The Investigation of Health Education in the Irish Education System:
An Identification of Misconceptions and Knowledge Gaps relating to Cancer in second level students, pre-service teachers and practicing teachers.

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I hereby declare that this project is entirely my own work, other than the counsel of my supervisor, and that it has not been submitted for any academic award, or part thereof, at this or any other educational establishment.

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Jennifer Butler (Author)               Date
Abstract:

Rising cancer rates coupled with a deteriorating health status among young people in Ireland is a cause for serious concern. Studies examining the health of young people in Ireland have highlighted teenage obesity, low levels of physical activity, smoking and alcohol consumption as areas for concern. These factors can play a substantial role in a teenager’s health, specifically their risk of developing cancers, moving from adolescence to adulthood.

The purpose of this investigation is to examine the level of cancer related health education currently integrated into the Irish Education System and to identify health related misconceptions and knowledge gaps in second level science pupils, pre-service science teachers and practicing science teachers. A pen and paper Identification Instrument was used to assess participants’ conceptual understanding of health education. The Identification Instrument utilized both open-ended and multiple-choice style questions in an attempt to ascertain a true understanding of participants’ beliefs.

The findings of this study indicate that the level of health education, specifically relating to cancer in the Irish Education System is unacceptably low. This has given rise to a high incidence of misconceptions and knowledge gaps in second level science students, pre-service science teachers and practicing science teachers. Participants were found to have equally low levels of awareness of how lifestyle factors can affect this risk of developing cancer. It was found that misconceptions do not reduce with level of study of participant thus highlighting that the levels of health education currently in place is not tackling the predominance of these misconceptions.
Acknowledgments:

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Chapter 1: Introduction

1.1: Context of the research

Rising health problems among young people in Ireland is a cause for serious concern. It is vital that these issues are addressed sooner rather than later. Second level education plays a huge part in Irish teenager’s lives. Therefore this presents a perfect opportunity to implement change through core subjects such as Science. For instance, cancer levels in Ireland are increasing at an alarming rate, yet many of these cancers are preventable (Central Statistics Office 2007). There are serious misconceptions regarding health issues in Ireland, both among students and educators (Department of Health and Children 2005; McCroie et al. 2010). These misconceptions coupled with lack of basic information means that health education is needed immediately in schools. These misconceptions and lack of basic knowledge must be identified in both Irish students and educators in order to determine possible avenues to overcome such issues. Health problems are a huge cost to the Irish state, and it imperative that there is a change to health education policy to enhance students futures (Department of Health and Children 2005).

1.2 An overview of the project

This project is designed to assess the level of misconceptions and knowledge gaps relating to health education, specifically cancer, present in Junior Certificate Science pupils. Misconceptions and possible knowledge gaps will be identified from previous research by carrying out an extensive literature review (Chapter 2). In order to assess Junior Certificate Science pupils a Diagnostic Instrument (see Appendix 2) will be designed utilising the misconceptions and knowledge gaps which had been identified. This Diagnostic Instrument will also be implemented on pre-service and in-service science teachers. Results gathered from all three groups of participants will be compared in order to ascertain if there is any link between the three groups.
1.3 Research objectives, hypothesis and questions

The objectives of this research are as follows:

- To determine the specific health misconceptions present in second level science pupils completing the Junior Certificate science course.
- To observe whether these misconceptions are in keeping with the misconceptions found in pre-service and in-service science teachers.
- To determine any knowledge gaps relating to health education and cancer present in the three groups of participants.

The hypothesis being tested is that the misconceptions and knowledge gaps present in pre-service and in-service science teachers is comparable with the misconceptions and knowledge gaps present in Junior Certificate science pupils due to the limited availability of health education in the Irish Education System. This hypothesis was developed based on a review of the literature.

A number of research questions were developed after a review of the literature in order to test this hypothesis.

1. What misconceptions relating to health education, specifically cancer, do Junior Certificate science pupils hold?
2. What are the cancer misconceptions relating to health education held by pre-service and in-service science teachers?
3. Is there any link between the misconceptions held by pre-service and in-service teachers and those held by second level pupils?
4. Is there a link between misconceptions and age?
5. Are their knowledge gaps in the three groups of participants relating to health education?
Chapter 2: Literature Review

2.1: Introduction

This chapter firstly outlines some of the specific causes of cancer. The structure of the Irish Education System is reviewed, with particular emphasis on the provisions made for inclusion of health education. Studies which have investigated the current health status and health awareness of Irish adolescents are examined. The sources of misconceptions in education and their effects on new learning are reviewed. The particular misconceptions relating to cancer and general health are studied. Finally, methods cited within the literature to overcome misconceptions and achieve conceptual change are examined.

2.2: Causes of Cancer

Cancer is not a single disease; it is a group of more than 200 diseases arising from different cells in the body, characterised by uncontrolled cellular growth (Mills Shaw et al. 2008; Almeida & Barry 2011). Despite significant progress in tumour diagnosis and treatment in the medical field, cancer remains a major cause of death worldwide (Jemal et al. 2011). Ireland has some of the highest cancer rates in the world. Based on age-standardised 2008 WHO statistics, at 317 cases per 100,000 people, Ireland has the second highest diagnosis of all forms of cancer out of 50 nations analysed worldwide (Ferlay et al. 2010).

By the year 2030 cancer rates in Ireland are due to rise by 72%. It is estimated that in 2030 there will be 33,416 new cases of cancer in Ireland compared with 19,454 in 2008. In the ‘league table’ of 27 European Union member states – calculated using WHO estimates for new cancer cases in 2030 – Ireland have the greatest predicted percentage increase (Appendix 1) (Ferlay et al. 2010).

Cancer is characterised by the unregulated division of cells caused by mutations of genetic material. This can be caused by a number of factors. Although 100% of cancers are as a
result of genetic mutations, about 5% to 10% of cancers are inherited (Fletcher & Houlston, 2010; Litton et al. 2012). There is a distinction between the term genetic and inherited. Inherited cancers result from the inheritance of genes associated with the development of cancerous cells. Not all cancers are inherited. However the majority of cancers result from the alteration or damage of the genetic material within a person’s cells over time (Fletcher & Houlston, 2010).

Cancer prevention through lifestyle changes are considered vital as our understanding of the link between these factors and cancer is growing (Anand et al. 2008). The correlation between lifestyle and cancer is evidenced by the large variation in rates of specific cancers in different countries. For example, it has been noted that the rate of breast cancer in Asian women is historically four to seven times lower than women in the United States (Curado et al. 2007). The rise in incidence of breast cancer observed in Asian women who migrate to Western societies further boosts the correlation between lifestyle and cancer. Immigrants take on the cancer risk of their new country, often within one generation (Compton et al. 2000; Lichenstein et al 2000). These findings indicate that lifestyle and environmental factors have the principal role in causing sporadic cancer; that is cancers that occur in people who are not carrying a high-risk mutation to increase their susceptibility to cancer (Irigaray et al 2007; Mucci et al 2001).

The WHO has stated that one-third of all cancers are preventable and this is the most cost-effective long-term strategy for the control of cancer (F – Petersen 2008). Considering the costs associated with the treatment of cancer for the health care system, the patient and society as a whole, the opportunity to reduce this burden is desirable (National Cancer Registry Ireland 2011). The average (state weighted) lifetime cost of managing a case of colorectal cancer from the health care payer perspective was €39,607 in 2008. For rectal cancer this cost was 16% higher at €43,502 (Tilson et al 2010).
The major risk factors of genetic alterations have been classified in Table 2.1 below. These will be discussed and referenced in the sections to follow.

**Table 2.1: Risk Factors of Genetic Mutations and Cellular Abnormalities**

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<th>Poor Diet</th>
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**2.2.1: Diet and Physical Activity**

*Diet*

Work pioneering the link between poor diet and cancer was first published by Doll and Peto (1981). It has since become well established that nutrition can directly influence several stages of the process of cancer development (Agarwal et al. 2013; Ross & Davis, 2011) In addition to this, food components and nutrients can indirectly influence or protect from the development of cancer through their influence on body composition, hormones and growth
factors (Shaw 2011). An individual consumes thousands of dietary components on a daily basis; these dietary components affect biological processes in both normal and cancerous cells. Different food components and nutrients have been found to have both preventative and stimulating effects on the development of cancer.

Foods which have been identified as risk factors in the development of cancer include animal products such as meat and dairy products. People in Western countries, having diets high in animal products, fat, and sugar, have been known to have higher rates of cancers of the colorectum, breast, prostate, endometrium and lung. In contrast, individuals in developing countries, usually having diets based on one or two starchy staple foods, with low intake of animal products, fat and sugar, have low rates of these cancers (Denis et al. 2013).

The increased risk associated with the consumption of meat and dairy products for the development of breast cancer has been explained using multiple biological mechanisms. For example, during the high-temperature cooking of red meat heterocyclic amines and polyaromatic hydrocarbons are created. These are established mammary carcinogens (Butler et al. 2003). It is also thought that exogenous hormones administered to cattle to increase muscle mass and promote milk production could be passed on to consumers of meat and dairy products and stimulate the growth of hormone-sensitive breast tumours (Linos and Willett 2009).

Meta-analyses studies have identified red meat and processed meats as significant risk factors for colorectal cancer development (Larsson and Wolk 2006; Chan et al. 2011; Alexander et al. 2011). Several theories have been proposed to explain this association. These include:

High-fat diets could promote carcinogenesis. Studies carried out on rats have established a relationship between high fat diets and carcinogenic-induced tumours in the colons of rats (DeLany et al. 2012; Pai et al. 2012). This has been attributed to high fat diets signalling the
activation of oncogenic (cancer causing) cascades. These have been shown to play an important role in tumour growth and progression.

