**SP2171 Discovering Science: The Final Report**

**Task 1.** Identify the different levels of information in sentences 1-16 of the text below and write your answer in the table which follows it.

**(1)** Playing video games has become a popular leisure activity among children and adults. **(2)** Today, people spend a collective 3 billion hours per week on video gaming. **(3)** It is predicted that the average young person will spend about 10,000h gaming by age 21, twice the time it would take to earn a bachelor's degree. **(4)** This intense exposure is bound to have effects on neural structure and function.  **(5)** The current psychological literature reports favourable as well as adverse effects of frequent video game playing*.* **(6)** Favourable effects are mainly reported in the cognitive-perceptual domain,whereas adverse effects have been shown in the social-affective domain. **(7)** It has been demonstrated that video game playing can enhance pro­babilistic inferences as well as visual skills related to attention, memory and the spatial resolution of vision. **(8)** Furthermore, improvements in higher-level cognitive functions such as task switching, working memory and reasoning have been associated with video gaming improvements. **(9)** In addition, video games have been shown to enhance spatial and motor skills such as endoscopic surgical performance in medical doctors. **(10)** For violent video games, detrimental effects have been reported in the social domain, namely short-term increases in a session and reductions of empathy and pro-social behaviour.

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**(11)** Surprisingly, studies exploring the functional and structural neural correlates of frequent video gaming are scarce. **(12)** We have recently collected cross-sectional data in adolescents, in which we investigated the neural correlates of acute amount of video gaming. **(13)** We found more gray matter (GM) volume in the left ventral striatum for frequent (> 9 h per week) compared with infrequent gamers (≤ 9 h per week). **(14)** However, video gaming is not restricted to adolescence. **(15)** The average age of a video gamer in the United States was 30 years and he has on average played for 12 years in 2012 (according to the Entertainment Software Association, <http://www.theesa.com/> facts/gameplayer.asp). **(16)** As the participants in our previous study were considerably younger (14 years of age) than the average video gamer, the identified neural correlates of frequent video gaming in ventral striatum may only reflect a small fraction of the potential neural long-term effects in adults. **(17)** We theorized that because of the prominent navigation component in many three­ dimensional (3D) video games, the hippocampal formation may be enlarged in frequent gamers. **(18)** In order to test this hypothesis, we investigated the structural correlates of video gaming in an adult population within the scope of the present study. **(19)** Our main goal was to identify brain structures associated with the lifetime amount of video gaming in an adult population.

Kuhn, S. and Galli nat, J. (2014). Amount of lifetime video gaming is positively entorhinal, hippocampal and occipital volume.*Molecular Psychiatry*. 19, 842-847.

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| **Level of information** |  |
| Level 1: Context (background information) |  |
| Level 2: Context ( ideas related to topic) |  |
| Level 3: Key topic  |  |

**Task 2.** Annotate texts 2(A) and 2(B) by classifying the different types of information which you can find in them.

**Text 2(A)**

Earlier research on properties of MLE mainly focused on large samples. It was found that MLE has good large sample properties such as asymptotical unbiasedness. However, it was found subsequently that MLE is significantly biased and has a low efficiency when dealing with small data sets and/or data sets with high censoring levels. In the attempt to search for unbiased estimators, Engelhardt and Bain (1973, 1974, 1977) modified the MLE method and proposed several methods but one limitation is that the methods involved cumbersome calculation of the covariance matrix. In the 1990s, several new methods were proposed to correct the biases of the ML estimators. Jacques (1993) modified the two estimating equations of MLE and named the method generalized MLE. Subsequently, Ross (1994, 1996) proposed two simple correcting formulas for the ML shape parameter estimator, applied to complete data and singly censored data respectively. Hirose (1999) provided another bias correcting method and tabulated the coefficients of the bias correcting factors for the MLE of both Weibull parameters. Among these methods, the ones proposed by Ross (1996) and Hirose (1999) are more promising because they involve simple formulas that can be easily applied without loss of accuracy. Moreover, their bias correcting formulas can be added to the end of the conventional MLE routine to generate more accurate estimates.

Lee, W.Y., Ho, L. and Ng, M. E. T. (2009). *Research Writing: A Workbook for Graduate Students*.

 Prentice Hall. Singapore.

**Text 2(B)**

Doxorubicin is one of the most commonly used chemotherapeutic agents against a range of cancers [1]. The widely accepted mode of action of doxorubicin is via its intercalation into the DNA helices, whereby it interferes with the re-ligation of the cleaved DNA ends by topoisomerase II (Top2) during decatenation of the supercoiled DNA, and results in the formation of double stranded breaks [2]. The persistence of DNA breaks in the genome probably induces cell death via either apoptosis or mitotic catastrophe [2, 3]. Other mechanisms of doxorubicin action have been described to involve disruption of the membrane structure and the production of reactive oxygen species [1].

The therapeutic efficacy of doxorubicin is challenged by the development of resistance, which allows cancer cells to withstand concentrations of the drug that would otherwise be

lethal[4]. Although the precise mechanisms of doxorubicin resistance are not fully understood, one major drug resistance pathway involves the active efflux of the drug by membrane associated transporter proteins. This efflux occurs against the concentration gradient and thus, prevents the accumulation of the drug to a critical cytotoxic level within cancer cells [5-7]. One major class of membrane transporters that mediate drug resistance is the ABC transporter family of which Pglycoprotein (P-gp) (also known as ABCB1 or MDR1) is a prominent member [6, 8].

