13.725 \times v^2$
$148.32 \div 13.725 = v^2$
$10.806557 38 = v^2$
$\sqrt{10.8} = v$
$3.28 = v$
$V = 3.28$ m/s
make seat to the rear capsule, release seatbelt, slide forwards into the rear position.
you got. You always talking, but you're not playing. It doesn't match your
face. I-I want it, I want it real. Are you afraid of me now? Are you afraid of me now?

WHY INTERDISCIPLINARY?

- *It is a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession.*

  Julie Klein and William Newell

- *We must bring together insights from the natural and social sciences, the arts, engineering and the humanities to produce explanations, create products, ask new questions, and find solutions to contemporary issues.*

  Veronica Boix-Mansilla

- *Arts and Humanities are not 'soft skills' but as a meta-language that anchors multi-dimensional thinking, applied ethics, global responsibility and principled social transformation through STEM innovations.*

  Vanessa Andreotti

THE CHANGING NATURE OF ASSESSMENT…

2003-2010

- SACE Stage 1
  - Physics
  - Chemistry
  - Biology
  - Mathematics
  - English/ESL
  - etc
- SACSA Standard 5

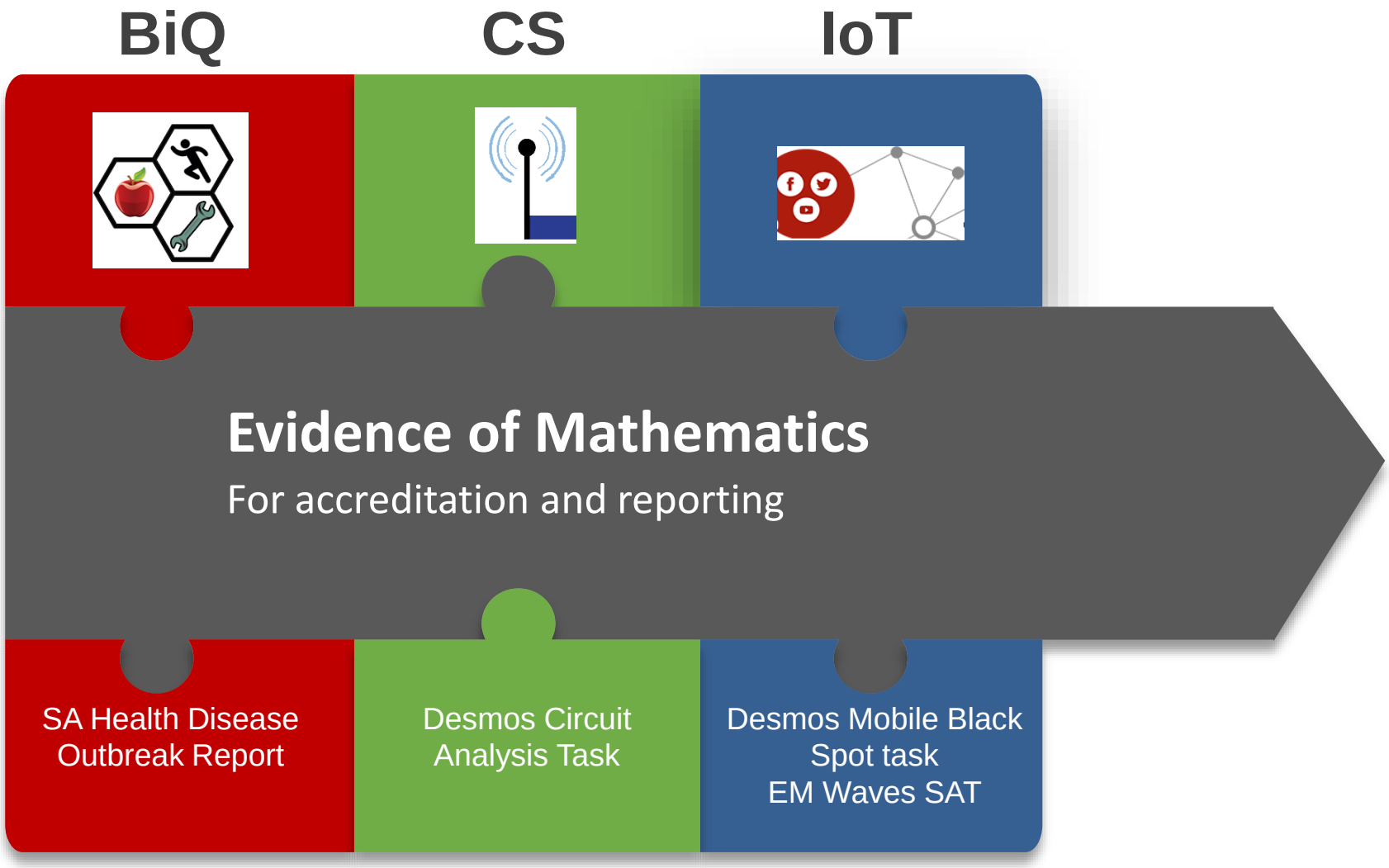
2011-2016

- SACE Stage 1
  - ***Scientific Studies***
  - Mathematics
  - English/ESL
  - etc
- SACSA Standard 5 → ***AC 10***
  - ***10A Maths***

2017-Beyond?

- SACE Stage 1
  - Scientific Studies
  - ***Essential*** Mathematics
  - English/EAL
- Australian Curriculum 10
  - 10A Maths

WHERE IS THE MATHS?



STUDENT SAMPLE 1 BIQ – GOING VIRAL

Body In Question: Going Viral Folio Task

Lachie Jaensch

Introduction

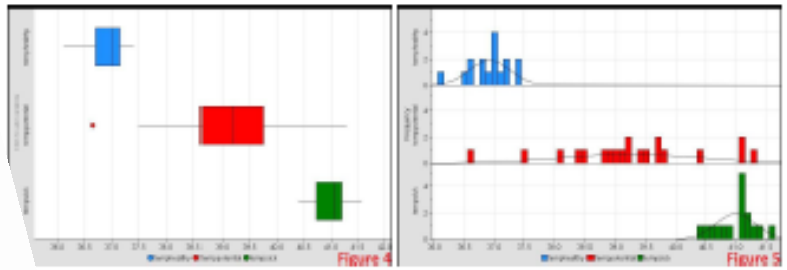
A new outbreak of disease has recently struck Adelaide and is creating panic among the general public. Little is known about this new unfamiliar disease but action must be taken immediately to prevent further spreading across Adelaide. With the limited data supplied, a course of action needs to be devised to minimise the effects this disease can