Cooking meat at high temperature forms mutagenic and carcinogenic heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs). HCAs are formed by pyrolysis of creatinine (a breakdown product in muscles) with specific amino-acids. The type of HCAs formed is dependent on many factors such as the type of meat, the cooking temperature; the chemical environment cooking is carried out in (e.g. in oil or water). PAHs are formed as a result of the incomplete combustion of organic compounds (John et al. 2011). For humans, the main sources of PAHs include cooked and smoked meat and fish and tobacco smoke (Phillips 1999). A Swedish study carried out in 1991 found that frequently consuming fried meat with heavily browned surfaces leads to a 3-fold increase risk of developing colorectal cancer (de Verdier et al. 1991). This has since been confirmed by numerous analytical studies (Sinha et al. 1999; Sinha 2002; Le Marchand et al. 2001).

Potentially carcinogenic N-nitroso compounds (NOCs) are present in some processed meat, and are formed endogenously after red and processed meat consumption by nitrosation of amines and amides. NOCs are alkylating agents which are capable of reacting with DNA. Many NOCs are carcinogenic in laboratory animals and can be exposed to humans from certain processed meats (e.g. grilled bacon) (Lijinsky 1999). Studies have associated the NOC N-nitrodimethylamine (present in smoked and salted fish, and cured meat) with colorectal cancer risk (Knekt et al. 1999). Human studies by Lewin et al. (2006) have found that those with high quantities of red meat in their diets formed the DNA adduct O6-carboxymethyl guanine in colonic exfoliated cells. This suggests that increased production of NOCs may be relevant to the causation of colorectal cancer.

Evidence also suggests that salt and salty foods contribute to the development of gastric cancer. In a prospective population study, D’Elia et al. (2012) found that intake of dietary
salt is directly related to risk of developing gastric cancer. The risk increases progressively with increasing levels of consumption. The biological mechanisms by which salt increases the risk of gastric cancer are not yet definitely known. However, the link between gastric cancer and the bacterium *Helicobacter pylori* has been widely investigated (Suzuki et al. 2009; Suzuki et al. 2007; Uemura et al. 2001). Studies regarding the potential synergism between these two factors (high salt concentrations in diet and infection with *H. pylori*) have found that high salt concentrations in the stomach induce gene activity in *H. pylori*, thus increasing the risk of an infected person developing gastric cancer (Loh et al. 2012; Peleteiro et al. 2011).

Gastric cancer is sub-categorised into the diffuse type and the intestinal type (Fritz 2010). The diffuse type is linked with genetic factors and is thought to arise from single cell mutations and subsequently proliferate and invade the rest of the stomach. The intestinal type, which has an environmental causation, develops through a series of precursor lesions which gradually transform the normal gastric mucous into a mucosa similar to the intestinal epithelium. The intestinal type of gastric cancer most commonly begins with chronic gastritis and atrophic gastritis (inflammation and cellular changes in the lining of the stomach) which develops into dysplasia (abnormal changes in cells) and finally cancer of the epithelium of the stomach. Infection with the bacterium *H. pylori* has been associated with both types of gastric cancer (Crew and Neugut 2006; Fritz 2010).

Certain foods are also associated with having preventative effects on the development of cancer. An inverse association between gastric cancer risk and high plasma vitamin C, some carotenoids and high intake of cereal fibre was recently observed (Lam et al. 2013). High intake of fruit and vegetables in current smokers has also been associated with a decreased risk of lung cancer (Gnagnarella et al. 2013).
Research has also indicated that the consumption of allium vegetables, such as onions and leeks, reduces the risk of developing stomach cancer (Gonzalez et al. 2012). Garlic is believed to reduce the risk of bowel cancer (Butt et al. 2009; Perera et al. 2012). Folate, in the form of Vitamin B, is thought to reduce the risk of pancreatic cancer. Folate occurs naturally in some fruit and vegetables (Rossi et al. 2011). Furthermore, research shows that eating a wide range of fruit and non-starchy vegetables protects the body against cancers of the mouth, pharynx, larynx, oesophagus, stomach and lungs (Stidley et al 2010).

**Obesity**

Obesity is widely recognised as a major global health problem with the incidence of obesity having doubled worldwide since 1980. Obesity is defined as excessive fat accumulation on the body which may impair health; it is commonly determined using Body Mass Index (BMI). BMI determines if an individual is overweight or obesity on a scale of weight-for-height (Ferrera, 2006). Despite BMI being somewhat outdated in the medical field, it was decided to include this scale in this research as it is a scale commonly known by the general population and is also still widely included in school curricula (National Council for Curriculum and Assessment 2011).

Obesity is a leading cause of many diseases such as type II diabetes and cardiovascular diseases which can lead to coronary heart disease, strokes, hypertension, cancer and osteoarthritis (Dixon, 2010). The link between cancer and obesity has been largely overshadowed by its cardiovascular effects; however obesity is a known risk factor for a number of types of cancer. These include cancer of the breast (post-menopausal) (Sinicrope et al. 2011), colon and rectum (Bardou et al. 2013), oesophagus, kidney, pancreas, gallbladder, ovary, cervix, liver and prostate (Dixon, 2010). Research into the biological mechanisms which link obesity and specific forms of cancer are still in their infancy; this is an evolving and currently active area of research (Dixon, 2010).
Obesity is a multi-factorial disease, with both genetic and environmental factors contributing to its development. Although obesity is strictly dependent on excess energy intake for corresponding energy expenditure, significant quantities of research have illustrated the importance of genetic susceptibility in the development of obesity (Bell et al. 2005; Boutin and Froguel 2001). The link between obesity and cancer development can therefore also be classified as genetic. The Melanocortin 4 Receptor (MC4R) is expressed in a number of locations in the central nervous system, and is concentrated in the paraventricular nucleus of the hypothalamus. Its primary function is to regulate food intake following the binding of $\alpha$-melanocyte stimulating hormone ($\alpha$-MSH), which signals the feeling of fullness through the activation of the cyclic adenosine monophosphate (cAMP) second messenger system. Obesity occurs in individuals who carry mutations in the MC4R gene due to a hyperphagic state (state of extreme increased appetite) (Logan and Pepper 2010).

**Physical Activity & Sedentary Lifestyle:**

Physical activity encompasses any movement using skeletal muscles. It is undertaken in several domains of daily life and all people experience some exposure to physical activity. Physical activity can range from the strenuous physical activity such as manual labour, to the sedentary activities such as maintaining posture (World Cancer Research Fund and American Institute for Cancer Research 2007; McTiernan et al. 1998).

As discussed in Section 2.2.1.2 obesity, which can sometimes result from a lack of physical activity, is a risk factor for some cancers. Physical activity, which promotes healthy weight, can therefore protect against some cancers. Despite this, changing lifestyles and development of technology reduces people’s level of physical activity. Sedentary lifestyles are becoming more and more the norm with cars and buses replacing walking and cycling, and active recreation being replaced with watching television (World Cancer Research Fund and American Institute for Cancer Research 2007).
However, the benefits of physical activity in cancer prevention are further reaching than the prevention of obesity. The relationship between physical activity and cancer etiology (primary prevention) has been examined using observational studies and meta-analysis. Following the collection and examination of evidence from a number of studies relating to physical activity and cancer prevention by the World Cancer Research Fund and American Institute for Cancer Research (2007), the link between physical activity and cancer was deemed convincing. Results from the amalgamation of 73 studies investigating the link between breast cancer and physical activity found that the average reduction in breast cancer risk, when comparing the most to least physically active women, was 25% (Friedenreich et al. 2013).

2.2.2: Environmental Risks

Pollution

Harmful chemicals and pollution can be a cause of cancer but it is generally accepted that they pose only a minor risk. The World Health Organisation (WHO) and the International Agency for Research into Cancer estimated that pollution and chemicals in the environment only account for about 3% of all cancer (cited in Cancer Research UK 2009). People most at risk include those who work in industries where they are exposed to high level of chemicals in their jobs. The low level of threat associated with chemical pollution can be accounted for by the low dose levels most people are exposed to.

In relation to air pollution, evidence has shown that a mild association exists between air pollution from traffic and lung cancer (Raaschou-Nielsen et al. 2010; Vineis et al. 2006). This correlation has been attributed to the airborne presence of nitrogen oxides (NO\textsubscript{x}), sulphur dioxide, black smoke and particulate matter of aerodynamic diameter \(\leq 2.5\mu\text{m}\). However, it is accepted that the level of risk associated with air pollution is substantially lower than that associated with tobacco smoke (Cancer Research UK 2012a).
Exposure to diesel exhaust has been proven as a cause of lung cancer in humans. The study, carried out in non-metal mining facilities, found statistically significant increasing trends in lung cancer risk with increasing diesel exhaust exposure (Silverman et al. 2012). People working in at-risk industries, such as miners and railway workers, have about a 40% increased risk of developing lung cancer (Gallagher 2012).

*Ultra-Violet Light*

Skin cancer is the most common form of cancer in Ireland, with 7424 cases being reported in 2009. Although it is important to note here that despite being the most common form of cancer, it is not the cancer with the highest mortality rate in Ireland. This is because a large proportion of the reported cases of skin cancer are basal cell carcinomas (BCCs), which in general do not spread to other tissues or organs (Irish Cancer Society 2011b). There are three common forms of skin cancer; BCC, squamous cell carcinomas (SCC) and cutaneous malignant melanoma (CMM) (Armstrong and Kricker 2001). Ultraviolet (UV) light from the sun is the main cause of skin cancer; this can be in either UVA or UVB form. UV light is a physical mutagen; that is an agent which interacts with DNA in ways that cause mutations (24 - 2009). Mutations caused by UV light are distinctive; predominantly they result in C to T transitions at dipyrimidine sites, including CC to TT double base mutations (Brash et al. 1991). According to Irish Cancer Society (2011b), the majority of skin cancers could be prevented by avoiding sun exposure when the sun’s rays are at their strongest, wearing protective clothes and wearing sunscreen.