Tay, Z., Koo, S.H. , Nguyen, T.T.T, Tan, T.S, Chen, M.L., Chee F.C., Lim, K.K., Wee, H.A., Bay, B.H., Lee, E.J.D., and Chen, E.S. (2014). P-glycoprotein and Vacuolar ATPase Synergistically Confer Anthracycline Resistance to Fission Yeast and Human Cells, *Current Medicinal Chemistry,* 2014, *21,* 251-260.

**Task 3**

Underline statements used to identify research gaps and suggest the types of research gaps presented.

# Text 3A

While the above studies have analyzed the effects of various environmental conditions on the performance of the unglazed solar collector, no research has been carried out so far to study the effect of the relative humidity (RH) on the performance of the collector. The effect of RH in tropical areas (where RH is typically higher than 80%) is significant as the low dew point caused by high RH will lead to condensation on the surface of the unglazed solar collector. The water film produced in the condensation process is expected to have a negative effect since the film would reflect some of the radiation, which would reduce the amount of absorbed solar radiation, and thus would lower the performance of the solar collector. On the other hand, condensation would also enhance heat transfer from ambient to the collector since latent heat is released during the process of condensation. Research is required to compare these negative and positive effects and determine how they affect the performance of the collector. The aim of this study was to examine the mechanism of condensation in the unglazed solar collector in order to develop an equation that describes the relationship between RH and performance of the collector in high RH environments.

Type(s) of gap:

# Text 3B

These contrary assignments of parity resulted in conflicting light scattering selection rules. According to Kanehisa [23], only torsional modes with 1=2 are Raman active, while Duval [10] argued that only spherical mode with 1=0 and 1=2 are Raman active. The conflict between the selection rules needs to be resolved since these rules are critical for explaining Raman results of confined acoustic modes in nanoparticles. The purpose of this research was to examine the fomulations of Kanehisa's and Duval's selection rules and to use the calculation approach of Montagna and Dusi [31] to determine whether the torsional modes are Raman active.

Type(s) of gap:

# Text 3C

From the above review, we can see that research on the gyroscopicallystabilized single-wheeled robots carried out so far is based on the common assumption of rolling without slip. However, in view of the potential application of such robots for space exploration, slipping needs to be considered. As terrains encountered are likely to be loose ~oil or sticky clay, slip effects may be significant due to the lack of traction force or slippage introduced by poor contact between the surface and the wheels of the robot. In addition, the presence of uneven terrains would also limit the use of existing gyroscopically-stabilized single-wheeled robots, which are designed for smooth surfaces or slopes. Locomotion in uneven terrains would involve dynamic impact from time to time, which would generate undesirable topple over forces and disturbance from all directions. The aims of this research were to incorporate slip effect into the kinematic and dynamic models designed for the robotic system of a gyroscopically-stabilized single- wheeled robot and to investigate the dynamic behavior of the robot under dynamic locomotion with and without slip.

Type(s) of gap:

# Text 3D

Based on the above review, it is clear that the wavelet basis is the preferred choice among the parametric models because it is both multi-scale and spatial- localized. In 2D, the wavelet basis paved the way for the development of Chang's [17] wavelet model which has been shown to possess the properties of compact representation, multi-shape description and spatial-localization of shape variation simultaneously. This model has proven to be an ideal choice for statistical shape analysis. It is thus desirable to extend the model and develop a 3D statistical model for surface shape analysis. This thesis proposes a Statistical Surface Wavelet Model (SSWM) for surface shape analysis. This 3D model adopts a newly developed wavelet scheme based on the lifting scheme in order to avoid the rigorous requirements in explicit surface parametrization.

Type(s) of gap:

Lee, W.Y., Ho, L. and Ng, M. E. T. (2009). Research Writing: A Workbook for Graduate Students.

 Prentice Hall. Singapore.

**Task 4**

Read the following abstract and discuss the direction that this research will take.

EF24 is a curcumin analog that has improved anticancer activity over curcumin, but its therapeutic potential and mechanism of action is unknown, although this is an important area to address as curcumin targets multiple signaling pathways. However, what is known is that EF24 inhibits the NFkB but not the JAK-STAT signaling pathway in DU145 human prostate cancer cells and B16 murine melanoma cells. EF24 also induces apoptosis in these cells apparently by inhibiting miR-21 expression, and enhances the expression of several miR-21 target genes, PTEN and PDCD4. EF24 treatment has been found to significantly suppress the growth of DU145 prostate cancer xenografts in immunocompromised mice and results in tumor regression. EF24 enhances the expression of the miR-21 target PTEN in DU145 tumor tissue, but suppresses the expression of markers of proliferating cells (cyclin D1 and Ki67). In syngeneic mice injected with B16 cells, EF24 treatment inhibits the formation of lung metastasis, prolonged animal survival, inhibits miR-21 expression and increases the expression of miR-21 target genes. Expression profiling of miRNAs regulated by EF24 in vitro and in vivo show that the antitumor activity of EF24 reflect the enhanced expression of potential tumor suppressor miRNAs as well as the suppressed expression of oncogenic miRNAs, including miR-21. Taken together, our data suggest that EF24 is a potent anticancer agent and selectively targets NF-kB signaling and miRNA expression, indicating that it has significant potential as a therapeutic agent in various cancers.

Yang, C.H., Yue, J., Sims, M., Pfeffer, L.M. (2013) The Curcumin Analog EF24 Targets NF-kB and miRNA-21, and Has Potent Anticancer Activity In Vitro and In Vivo. *PLoS ONE* 8(8): e71130. doi:10.1371/journal.pone.0071130