have. The disease was first reported on the 13th of February at the Marion Medical Centre. Patient zero was described to have a serious, life-threatening infectious disease by the general practitioner who tended to him. The patient was noted to be displaying symptoms including a severe headache, fever, fatigue, nausea, sensitivity to light, confusion, irritability, coughing, sneezing, blocked sinuses and neck stiffness. It has since been determined that this disease is transmitted by droplets and is likely to be caused by a bacterial pathogen. The disease has now started to spread at an alarming rate. Much of the public are taking preventative measures but are questioning if they are have any effect on reducing the spread of this disease. Since the outbreak many more cases have been reported in many different regions of Adelaide. It is important that action is taken so that the outbreak can be dealt with and the potential harm from the disease is minimised. This report will analyse what is known about this disease, determine most at risk of contracting it is, and how to treat them. The scepticism of whether preventative measures are necessary to be taken will be assessed and either dismissed or confirmed conclusively. With information on who is most at risk gathered, a means of identifying who is affected needs to be devised. This will allow easy identification of sick patients, meaning action can be taken in preventing this patient from spreading the disease earlier.

Method

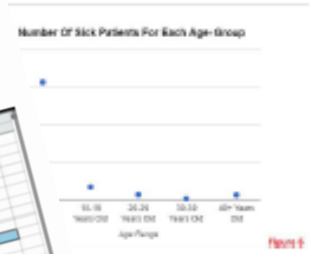
How do we know when someone is sick?

The data sets for patient temperature, gathered one week after initial outbreak, were used for this part of the statistical analysis. The data sets of temperature for healthy, potentially sick and sick patients (see *APPENDIX 1* for data sets) were converted into both boxplots and normal distribution graphs by calculating the mean, median, quartiles and standard deviation of each data set (Figures 1, 2 & 3).