Another major cause of skin cancer is the use of sunbeds. Typically, sunbeds are in the form of a battery of fluorescent tubes underneath a UV-transmitting Perspex support with a top canopy with another battery of tubes (Young 2004). It has been shown that people who have used a sunbed, even once, have a 15% increased risk of melanoma (Gandini et al. 2013). Using a sunbed, once a month or more, may increase the risk of developing skin cancer by
more than half. The risk associated with using sunbed is particularly high for those aged below 20 (Fledman et al. 2011). Studies in England have shown that 83% of tanning beds evaluated exceed European standards for UVB radiation levels (Oliver et al. 2007); this is owing to the development of high powered lamps. UV radiation received from sunbeds can significantly stronger than that received from natural sunlight; a half-hour dose of UV radiation from a sunbed can be equivalent to the radiation received from an entire day spent in the sun (Hales 2008).

**Radiation**

Radiation can be categorised as either ionising or non-ionising. This is an important categorisation as ionising radiation, such as gamma rays, x-rays and high-energy UV rays have high enough energy to damage DNA in cells. Non-ionising radiation, such as infrared rays, microwaves or radio waves do not have enough energy to damage DNA. The bone marrow is particularly sensitive to radiation (American Cancer Society 2010). Leukaemia, a type of cancer of the bone marrow, has been linked with exposure to radiation (Pearce et al. 2012). According to American Cancer Society (2010) exposure to ionizing radiation occurs from three main sources; these are natural background radiation from cosmic rays in the solar system, medical radiation from x-rays and radiation therapy, and man-made radiation from workplaces or nuclear weapons testing in the past.

**2.2.3: Addictive Substances:**

**Smoking**

Smoking is recognised as being the most important preventable cause of cancer in the world. It is associated predominantly with lung cancer, but also increases an individual’s risk of developing cancers of the mouth, larynx, pharynx, oesophagus, liver pancreas, stomach, kidney, bladder, cervix and bowel. Evidence suggests it could also increase the risk of breast cancer (Cancer Research UK 2012c). The health risks associated with smoking are not
limited to cancer; smoking also increases risks of developing heart disease, bronchitis, emphysema, fertility and birth problems, and having a stroke. Tobacco contains around 4000 chemicals, of which 60 are known carcinogens (Crawford et al. 2012). For example, benzo(b)pyrene in cigarette smoke binds directly to DNA causing mutations (Kenny 2007).

Currently in Ireland, 29% of the population smoke (World Health Organisation 2012d). In comparison to the UK who have reduced smoking rates to 21%, Ireland is lagging behind in tackling tobacco control (O'Meara 2012). Evidence from a study spanning over 40 years, referred to as “The Doctors Study”, has proven that one in every two smokers die of a tobacco related disease (Doll et al. 1994). With such a wide spectrum of diseases caused by smoking and a high probability of smokers developing these diseases, tobacco related diseases accounts for a considerable cost to the Irish Health Service. Irish data has shown that each time a smoker is admitted to hospital with a tobacco related disease it costs, on average, €7,700 (Health Services Executive 2012).

Recent Irish data shows an average cost of €7,700 every time a smoker is admitted to hospital with a tobacco related disease. In 2008, there were over 36,000 such admissions. That cost does not include out-patient costs, GP visits, medicines and other supports provided by the HSE (Health Services Executive 2012).

Second hand smoke

Second hand smoke (SHS) is defined as “the smoke emitted either from the burning end of a tobacco product or by the exhalation of smoke-filled air by a smoker, both of which contain known human carcinogens” (IARC 2004). Air in the immediate environment of a smoker becomes contaminated with carbon monoxide, particulate matter and human carcinogens such as formaldehyde. The WHO Framework Convention on Tobacco Control have stated unequivocally that exposure to tobacco smoke causes death, disease and disability. This creates an obvious need to find ways of providing protection from exposure to tobacco smoke.
in public places (World Health Organisation 2007b). Research by Boyle and Levin (2008) found that 10-15% of lung cancers in non-smokers can be attributed to SHS.

**Alcohol**

The conformation that alcohol is carcinogenic is a recent development in cancer research; ethanol is now verified as the most important carcinogen in alcoholic beverages (Lachenmeier et al. 2012). A study by a Collaborative Group on Hormonal Factors in Breast Cancer (2002) has shown that levels lower than one alcoholic drink a day can have significant effects on breast cancer. Prior to the recent confirmation that alcohol is carcinogenic; its consumption had been associated with cancers of the mouth, pharynx, larynx, oesophagus, liver and bowel. The negative effects of alcohol is not restricted to cancer; it has also been linked with liver disease, cardiovascular disease, disorders of the digestive tract (Bagnardi et al. 2001).

Despite this, alcohol consumption trends are on the increase and according to WHO, alcohol is the third leading factor for risk to health. In Western Europe, alcohol consumption trends have been noted to be especially fatal for younger age groups and only 2% of adults completely abstain from alcohol consumption (World Health Organisation 2011b). This problem surrounding the dangers of alcohol consumption has been found to be more significant for men with 6.2% of all male deaths globally being related to alcohol, compared to 1.1% of female deaths (World Health Organisation 2011a).

**2.2.4: Sexual and Reproductive Health**

Some sexually transmitted diseases have been linked with certain cancers; the most well documented of these is Human Papillomavirus (HPV). HPV, the most common sexually transmitted disease in the world, is an infection of the cervix (Botha & Dochez, 2010). HPV is passed on through direct skin contact during sex and it show few symptoms so most women will be unaware if they have contracted the infection. This is despite the fact that
most sexually active women will contract it as some stage of their life. There are about 100
different types of HPV, most of which do not cause harm. HPV 16 and 18 are high-risk types
of HPV as these can cause cervical cancer; however they show no symptoms (Cuzick et al.
2010). Not all women who contract HPV develop cervical cancer; however 99.7% of women
who get cervical cancer are HPV positive. Smear tests are used to diagnose women with
HPV; the cells from the cervix collected can be tested to determine the type of HPV present.
Viral genes in HPV can destroy growth regulatory proteins in cervical cells leading to
unregulated division of cervical cells (Kenny 2007). Free smear tests are provided for Irish
women between the ages of 25 to 60 (The National Cancer Screening Service 2005). The risk
of cervical cancer through infection by HPV can be reduced by being vaccinated against
HPV; this helps the body’s immune system recognise and fight infections by making
antibodies. This vaccine is now provided free of charge for all girls in their first year of post-
primary school as part of the national cervical vaccination programme (Irish Cancer Society
2011c).

2.2.5 Other Selected Risks:

Genetic Susceptibility

The contribution of genetics to cancer development is a difficult area to investigate as
population-based studies provide quantitative estimated of inherited risks; they do not
however differentiate between the effects of shared genes and the effects of shared
environment. Environmental factors, such as habits and diet, can affect susceptibility to
developing cancer, as discussed in Sections 2.2.1 to 2.2.4 (Czene et al. 2002). All cancers
develop because of genetic problems; something going wrong with one or more of the genes
in a cell. However, the distinguishing factor between a cancer which is inherited and one that
is not is if the problem with the genes occurs during a person’s life or if they are born with
the defective gene. The inheritance of a specific cancer gene is relatively rare. For example
only 3% of breast cancers are due to inherited defective genes (Cancer Research UK 2011a).
Despite the general perception that a person’s family history puts them at greater risk of developing cancer, this is largely owing to the fact that cancer is a common disease and most families have some history of the disease; cancer is the leading cause of death worldwide (World Health Organisation 2012a). The more relatives who have had cancer and the younger they were at diagnosis makes a person’s family history is more significant (Cancer Research UK 2011a).

Certain genes are however linked directly to certain cancers. For example, the Familial adenomatous polyposis (FAP) gene is a faulty inherited gene which is the cause of about 1% of bowel cancers. This is due to its ability to cause hundreds of non-cancerous growths in the bowel called polyps. These polyps develop at a young age and increase the risk of bowel cancer development due to their abundance (Campbell et al. 1994; Lal and Gallinger 2000).

Mutated versions of the genes, BRCA1 and BRCA2, are associated with the development of breast and ovarian cancer. The inheritance of these genes is rare; however 50 to 80% of women who do inherit one of these genes develop breast cancer. 40% develop ovarian cancer (Cancer Research UK 2011b).

**Viruses**

Human cancers do not commonly have viral components (Kenny 2007). However, two better known cancer-causing viruses are HPV and Hepatitis B (HBV). HPV, a sexually transmitted disease discussed in Section 2.2.4. HPV is the leading cause of cervical cancer worldwide (National Cancer Institute 2012a).

HBV is an extremely infectious disease which can cause liver cancer. HBV is transmitted by direct blood-to-blood contact or through semen and vaginal fluids. It is a particularly chronic virus if infected in early childhood. 25% of adults who contracted HBV in childhood die of
liver cancer (World Health Organisation 2012b). The process by which HBV causes liver cancer is outlined in Figure 2.1.

![Figure 2.1: Hepatitis B Virus and Liver Cancer](image)

Adapted from (Cancer Research UK 2012b)

**Aging**

Cancer is the result of a collection of specific mutations. As we age, we accumulate more of these mutations. This is despite the fact that cancer is a disease associated with excessive growth of cells and aging is the tiring of cell division in a body. According to the American National Cancer Institute, those in the age bracket of 65+ are 10 times more likely to get cancer and 15 times more likely to die from cancer compared to those under 65 (cited in USC Health 2005). Similar figures were found in Ireland, with the vast majority of cases of cancer
occurring in over 60’s (Table 2.2). The association between aging and cancer has been attributed to that fact that the same damaging forces drive both cancer and aging. For example, oxidative stress which damages DNA though free radicals and other molecules has been associated with aging and cancer (Hobson 2009).

Table 2.2: Percentage of cancers in Ireland attributed to people aged 60+, 1995 - 2007

<table>
<thead>
<tr>
<th>Type of Cancer</th>
<th>Percentage of Males</th>
<th>Percentage of Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-melanoma skin cancer</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>-----</td>
<td>50</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>83</td>
<td>82</td>
</tr>
<tr>
<td>Prostate cancer</td>
<td>87</td>
<td>-----</td>
</tr>
<tr>
<td>Non-Hodgkin’s Lymphoma</td>
<td>57</td>
<td>76</td>
</tr>
<tr>
<td>Stomach cancer</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>51</td>
<td>47</td>
</tr>
<tr>
<td>Bladder cancer</td>
<td>51</td>
<td>47</td>
</tr>
<tr>
<td>Neck cancer</td>
<td>61</td>
<td>66</td>
</tr>
<tr>
<td>Leukaemia</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>Pancreatic cancer</td>
<td>81</td>
<td>87</td>
</tr>
<tr>
<td>Kidney cancer</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>Oesophageal cancer</td>
<td>75</td>
<td>86</td>
</tr>
<tr>
<td>Ovarian cancer</td>
<td>-----</td>
<td>61</td>
</tr>
<tr>
<td>Brain and other Central Nervous System cancers</td>
<td>45</td>
<td>53</td>
</tr>
<tr>
<td>Uterine cancer</td>
<td>-----</td>
<td>62</td>
</tr>
<tr>
<td>Cervical cancer</td>
<td>-----</td>
<td>23</td>
</tr>
</tbody>
</table>

(National Cancer Registry and Northern Ireland cancer Registry 2011)

2.3: Cancer and other Health Issues

Although cancer is one of the leading causes of death in Ireland there are many other serious contributors to be considered. The main causes of death in Ireland are summarised in Figure 2.2. Diseases of the circulatory system are the leading cause of death in Ireland; closely followed by cancers.
The substantial link between cancers and certain diseases (such as HPV) and lifestyle factors (such as obesity) have been established in Section 2.1. The general health and well-being of a population is therefore an important determinant in cancer development rates as well as the development of other chronic diseases. Lifestyle factors such as alcohol consumption, obesity and smoking are linked with health issues such as cardiovascular diseases (Vandongen et al. 1995), diabetes (Brage et al. 2004), and hormonal disorders (e.g. Polycystic Ovarian Syndrome) (Huber-Buchholz et al. 1999). Physical activity in particular has been identified by the World Health Organisation (2002b) as a positive contributor to the prevention and management of over 20 chronic diseases. It is estimated that 3% of disease burden in developed countries is caused by physical inactivity and that over 20% of chronic heart disease and 10% of stroke in developed countries is due to physical inactivity.

These health issues with a preventable nature account for a large portion of Health Service costs, both nationally and internationally. In Ireland the Taskforce on Obesity Report
estimated direct healthcare costs for treating obesity in 2002 at €70 million (Department of Health and Children 2005). In Britain, chronic heart disease cost the Health Care System £3.5 billion in 2003 (British Heart Foundation 2006). Furthermore, the direct costs of obesity in 2002 were estimated at £46-49 million per year and the costs of treating the consequences of obesity at approximately £945-£1,075 million per year (House of Commons Health Committee 2004).

Such realisations lead logically to the need for health promotion campaigns. Mass media techniques of health promotion to reach the general population have potential value in raising the profile of health issues (Wellings and Macdowall 2000). Roisin Shortall, Minister of State in the Department of Health, recognised the success of HSE media campaigns informing communities about many lifestyle issues that affect health (Shortall 2011). Despite the accomplishments of such mass media campaigns, the importance of health promotion in schools cannot be denied (Hales 2008; Jourdan et al. 2008). The World Health Organisation (2002a) has identified an effective school health programme as one of the most cost effective investments a nation can make to improving education and health. The WHO promotes school health programmes as a strategic means to prevent important health risks among youth (World Health Organisation 2002a).

2.4: Health Promotion and Health Education

The terms health promotion and health education are closely related paradigms; they are however not interdependent. After the analysis of a broad range of health-related literature, they have been defined by Whitehead (2004) as follows:

“Health Education is an activity that seeks to inform the individual on the nature and causes of health/illness and that individual’s personal level of risk associated with their lifestyle-related behaviour. Health education seeks to motivate the individual to accept a process of behavioural-change through directly influencing their value,
belief and attitude systems, where it is deemed that the individual is particularly at risk or has already been affected by illness/disease or disability.”

(Whitehead 2004)

“Health promotion is the process by which the ecologically-driven socio-political-economic determinants of health are addressed as they impact on individuals and the communities within which they interact. This serves to counter social inaction and social division/inequality. It is an inherently political process that draws on health policy as a basis for social action that leads to community coalitions through shared radical consciousness. Health promotion seeks to radically transform and empower communities through involving them in activities that influence their public health – particularly via agenda setting, political lobbying and advocacy, critical consciousness-raising and social education programs. Health promotion looks to develop and reform social structures through developing participation between representative stakeholders in different sectors and agencies.”

(Whitehead 2004)

Both terms are relevant for this study, although health promotion can be seen to relate more strongly to the process of improving pupil populations understanding of health issues through a formal educational setting. Health education is concerned with identifying factors in a pupil’s life-style which may pose health risks.

2.4.1: Introduction to Irish Education System

The Irish Education System is divided into three major sections; primary education, post-primary education and third-level education. Children begin primary education between the ages of four and six; they remain in primary education for eight years. The curriculum for primary education covers key areas including language, mathematics, social, environmental and scientific education, arts education, physical integration, and social personal and health education (Citizens Information 2011).
Post-primary education in Ireland is divided into two main sections; the Junior Cycle and the Senior Cycle. The Junior Cycle is part of the compulsory period of education taken by Irish pupils (Citizens Information 2011). The Junior Cycle curriculum is based on the principles of breadth and balance, equity, relevance, coherence, continuity and progression (Department of Education and Science 2003a). Pupils commence the Junior Cycle at about the age of 12. The Junior Certificate examinations are taken after three years when pupils are about 15 years of age; these are state examinations set by the Irish Department of Education.

Subjects for the Junior Certificate are usually studied at Ordinary Level or Higher Level; English, Irish and mathematics can also be studied at foundation level (National Council for Curriculum and Assessment 2011). Also available at Junior Cycle, as an alternative to the Junior Certificate, is the Junior Certificate School Programme (JCSP). This programme targets pupils at risk of leaving school before completing the Junior Certificate and is available in schools participating in the Delivering Equality of Opportunities in Schools (DEIS) initiative, traveller training centres, children detention schools and youth encounter projects. JCSP facilitates a profiling system which allows teachers to monitor and record progress and achievements of pupils. Learning targets are supplied to encourage pupils to work through short-term manageable units of work (National Council for Curriculum and Assessment 2010). The Junior Cycle has recently undergone a review and a new Junior Cycle framework was published in October 2012; this aims at improving the experience of Junior Cycle pupils and reducing the emphasis on rote learning for the Junior Certificate examinations. Major changes in the new framework include the introduction of short courses which link directly to the key skills; these are equivalent to half a traditional subject such as English or mathematics. The new Junior Cycle will be implemented over four phases between 2014 and 2020 as outlined in Table 2.2 below (Department of Education and Skills 2012).
<table>
<thead>
<tr>
<th>Phase 1: Introduced to 1st years in school year 2012-15</th>
<th>Phase 2 Introduced to 1st years in school year 2015-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>First certification in autumn 2017</td>
<td>First certification in autumn 2018</td>
</tr>
<tr>
<td>English</td>
<td>Irish</td>
</tr>
<tr>
<td></td>
<td>Science</td>
</tr>
<tr>
<td></td>
<td>Business Studies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 3 Introduced to 1st years in school year 2016-17</th>
<th>Phase 2 Introduced to 1st years in school year 2017-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>First certification in autumn 2019</td>
<td>First certification in autumn 2020</td>
</tr>
<tr>
<td>Art, Craft, Design</td>
<td>Mathematics</td>
</tr>
<tr>
<td>Modern Languages</td>
<td>Technology subjects</td>
</tr>
<tr>
<td>Home Economics</td>
<td>Religious Education</td>
</tr>
<tr>
<td>Music</td>
<td>Jewish Studies</td>
</tr>
<tr>
<td>Geography</td>
<td>Classics</td>
</tr>
<tr>
<td></td>
<td>History</td>
</tr>
</tbody>
</table>

(adapted from Department of Education and Skills 2012)

**Transition Year** (TY), an optional year of study, follows the Junior Certificate examination. It is free from formal examinations and allows pupils to experience a wide range of educational inputs (National Council for Curriculum and Assessment 2004). It is offered by approximately 75% of Irish post-primary schools. The design of the TY programme differs from school to school, within set guidelines, to suit the needs and interest of the pupils (National Council for Curriculum and Assessment Undated).

The final two years of post-primary education is referred to as the **Senior Cycle**. This gives the pupils an option of three programmes to participate in; the established Leaving Certificate, the Leaving Certificate Vocational Programme or the Leaving Certificate Applied. The established Leaving Certificate is the main basis upon which places in third-level education are allocated. The Leaving Certificate Vocational Programme (LCVP) places a concentration on technical subjects and includes additional modules which have a
vocational focus. The Leaving Certificate Applied (LCA) programme primarily aims to prepare the participants for adult and working life through relevant learning experiences. These aim to develop the following areas: spiritual, intellectual, social, emotional, aesthetic and physical (Citizens Information 2011). The Leaving Certificate Applied is not recognised for direct entry to third-level courses but it enables pupils to take Post-Leaving Certificate (PLC) Courses (Citizens Information 2011). PLC Courses are full-time one year courses which prepare participants for employment or further education. They integrate education, training and work experience and provide an alternative route to third-level education (Qualifax 2012).

Within the context of this current post-primary education system, there are a number of subjects which incorporate health education and health promotion. In Junior Cycle these include SPHE (Department of Education and Science 2000), Science (Department of Education and Science 2003a), Home Economics (Department of Education and Science 1991), and Physical Education (Department of Education and Science 2003b). In the Senior Cycle, health education and health promotion are integrated into the Biology (Department of Education and Science 2001a) and Home Economics (Department of Education and Science 2001b) syllabi.