A graphics calculator was used in calculating the mean, median, quartiles and standard deviation, and then to display the information in the form of a boxplot and normal distribution graph (Figures 4 & 5).



APPENDIX 1 for elaboration on Figure 5)

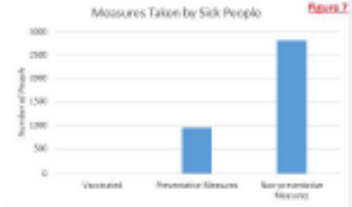


Which age group is most at risk of being affected?

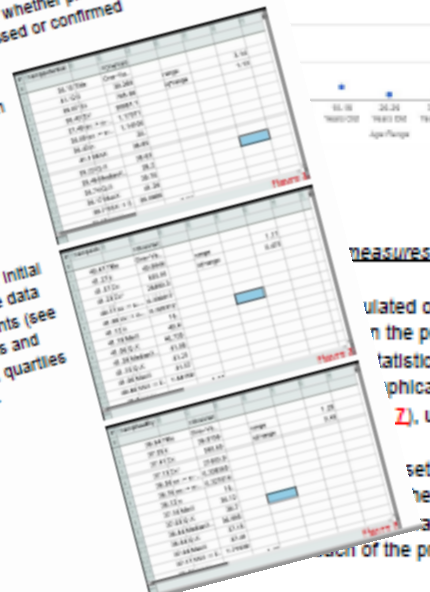
A scatterplot was made by analysing the data set on ages affected, gathered three weeks after the initial outbreak, and grouping the ages of sick patients into 10 year interval groups (see *APPENDIX 2* for data set). The data was then transformed into a graphical representation (Figure 6), using excel, which shows the relationship between the age group (independent variable) and the number of each age group affected (dependant variable).

neasures and vaccines effective?

uated on the rates of infection for
n the preventative measures they
tatistics were then able to be
phical representation in the form
7), using excel.



set, Table 1 was produced to summarise the data set in an organised
hen easily transformed into the statistics used in the bar graph above
ate was calculated by dividing the sick population by the not sick
ch of the preventative categories.



Appendix

APPENDIX 1

Data set for patient temperature:

Temperatures of sick patients							
40.47	41.27	41.57	41.23	40.77	41.06	41.12	41.19
41.05	41.39	41.16	41.06	40.65	40.70	40.40	40.61
Temperatures of people who were tested but confirmed to be healthy							
36.94	37.35	37.41	37.13	36.58	36.76	36.12	37.18
37.03	36.84	36.64	37.04	37.17	36.46	36.96	37.04
Temperatures of people who have been in close contact and might be sick							
38.15	41.12	39.07	38.43	37.48	38.89	38.43	41.10
39.74	39.17	39.70	38.65	40.42	41.25	38.80	39.00

he mean of the patient temperature for each data set is calculated by adding all the values
ether and then dividing by the number of values. This is calculated using this formula:

$$\mu = \frac{\Sigma X}{N}$$

s the average of all the values
s the sum of all the individual values
deviation of each of the patient temperature data sets can be calculated using this

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

of all the values
dual values
of values

STUDENT SAMPLE 2 BIQ – GOING VIRAL

ntroduction

On Monday the 20th of February, the first recorded case of the currently unidentified disease was documented. The South Australian Health Organization were notified immediately, however, over the course of 28 days since the initial contaminated patient was identified, approximately 2,909 civilians have been affected, 566 of which have died from the complications. As the disease has continued to progress, the Communicable Disease Control Branch (CDCB) of South Australia Health have assigned a team of researchers to investigate the disease, analyse data sourced over the past four weeks, and determine how South Australia can minimise the effects of the epidemic. Currently, researchers are aware that the disease is spread through contact droplet transmission. Some of the leading symptoms which have presented among victims include; severe headache, fever, fatigue, nausea, irritability, confusion, sensitivity to light, sneezing, coughing, blocked sinuses and neck stiffness.

Infectious diseases are illnesses which caused as a result of the transmission of microorganisms (such as bacteria, fungi, viruses or parasites) or prions among humans and animals (SA Health, 2017). As infections are as a result of the presence of pathogens, symptoms of illnesses may be prolonged and unidentifiable in the early stages of development (Comcare, 2016). Due to the elongated diagnosis period, the focal disease of this investigation has been able to spread throughout much of South Australia.