**Health Promotion in Irish Education System**

A report by the Institute of Public Health in Ireland (2008) stated that Education is an important social determinant of health as it provides individuals with the knowledge and skills to maintain and improve their health. The strong link between education and health has also been affirmed by the Organisation for Economic Cooperation and Development (OECD) in the Social Outcomes of Learning project (Feinstein et al. 2006). Low educational attainment has been associated with increased risk of lung cancer, stroke, cardiovascular disease and infectious disease (Ross and Wu 1995; Feinstein et al. 2006; Comstock and
The link between educational attainment and health status has largely been associated with the engagement in healthy behaviours by those with a higher level of education. In relation to physical activity, diet, smoking and sexual activity; those with higher levels of education are less likely to develop unhealthy habits (van Oort et al. 2004).

In Ireland legislation governing school attendance states that the minimum school leaving age is 16. Children are required to attend a recognised school from the ages of 6 to 16 (Citizens Information 2009). About 55,000 remain in second level education to complete the Leaving Certificate each year (54,481 in 2010) (State Examinations Commission 2010). Ireland was ranked 7th out of 28 countries for post-primary school graduation rates in 2009, with just over 90% of pupils graduating from post-primary school. Ireland was also ranked 1st out of the 28 countries who participated in the OECD report for access to third-level education (Organisation for Economic Co-operation and Development 2011). In 2010, 32,782 pupils under the age of 20 enrolled in Undergraduate courses in Irish Universities and Institutes of Technology (Higher Education Authority 2010). No statistics could be obtained for the exact number of pupils who moved directly from second-level education to third-level education in 2010; the age bracket of these figures however, suggests that the majority of these pupils would have completed the Leaving Certificate in the previous year. Overall the figures represent verification that the level of educational attainment in Ireland is reasonably high.

Despite this high level of educational attainment in Ireland, the corresponding high level of health awareness that would be expected is not apparent. A recent survey carried out at University College Cork in conjunction with Breakthrough Cancer Research and the Irish Cancer Society found that the public lack basic knowledge of proven cancer health threats such as obesity, age, sunlight, alcohol and lifestyle. This study constituted of 748 participants aged between 18 and 74, representing a broad age bracket (Breakthrough Cancer Research 2012). Many mistaken beliefs were identified, such as a quarter of participants believing that
more than 50% of cancers are inherited and over 70% not believing obesity was a risk factor for developing cancer. These health threats are further reaching then cancer alone; many of the risk factors associated with cancer are also associated with, for example, cardiovascular disease and diabetes (World Cancer Research Fund and American Institute for Cancer Research 2007). The findings of this study suggest a low level of health education in the Irish public.

**Social Personal and Health Education**

Health education is largely facilitated in post-primary education through the subject Social, Personal and Health Education (SPHE) which has an established syllabus since 2000. It is a core curriculum requirement in the Junior Cycle since 2003 (Gabhainn et al. 2010). The modules to be completed over the three years of the Junior Cycle are outlined in Table 2.4 below.
### Table 2.4: The Structure of an SPHE Programme

<table>
<thead>
<tr>
<th>Modules</th>
<th>Topics for Year 1</th>
<th>Topics for Year 2</th>
<th>Topics for Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belonging and integrating</td>
<td>1. Coping with change</td>
<td>1. Looking back, looking forward</td>
<td>1. Goal-setting for third year</td>
</tr>
<tr>
<td></td>
<td>2. Joining a new group</td>
<td>2. Group work</td>
<td>2. Work contract</td>
</tr>
<tr>
<td></td>
<td>3. Appreciating difference</td>
<td>3. Family ties</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Bullying is everyone’s business</td>
<td></td>
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<tr>
<td></td>
<td>5. Coping with loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Organising my work at home and in school</td>
<td>2. Study skills</td>
<td>2. Planning for effective study</td>
</tr>
<tr>
<td>Communication skills</td>
<td>1. Express yourself</td>
<td>1. Assertive communication</td>
<td>1. Learning to communicate</td>
</tr>
<tr>
<td></td>
<td>2. Learning to listen</td>
<td></td>
<td>2. Communication and situations of conflict</td>
</tr>
<tr>
<td></td>
<td>3. Passive, assertive and aggressive communication</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>2. Healthy eating</td>
<td></td>
<td>2. Relaxation</td>
</tr>
<tr>
<td></td>
<td>3. Exercise</td>
<td></td>
<td>3. Diet</td>
</tr>
<tr>
<td></td>
<td>2. A good friend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationships and sexuality</td>
<td>1. Me as a unique and different</td>
<td>1. From conception to birth</td>
<td>1. Body image</td>
</tr>
<tr>
<td></td>
<td>2. Friendship</td>
<td>2. Recognising and expressing feelings and emotions</td>
<td>2. Where am I now?</td>
</tr>
<tr>
<td></td>
<td>4. The reproductive system</td>
<td>4. Managing relationships</td>
<td>4. The three R’s – respect, rights and responsibilities</td>
</tr>
<tr>
<td></td>
<td>5. Images of male and female</td>
<td>5. Making responsible decisions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Respecting myself and others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional health</td>
<td>1. Recognising feelings and the feelings of others</td>
<td>1. Self-confidence</td>
<td>1. Stress</td>
</tr>
<tr>
<td></td>
<td>2. Respecting my feelings</td>
<td>2. Body image</td>
<td>2. Feelings and moods</td>
</tr>
<tr>
<td>Influences and decisions</td>
<td>1. My hero</td>
<td>1. Positive and negative influences</td>
<td>1. Making a good decision</td>
</tr>
<tr>
<td></td>
<td>2. Making decisions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Smoking and its effects</td>
<td>3. Alcohol: why, why not?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Cannabis: Why, why not?</td>
<td></td>
</tr>
<tr>
<td>Personal safety</td>
<td>1. Looking after myself</td>
<td>1. Accidents at home and in school</td>
<td>1. Recognising unsafe situations</td>
</tr>
<tr>
<td></td>
<td>2. Feeling threatened</td>
<td></td>
<td>2. Violence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Help agencies</td>
</tr>
</tbody>
</table>

(Department of Education and Science 2000)
SPHE aims to promote self-esteem and self-confidence, personal skills, responsible decision-making, opportunities to reflect and discuss and to promote physical, mental, emotional health and well-being (Geary and Mannix McNamara 2003). Within the structure of the SPHE course outlined in Table 2.2, health education is incorporated into the modules physical health and substance use. According to the Department of Education and Science, SPHE provides pupils with dedicated time and space to develop the skills and competencies to learn about themselves and care for themselves and others, and to make informed decisions about their health, personal lives and social development (Department of Education and Science 2000). SPHE was introduced into secondary schools in 2000 and is a mandatory subject for all Junior Cycle pupils. Uptake of the subject is in accordance with its mandatory status; over 99% of pupils in Junior Cycle programmes partake in SPHE (Table 2.5).

Table 2.5: Comparison of Total Pupils Enrolled at Junior Cycle (all years) with Total Pupils Partaking in SPHE at Junior Cycle (all years)

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils Enrolled at Junior Cycle in Second Level Schools</td>
<td>172,648</td>
<td>176,706</td>
<td>180,470</td>
</tr>
<tr>
<td>Pupils taking the subject SPHE in Junior Cycle</td>
<td>172,340</td>
<td>176,617</td>
<td>180,341</td>
</tr>
<tr>
<td>Pupils partaking in SPHE as a percentage of all Junior Cycle pupils</td>
<td>99.82%</td>
<td>99.94%</td>
<td>99.92%</td>
</tr>
</tbody>
</table>

Footnote: Figures given are in number of pupils. Year refers to school year end, i.e. 2010 refer to 2009/2010 school year.

(The Department of Education and Skills 2010 - 2012)

Requirements for the teaching of SPHE at Junior Cycle are outlined in the Teaching Council Report, ‘General and Special Requirements for Teachers of Recognised Subjects in Mainstream Post-Primary Education’ (The Teaching Council 2012a). Teachers recognised to teach SPHE must fulfil the following criteria:

1. Prior achievement of the general and special requirements for recognition to teach at least one of the recognised subjects in mainstream post-primary education.
2. The study of a suitable graduate diploma or equivalent in SPHE.
3. The skills, knowledge and understanding to effectively design and deliver the SPHE and RSE (Relationships and Sexuality Education) curricula to the highest level in mainstream post-primary education.

4. Explicit details of standards achieved in the above graduate diploma with at least an overall Pass result in the examinations.

(The Teaching Council 2012a)

It has been recognised that the requirements are seldom enforced. No specific degree or teacher education programme was included on ‘Post-Primary Registration Document’ published by the Teaching Council, as SPHE is recognised as a specialist area, not a curricular subject (The Teaching Council 2012b). The NCCA recognised that SPHE is seen as a time table filler for teachers and there is a need for teachers to be properly trained (National Council for Curriculum and Assessment 2006).

Despite SPHE being the primary facilitator of health education and health promotion in secondary schools, it is only available at Junior Cycle level; no corresponding or continuing course exists for Senior Cycle pupils. The need for a SPHE to be integrated to the Senior Cycle has previously been recognised. In 2006, the National Council for Curriculum and Assessment (NCCA) published a consultation report on SPHE for Senior Cycle inclusion. The conclusions formed from this report recognised the need for SPHE in Senior Cycle in order to allow students to develop their understanding of health and wellbeing (National Council for Curriculum and Assessment 2006). Since this report, no further action or progress has been published by the NCCA in relation the development of Senior Cycle SPHE (National Council for Curriculum and Assessment 2005). Other subjects stated to have cross curricular links with the SPHE syllabus include science and home economics for their roles in health promotion (Department of Education and Science 2000).
2.4.2: Incorporation of Health with Other Subjects

Health education should contribute directly to a student’s ability to successfully practice behaviours that protect and promote health and reduce health risks (Child-to-Child Trust and UNICEF 1997). In the absence of a standalone health education subject in the Irish Education System, the incorporation of health into other core academic disciplines is necessary. Such disciplines at Junior Cycle education include Home Economics and Science.

Home Economics

The rationale of the Junior Cycle subject Home Economics leaves significant scope for integration of health education and health promotion. It states that Home Economics has direct relevance to the present and future life of students. Two of the main content areas for the Home Economics syllabus which particularly relate to health promotion are food studies and social/health studies (Department of Education and Science 1991).

The area of food studies aims to impart knowledge relating to the role diet plays in health, nutritional requirements, and current dietary advice and issues. Relevant learning outcomes listed from this section include:

- Why good health depends on eating a variety of foods.
- Why there is a range of dietary needs among people.
- Why current dietary advice should be considered.

In SPHE, the area of social and health studies is concerned with issues which influence the lifestyles and expectations of young people. The content relating specifically to health education in the SPHE syllabus includes:

- Care of the body
- Hygiene
- Health hazards – smoking, alcohol, and other substance abuse
- Sex education
These areas overlap extensively with the causes of chronic diseases discussed in Section 2.2 and 2.3 signifying an opportunity to assimilate specific material relating to, for example how healthy diets and exercise routines can vastly reduce an individual’s likelihood of developing chronic diseases such as colon cancer or diabetes. Problems with the Junior Certificate Home Economics syllabus include the fact that it has not been updated since 1991. Integration of up-to-date health related issues is reliant on individual teachers.

**Science**

Science is widely recognised as an ideal subject for the incorporation of health related issues (Child-to-Child Trust and UNICEF 1997; Alliance for a Healthier Generation 2012). For example, Child-to-Child Trust and UNICEF (1997) lists learning about air, water and how the body works as areas with opportunity for health integration. The suitability of science as a subject for integrating health education is evident in the syllabus aims for the Irish Junior Certificate Science Syllabus. These state that science education at junior cycle should “enable students to acquire an understanding of relevance and applications of science in their personal and social lives” (Department of Education and Science 2003a). The area of biology on this syllabus in particular leaves scope for assimilation for health issues. Biology is prominently concerned with understanding how the body functions and how it develops allowing students to gain an appreciation of the processes of change that occur during a person’s life (Department of Education and Science 2003a). Learning outcomes expected from the area of Human Biology with opportunity for the integration of health education include:

- Recall that a balanced diet has six constituents
- Describe a food pyramid and give examples of types of food recommended in a balanced diet
• Read and interpret the energy values indicated on food product labels and compare
  the energy content per100g of a number of foods, and identify that food types on the
  label that form part of a balanced diet
• Describe how oxygen is taken into the bloodstream from the lungs and how carbon
dioxide is taken into the lungs from the bloodstream during gaseous exchange and
how these processes are affected by smoking
• The effect of exercise and rest on pulse and breathing rate and understand that a
  balance of each promotes good health
• An understanding of human reproduction
• An understanding of forms of contraception
• An understanding of inheritable and non-inheritable characteristics and that genes
  control inheritable characteristics

(Department of Education and Science 2003a)

Child-to-Child Trust and UNICEF (1997) outlined twenty possible activities where science
  can be linked with health (Figure 2.6), showing numerous opportunities to improve students
  level of health awareness. These activities outline areas of Chemistry, such as water quality,
  and areas of Physics, such as friction, which are also appropriate for the integration of health
  education. However, the areas health education being focused on for this study (causes and
  prevention of chronic diseases) can mostly be integrated into the area of Biology at Junior
  Cycle Science.
<table>
<thead>
<tr>
<th>Twenty Activities Linking Science with Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hygiene</td>
</tr>
<tr>
<td>1. Investigating hand washing, How do we get our hands really clean? (L)</td>
</tr>
<tr>
<td>2. Investigating different ways of cleaning teeth. How can we make materials for cleaning teeth? (L)</td>
</tr>
<tr>
<td>3. How can we improve water quality? (M/U)</td>
</tr>
<tr>
<td>4. How can we make pure drinking water by evaporation and condensation? (U)</td>
</tr>
<tr>
<td>5. How can we measure air pollution? (U)</td>
</tr>
<tr>
<td>6. Experiments to show how sweet drinks rot teeth. (M)</td>
</tr>
<tr>
<td>7. Investigating the best ways of washing and drying clothes. (M/U)</td>
</tr>
<tr>
<td>8. Looking at ways of putting out fires (burning needs air). (M/U)</td>
</tr>
<tr>
<td>9. Investigating what makes loads on lorries or bikes tip over (centre of gravity).</td>
</tr>
<tr>
<td>10. Looking at how braking works, and what conditions make braking on cars and bikes more difficult (friction). (U)</td>
</tr>
<tr>
<td>11. Finding out what values different foods habe and how different kinds of food can help us grow well and stay healthy. (U)</td>
</tr>
<tr>
<td>12. Looking at micronutrients such as iron and iodine and how these need to be present in our foods to help us stay healthy. (U)</td>
</tr>
<tr>
<td>13. Finding out how dangerous insects breed and how to prevent them breeding. (L/M)</td>
</tr>
<tr>
<td>14. Investigating how microbes make food go bad. (U)</td>
</tr>
<tr>
<td>15. Why boiling water kills bacteria. (U)</td>
</tr>
<tr>
<td>16. How germs can be passed through hands and water.</td>
</tr>
<tr>
<td>17. How epidemics such as Cholera can be spread. (M/U)</td>
</tr>
<tr>
<td>18. Experiments about breathing.</td>
</tr>
<tr>
<td>- How children breathe at different rates at different ages. (M)</td>
</tr>
<tr>
<td>- Recognising danger signs in breathing (when little children have infections such as pneumonia). (M)</td>
</tr>
<tr>
<td>19. Investigation (models) of how smoking makes our lungs dirty. (U)</td>
</tr>
<tr>
<td>20. Models to show how babies are born and why training help is sometime important. (U)</td>
</tr>
</tbody>
</table>

(L): Suitable for lower primary classes; (M): Suitable for middle primary classes; (U): Suitable for upper primary and lower secondary classes.

Figure 2.3: Twenty Activities Linking Science with Health

(Child-to-Child Trust and UNICEF 1997)

Furthermore, the ways of learning and thinking which science helps to develop are an important skill to develop when learning how to lead a healthier life (Child-to-Child Trust
and UNICEF 1997). Skills a student should develop from participation in the Junior Cycle Science Curriculum include procedural planning, problem solving, observation, obtaining useful information from a variety of sources, logical thinking, inductive and deductive reasoning and the formation of opinions based on evidence and experiment (Department of Education and Science 2003a). The ability to think like scientists when approaching health content will help students to ask questions and seek answers rather than just believing everything they are told. For example, the skill of observation will allow students to see what really is, not what they want to see (Child-to-Child Trust and UNICEF 1997).

2.4.3: Health Education from an International Perspective

A review of health education from an international perspective has exposed a wide variety of systems and techniques used to impart health related knowledge to students. In Canada health education is provided in conjunction with physical education. The subject, referred to as Health and Physical Education, aims at helping students develop an understanding of what they need in order to make a commitment to lifelong healthy, active living and develop the capacity to live satisfying, productive lives. Achieving ‘Health Literacy’ is an aim listed in the Health and Physical Education syllabus. Health literacy is having the skills needed to obtain, understand and use information to allow individuals make good decisions for their health. A comprehensive Health and Physical Education curriculum has been drawn up by the Canadian government due to their belief that healthy, active living benefits both individuals and society; for example it increases productivity and readiness for learning, improving morale, decreasing absenteeism, reducing health-care costs, decreasing anti-social behaviour such as bullying and violence, promoting safe and healthy relationships, and heightening personal satisfaction (Ontario Ministry of Education 2010). The well-rounded nature of the Health and Physical Education curriculum is summarised in Figure 2.4.
The American Education System is also mindful of the importance of Health Education. The American Education System is decentralised; schools are primarily the responsibility of each individual state instead of having a national education system or a national curriculum (Bureau of International Information Programs undated). However, most states require students to complete health education courses in order to graduate from High School. The New York State Education Department (2011) lists health education as a diploma requirement. Washington State outlines Health and Fitness Learning Standards from kindergarten to high school (Superintendent of Public Instruction Washington 2008).

In the United Kingdom (UK) the subject Personal, Social, Health and Economic Education (PSHEE) is the main programme which provides students with health education. This is provided at Key stage 3 (Ages 11-14) and Key Stage 4 (Ages 14-16) of secondary education. Similarly to SPHE in Ireland, its syllabus is broad and encompasses a wide variety of areas for personal well-being of pupils. However, unlike SHPE, PSHEE is a non-statutory
programme in UK schools (Department of Education 2011a). PSHEE aims at helping pupils learn to recognise, develop and communicate their qualities, skills and attitudes, build knowledge, confidence and self-esteem and make the most of their abilities (Department of Education 2011b). The range and content of the PSHEE syllabus is outlined in Table 2.6. The similarities between PSHEE and the structure of the SPHE course (Table 2.4) are evident.