For this investigation folio, data sourced and related to the epidemic will be analyzed and applied to the contextual situation. Through the use of technology, an understanding of diseases and mathematical applications, one can visualise the rate at which the disease has progressed and determine useful information in the hope of diminishing the illness. The folio will focus primarily on investigating which age group is most affected by the disease and temperature range of patients which can be associated with the illness. Mathematical principles which will be utilised include graphical representations of data, standard deviation calculations, measures of spread and normal distribution calculations.

Fig 1

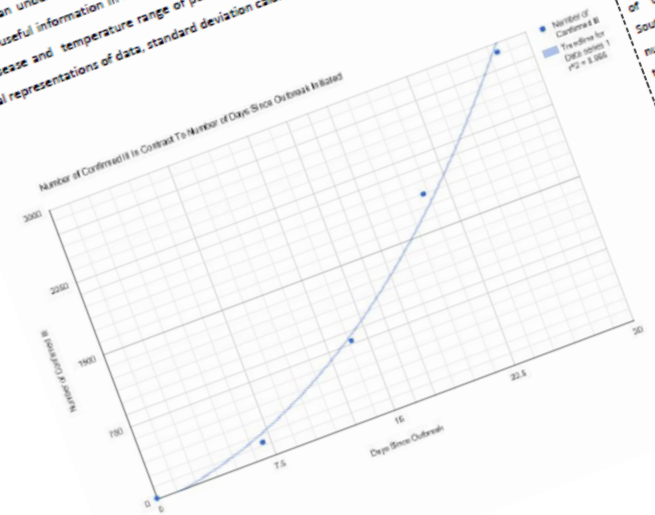


Figure 1 is a graphical representation of the number of ill citizens across South Australia in contrast to the number of days since the initiation of the communicable disease. As can be observed, the number of people affected by the disease appears to rise exponentially. The graph demonstrates the total number of people affected by the disease. A separate graphical representation could be comprised to demonstrate the number of deaths in contrast to days since the outbreak, however, the shape of the graph would appear similar.

Discussion

Which age range is primarily affected by the disease?

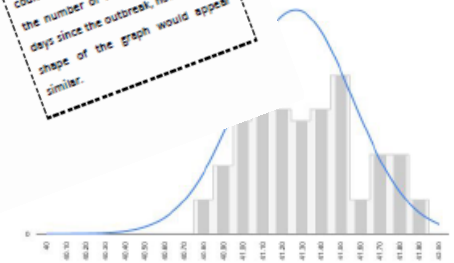
Through the investigation of data, a series of conclusions in regards to who was most affected, and potential prevention methods were established. Figure 2 and 3, shown above, represent the number of citizens aged between zero and one hundred who were affected. As can be observed through the graphs, the citizens who were primarily affected by the disease appeared to be aged between zero and five . The hypothesis which can be made as to why younger citizens are most affected by the disease may include their underdeveloped immune system or increased exposure to infected substances. How the was developed and why the disease primarily targets adolescents is currently unidentified.

The mathematical models developed, see figures 2, 3 and 4, represent the ages of patients most affected by the disease and also indicate critical values of the data including minimum age, maximum age and quartiles. The standard deviation value of the data set was calculated to be proximately 12.7. Standard deviation is an indication of by how much values in a data set differ from the mean. The normal distribution graph, figure 2, represents the distribution of values for the given data set. It can be concluded that the age of patients data set was not normally buted. The graph indicated that the majority of data fell between the values zero and five and therefore the data appeared to be positively . The use of a normal distribution graph did not provide additional information about how age impacted the number of patients who d the disease, therefore, the model was not overly useful. The column graph (Figure 3) clearly represented which age category was most id showed that on average, as the age of patients increased, the number of patients affected by the disease decreased.

of the data and graphical representations created can be determined by a number of different factors. Reliability can be 'measured' of information gained, the relevance of the data to the contextual situation and finally the overall usefulness of the data. Despite data provided was fabricated for the given assignment, the statistics were able to be used to determine information about the th relevance to the research question and evidently enabled further conclusions about the disease to be made.

estigation and analysis of the data, a series of recommendations associated with the prevention of the disease have been termined that the disease primarily affected citizens aged between zero and five years of age, children of this age category disease should be quarantined and handled only with protective equipment and masks. Preliminary education services ich work with children of the given age category should be postponed and ceased until the severity of the epidemic has ified that the disease was droplet spread. To reduce the likelihood of contracting or spreading the infection, all citizens d to wear face masks. The disease has affected many civilians over the course of the past four weeks. In order to the epidemic, it is essential that all of the South Australian population abides by the prevention regulations.