Other similarities between Ireland and the UK can be observed in the fact that health education is integrated into school subjects such as science and physical education. In the UK the science syllabus for Key Stage 4 includes a requirement to study organisms and health. This area includes examining how human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatments (Department of Education 2007c). Furthermore, Key Stage 3 allows students to consider how knowledge and understanding of science informs personal and collective decisions, including those on substance abuse and sexual health (Department of Education 2007b). For physical education, syllabi for Key Stage 3 and 4 emphasise the importance of giving students an understanding of how physical activity contributes to the healthy functioning of the body and mind and is an essential component of a healthy lifestyle (Department of Education 2007a). However, the importance of diet for a healthy lifestyle is not mentioned.
Table 2.6: Range and Content of PSHEE Syllabus

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>The effect of diverse and conflicting values on individuals, families and communities and ways of responding to them.</td>
</tr>
<tr>
<td>b</td>
<td>How the media portrays young people, body image and health issues.</td>
</tr>
<tr>
<td>c</td>
<td>The characteristics of emotional and mental health, and the causes, symptoms and treatments of some mental and emotional health disorders.</td>
</tr>
<tr>
<td>d</td>
<td>The benefits and risks of health and lifestyle choices, including choices relating to sexual activity and substance use and misuse, and the short and long-term consequences for the health and mental and emotional wellbeing of individuals, families and communities.</td>
</tr>
<tr>
<td>e</td>
<td>Where and how to obtain health information, how to recognise and follow health and safety procedures, ways of reducing risk and minimising harm in risky situations, how to find sources of emergency help and how to use basic and emergency first aid.</td>
</tr>
<tr>
<td>f</td>
<td>Characteristics of positive relationships, awareness of exploitation in relationships and of statutory and voluntary organisations that support relationships in crisis.</td>
</tr>
<tr>
<td>g</td>
<td>The roles and responsibilities of parents, carers, children and other family members.</td>
</tr>
<tr>
<td>h</td>
<td>Parenting skills and qualities and their central importance to family life</td>
</tr>
<tr>
<td>i</td>
<td>The impact of separation, divorce and bereavement on families and the need to adapt to changing circumstances.</td>
</tr>
<tr>
<td>j</td>
<td>The diversity of ethnic and cultural groups, the power of prejudice, bullying, discrimination and racism, the need to take the initiative in challenging this and other offensive behaviours and in giving support to victims of abuse.</td>
</tr>
</tbody>
</table>

(Department of Education 2012)

2.4.4: Health Status of Irish Adolescents

*Obesity*

A review of the available literature in relation to the general health status of Irish adolescents was carried out to determine the extent to which they are exposed to the risk factors discussed in Section 2.1. The prevalence of obesity in Irish adolescents was obvious from the extensive literature in this area. A study by Lissau et al. (2004) found that Ireland was one of the top four countries out of the 15 investigated for high prevalence of overweightness in adolescents. A more recent study by O'Neill et al. (2007) found that the occurrence of overweight and obesity in Irish school children is high and had had a two-to-fourfold increase in the 15 years previous to the study, indicating a growing public health problem. It has been proven that obesity in adolescents is a strong precursor for obesity and related morbidity in
adulthood; 50 to 80% of obese adolescents are obese in adulthood (Lissau et al. 2004). The Irish National Taskforce on Obesity published the report on their findings in 2005. One of their significant findings (Figures 2.1 and 2.2) was that adolescent boys and girls significantly underestimate their body size (Department of Health and Children 2005). This suggests a clear lack of knowledge and understanding of body size, weight and BMI in Irish adolescents. Results from the Health Behaviour in School Aged Children (HBSC) survey represent self-reported BMI-for-age and sex. These are compared with the North South Survey (NSS) results of measured BMI-for-age and sex.

Figure 2.5: Percentage of boys overweight and obese (BMI for age and sex ≥ 25kg/m²)

(Department of Health and Children 2005)
The Report of the Irish National Taskforce on Obesity also found a worrying trend in the energy dense food consumption patterns of Irish children. Figure 2.3 shows that, on a daily basis, 51% of Irish children consumed sweets, 37% drank fizzy drinks, 27% consumed crisps, 12% ate chips and 7% ate hamburgers (Department of Health and Children 2005).
Physical Activity

Consistent with the high level of obesity in Irish adolescents, studies have found that many Irish children also have low levels of physical activity. A number of studies investigating levels of physical activity among Irish children and adolescents were identified in the literature. A study by Hussey et al. (2001) of children in Dublin aged 7 to 9 reported high levels of sedentary behaviour. This study found that 77% of children in this age bracket spend at least two or three hours a day in front of a screen either playing computer games or watching television. Another study carried out in a rural area of Ireland which used an accelerometer device to measure movement of participants over a seven day period, confirmed sedentary behaviours in children of 5 years old. The participants in this study spent, on average, 78% of time monitored in sedentary behaviour; devices were worn from when the participants got up in the morning until they went to bed at night (Kelly et al. 2005). The take PART study carried out in Dublin City University between 2003 and 2005 investigated the levels of physical activity of Irish adolescents. They found that 65% of 15 – 17 year old Irish adolescents are not active for at least 60-minutes on four or more days per week (cited in Nelson et al. 2008). McCrorie et al (2010) used an activity monitor to assess the activity levels of 13 to 17 year olds in Northern Ireland. It was found that only 19.5% of participants reached the recommended sixty minutes of physical activity a day. As discussed in Section 2.2.1.3, physical activity is an important parameter for general health and the prevention of cancer.

Smoking and Alcohol Consumption

The substantial health risks associated with smoking and alcohol consumption are discussed in Section 2.1.3. Studies have shown that smoking and consumption of alcohol in Irish adolescents poses a serious problem. An Irish study into the association of cigarette smoking with drug use in adolescents found that, of the 370 pupils that completed the questionnaire, 48.4% had smoked tobacco at some stage of their lives. 18.1% had smoked tobacco in the last
30 days (O'Cathail et al. 2011). In 2009 the Tobacco Atlas placed Irish youths in the second worst tier for smoking; according to their statistics 16 to 29.9% of teenage boys and girls have started smoking (cited in O'Regan 2009). Other countries such as France, the United Kingdom and Italy were also classified in this tier. In Europe, only Germany and Latvia were placed in the highest tier of over 30% for teenage smoking rates (Shafey et al. 2009). The Pfizer report on teenagers attitudes to smoking found that most teenagers start smoking between the ages of 13 and 15, making intervention in the teenage years critical for prevention of smoking in Ireland (Pfizer Healthcare Ireland 2009).

Findings reported in the literature stated that frequency of alcohol consumption in Irish adolescents is also high. A study by UNICEF Ireland reported that 77% of the 16 to 20 year olds participants consumed alcohol. Of those who indicated that they do consume alcohol, 48% reported that they first got drunk before the age of 16, as seen below in Figure 2.4 (UNICEF Ireland 2010).

![Figure 2.8: Age when respondents stated they first got drunk](image_url)
Similar findings in relation to alcohol consumption have been found throughout Europe. The European School Survey Project on Alcohol and Other Drugs (ESPAD) investigated substance use of 15 year olds in 36 European countries; they found that in all but one country, 70% or more of the students have drunk alcohol at least once during their lifetime (Hibell et al. 2011).

2.4.5: Health Awareness Level of Irish Adolescents

There have been many national and international studies in recent years to investigate adolescent attitudes and awareness towards their general health. An investigation into the body image of young people in Ireland by the Department of Children and Youth Affairs found that 22% of males and 8% of females were dissatisfied with their body image. 60% of all participants said they felt pressurised to look good. Smoking was found to be an important issue with 11% of girls and 8% of boys indicated that they smoke as a weight control. 15% of males and 12% of females take diet or body-building supplements (O'Connell and Martin 2012). Issues with adolescent body image have been recognised internationally (Swami et al. 2011; Hintikka et al. 2000; Mission Australia 2010). Negative body image is associated with poor mental health, eating disorders, smoking and the use of dieting aids. Body image was found to decline rapidly throughout adolescent years (O'Connell and Martin 2012). According to McSharry (2009), schools are the sites where adolescents learn the most about their bodies and what is expected of them. Most of this learning takes place in the school yard as opposed to in official curriculum.

A study by Pfizer Healthcare Ireland (2008) used focus groups to investigate participants the attitudes of 10 to 14 year olds regarding diet, lifestyle and obesity. The participants of this study associated healthiness with being physical fit, active and slim. They were able to identify unhealthy foods as “sweets, chocolate and crisps”; however they naively interpreted healthy diets as the avoidance of becoming fat. They showed no awareness or concern
regarding the effect of diet on the internal workings of the body (for example cholesterol or heart disease). Staying healthy is linked exclusively with being slim and avoiding the social consequences of obesity such as peer rejection (Pfizer Healthcare Ireland 2008). Pfizer associates such basic thinking with fact that health issues such as cholesterol, heart disease and other internal health problems are less tangible than immediate changes to physical appearance.

Knowledge gaps of the participants, identified by Pfizer, include:

- Knowing what foods are healthy / unhealthy but lack understanding regarding why
- Lack knowledge regarding recommended daily allowance (RDA) of food

Findings concerning obesity are internationally recognised; data from WHO states that 22 million children under the age of five (79 countries) were overweight or obese (World Health Organisation 1998). However, in relation to health awareness and understanding of topics such as RDAs, Irish schoolchildren appear to be lagging behind. English schoolchildren (aged 10 to 12 years) were found to have far greater awareness of RDAs, with 76% surveyed knowing the correct number of portions of fruit and vegetables to be consumed daily (cited in Pfizer Healthcare Ireland 2008).

Pfizer Healthcare Ireland (2009) also published a report investigating teenagers’ attitudes to smoking. This study focused on adolescent smokers aged 16 to 18 years. It was found that teenagers were relatively well informed regarding the health consequences of smoking; many even showed an awareness of the consequences of heart disease and cancer. However, the mind-sets of these adolescents appeared to be preoccupied with current rather than future events; they ‘live in the now’. As a result, the delayed onset of such consequences has little effect on teenagers’ actions. Many of the teenage smokers indicated that they would cut down on smoking in later years (Pfizer Healthcare Ireland 2009).
The Pfizer Healthcare report on Irish adolescents (18 to 20 years old) attitudes to sexual health found that, in the opinion of those surveyed, formal school-based sex education is of limited value. This is despite the fact that the majority surveyed reported becoming sexually active between 16 to 17 years of age. The level of awareness of sexually transmitted diseases was found to be high among those surveyed; however their level of knowledge of diseases, symptoms and consequences was found to be low.

The combination of these reports shows a need to improve the level of health education in Irish Education System. In order to improve pupils understanding of such concepts, we must firstly consider how pupils learn.