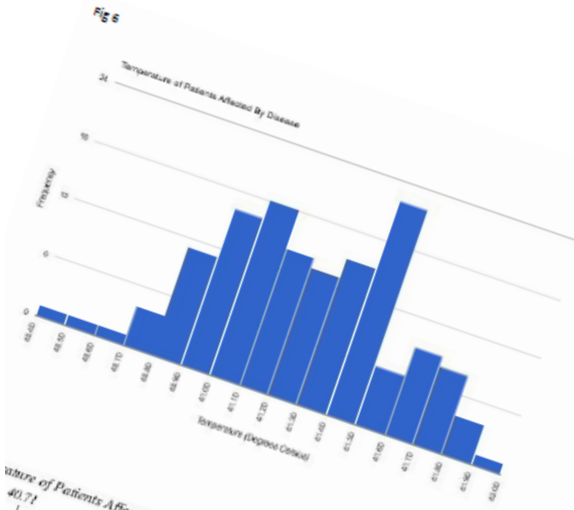
e correlated to contraction of disease?



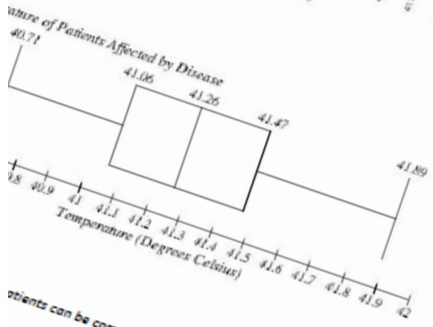
Displayed is a normal distribution graph which correlates with the temperatures of diseased citizens. The data is relatively normally distributed, as can be assumed when observing the graph. The more frequently occurring temperatures among diseased patients ranged between 41 °C and 42 °C. The highest recorded temperature of a disease patient was 41.90 °C whilst the lowest was approximately 40.40 °C. Temperatures between the ranges shown within the normal distribution graph can be associated with presence of disease.

4

Fig 6



The histogram patients who we disease. The gra occurring temperatu between 41.40 °C and



The box plot indicates the critical value The minimum, quartile 1, median, maximum values have been included wit As can be determined, the data appears to distributed and relatively evenly skewed.

atients can be correlated to contraction of disease?

estigation, data collected again enabled a number of suggestions to be made in regards to how the disease could be focused on the temperatures of diseased patients and the frequency at which the abnormal temperatures occurred. Encyclopedia, the average temperature of a healthy, resting adult human being is approximately 37 °C (Elert, n.d.). ic showed that the temperature of diseased patients ranged between 40.71 °C and 41.9 °C, roughly 5°C greater vated body temperature can be attributed to the presence of infection. Research conducted by non partnering ncreased body temperature plays an essential role in the generation of 'T cell mediated' immune response found evidence which correlates elevated body temperature with the improved functionality of immune connected to the generation of immune cells and hence the presence of infection.

d, see figures 5, 6 and 7, display the health data in a gr can be observed, the data appears to be n aning that the data ranged ge of 41 °C and

COMMUNICATION SYSTEMS

Electronic Circuits - Group conversation assessment

Communication Systems video sample

STUDENT EXAMPLES

EVALUATING THE IMPACT

Let's assume your school has already enabled the necessary 'structures' to facilitate the integration of Maths.

In small groups, discuss the potential impact that maths integration could have in your sites on:

- Leadership & teachers
- Students
- Assessment

ASMS Teaching Teams Video snapshots

Teaching Teams video 1

Teaching Teams video 2

WHAT DOES IT MEAN FOR US?

- Increasing expectations on collaborative practices
- Changing the way students engage in STEM learning and assessment
- Increasing focus on developing and demonstrating SACE capabilities

Questions & Feedback