2.5: Misconceptions

2.5.1: Concept Acquisition

The Traditional View of Learning

Teaching involves the presentation of a rigid body of facts, theories, and rules to be memorized and practiced, rather than a way of knowing about natural phenomena (van Driel et al. 2001). This traditional view of education involves methods of instruction that considers the pupils mind as a blank slate for which the teacher is to transfer knowledge directly and intact. This view of education takes no consideration for any prior knowledge a pupil may hold (Bodner 1986). This ‘jug and mug’ model of learning is where the teacher is considered to be the jug full of knowledge whose job it is to pour knowledge into the pupils mind, which is considered to be an empty mug. Research into this traditional use of teacher-directed, didactic methods of instruction has shown that pupils gain a poor acquisition of scientific concepts from this approach (Alparslan et al. 2003).

Traditional approaches to teaching and learning encourages learners to resort to rote-learning techniques which require the lowest level of cognitive skill, knowledge. According to Bloom’s Taxonomy (Krathwohl et al. 1973), which divides the skills in the cognitive domain
into six levels; knowledge, comprehension, application, analysis, synthesis an evaluation, ‘knowledge’ is the lowest and least challenging level of the cognitive domain (Gray and Waggoner 2002). Such findings within the research have encouraged further studies into the issue of how we learn.

**Views of learning**

There are many different interpretations of what learning means. The cognitive view of learning sees learning as an active mental process of acquiring, remembering and using knowledge. The behavioural view of learning focuses on learning as an effect of external events which cause behavioural changes (Woolfolk et al. 2007). Epistemology is the study of the nature of knowledge, including how knowledge is acquired and extended (Child 2004). There are many theories from epistemologists inquiring into how we obtain knowledge; one of the most widely recognised is Piaget’s Theory of Learning (Piaget 1970).

**Piaget’s Theory of Learning**

Piaget is the best known contributor to the field of cognitive development theories. Piaget’s greatest legacy for educational practice is the now widely accepted fact that education should develop sophistication of thought as well of just a body of knowledge (Jarvis 2005). Within this Piaget influenced educators to consider a child as more than a blank slate, but as an individual with sources of experience and information which they bring to the classroom.

Within his theory, Piaget identified four stages of cognitive development that an individual will pass through as they mature; sensorimotor, pre-operational, concrete operational, formal operational (Woolfolk et al. 2007). The table below shows the approximate ages and characteristics of each of these stages.
Table 2.7: Piaget’s Stages of Cognitive Development

<table>
<thead>
<tr>
<th>Stage</th>
<th>Approximate Age</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensorimotor</td>
<td>0-2 years</td>
<td>Beginning of logical, goal-directed actions</td>
</tr>
<tr>
<td>Preoperational</td>
<td>2-7 years</td>
<td>Egocentric, cannot focus on more than one aspect at a time</td>
</tr>
<tr>
<td>Concrete Operational</td>
<td>7-11 years</td>
<td>Logical – can solve concrete problems</td>
</tr>
<tr>
<td>Formal Operational</td>
<td>11 – adult</td>
<td>Fully Logical</td>
</tr>
</tbody>
</table>

(Woolfolk et al. 2007)

The sensorimotor stage of development, according to Piaget’s theory, is the infantile stage of life where the child’s main focus is on physical sensations and learning to coordinate their bodies. It is fuelled by curiosity for their environment. Following this stage a child will enter the preoperational stage where they have not matured sufficiently to grasp logical concepts but are in the process of mastering mental operations (Jarvis 2005). The concrete operational stage, classified to approximately children of 7 to 11 years of age, can be summarised as the stage of ‘hands-on’ thinking. At this stage the child’s mind has matured sufficiently to have a good understanding of the physical world but struggles to carry out mental tasks without concrete objects and stimulations (Woolfolk et al. 2007). The final stage of Piaget’s theory, which some children are reported to reach by age 11 or after, is the formal operational stage. Within this stage the individual can form an argument without needing concrete materials to form the substance of the argument. This is considered the highest level of thinking within the theory (Child 2004).

Piaget noted that individuals may have different periods of transition from stage to stage and age is not a sufficient determinant to classify anyone in a particular stage (Woolfolk et al. 2007). According to Bodner (1986), the ability to classify students as concrete or formal is not as important as the realisation that there are most often both present within a class and everyone reverts to concrete operational when they encounter a new area.
Such realisations have led logically to the theory of constructivism. Constructivism is the “view that emphasises the active role of the learner in building understanding and making sense of information” (Woolfolk et al. 2007 p.582). The core belief of constructivism is that human beings build up knowledge in a slow process, that beings with simple sensory-motor schema during early childhood and progresses to complex schema without physical referents from the late teens onwards (McCormick and Paechter 1999). This view of learning is largely attributed to the research of Piaget, along with Vygotsky and Kozulin (1986), Bartlett and Kintsch (1995), Bruner et al. (1986) and Dewey (2008). Piaget argued that knowledge is constructed as the learner strives to organize his or her experiences in terms of pre-existing mental structures or schemes (Bodner 1986). This theory expands from the traditional ‘jug and mug’ theory to see learning as an active, personal construction of knowledge (Woolfolk et al. 2007). Piaget’s theory and the constructivist model of learning have many links and similarities.

**Information processing model of memory:**

Continuing on from how we acquire knowledge, another important consideration in teaching and learning is how we process and store the knowledge we acquire. Information processing is the human mind’s activity of taking in, storing and using information. There have been many theories into how this process occurs. For this project the information derived from several theorists will be used, as found from Psychology in Education (Woolfolk et al. 2007). A basic illustration of the model is shown in Figure 2.11.
Sensory memory comprises of stimuli received from the environment being processed and made sense of. The sensory memory can take in vast amounts of information but can only hold this information for a short duration of one to three seconds. If the information within the sensory memory is not processed, it will be lost (Woolfolk et al. 2007).

Perception is the interpretation and assigning of meaning to sensory information. This is accomplished through the use of existing knowledge and physical representations from the world. Attention selects and focuses on a stimulus and ignores others. What we focus attention on depends on what we already know, what we need to know and what we want to know. The working memory is the information that is being focused on at a given moment. The long term memory is the permanent store of knowledge. Knowledge stored in long term memory is used to construct understanding of new information (Woolfolk et al. 2007).

This model of information processing has huge implications for the subject of teaching and learning and should be represented within the methods we teach by. The recalling of information, whether correct or incorrect, has a huge impact on the practice of processing
new knowledge for the learner. According to Yahaya (2008), teaching should include helping pupils to develop their information processing skills in order to systematically master a curriculum.

**The difficulty with conceptual understanding of health education**

Health education is a multidimensional subject which includes complex, interconnected issues such as disease prevention, causes, symptoms and treatments. However, health education faces many complications, such as ignorance in adolescents to the consequence of the issue for their lives (Pfizer Healthcare Ireland 2009) (Section2.7.3). Additionally, the complicated nature of health education can lead to difficulties with conceptual understanding in the area. The multifaceted task of health education can be obscured by the vague nature of chronic disease control procedures (Derryberry 2004). Chronic diseases are of long duration and generally progress slowly (World Health Organisation 2007a). The desirable actions to control or prevent such chronic diseases are less obvious to the public than, for example, the procedures to prevent infectious diseases. Infectious diseases, such as Methicillin-resistant Staphylococcus aureus (MRSA) or influenza, are passed from person to person through direct contact. Prevention of such infectious diseases involves observing precautions such as regularly washing hands to kill bacteria that one has come into contact with or being vaccinated for protection over a period of time (Cook 2012). In contrast, the actions taken to prevent a chronic disease often require a complete change in the pattern of one’s daily living; for example changing diet and amounts of physical activity. Changes such as these require radical readjustments to an individual’s life. However, the exact amount of action an individual should engage in cannot be defined. These actions do not seem to relate directly to prevention of a condition, and because these actions may require pervasive lifestyle changes, it is extremely difficult to effect desirable changes in an individual’s behaviour. Avoiding disability and death from chronic diseases depends greatly on an individual’s understanding and action in comparison to the prevention of infectious diseases (Derryberry 2004).
General health matters are an inescapable issue which all students will have encountered in their day to day life. The complex and elaborate nature of health education will therefore often results in pupils possessing inaccurate facts or naive perceptions (Bennett 2004). Such incorrect understandings in health education lead to poor depth of knowledge (Nic Gabhainn et al. 2001).

2.5.2: Misconceptions Theory

*Concepts or Conceptions*

In order to understand the processes by which concepts are acquired, an understanding of the end state which such processes give rise to is needed. Concepts are ways of categorizing and classifying the things around us based on their similar attributes; they are human inventions to organise the world meaningfully (Cakir 2008). Concept formation is dependent on many processes. The concepts a child may hold are a direct product of the culture into which they were born; they may be formed without a learner being conscious of the process. Much of a learner’s prior knowledge is maintained in the form of such concepts (Child 2004).

The popular constructivist theory of learning refers to “a view that emphasises the active role of the learner in building understanding and making sense of information” (Woolfolk et al. 2007). Constructivism pays particular regard to the existence of pupil’s prior knowledge when entering a learning environment. Considering this, current conceptions should be an important consideration in any curriculum planning (Hare and Graber 2007). For pupils in a learning environment, new information and experiences are filtered through prior knowledge. As new knowledge in attained; current conceptions are modified resulting in learners attempting to make sense of what they know (Brody 1994; Ritchie 1994; Vosniadou and Brewer 1987). Such attempts to understand new knowledge may develop inaccurate or incomplete conceptions for pupils. This is because pupils personally construct knowledge and actively interpret social classroom environments. These incorrect conceptions are referred to as misconceptions (Hare and Graber 2007).
**What are misconceptions?**

What defines a misconception can be subjective depending on the particular study (Wynn et al. 2009). In the literature, misconceptions are also referred to as alternative understandings (Munson 1994), misunderstanding (Krebs 1999), interpretations that are not scientifically accurate (Bahar 2003), inaccurate prior knowledge (van den Broek and Kendeou 2008) and naïve or erroneous ideas (Ebert-May et al. 2004). Within the literature the term ‘misconception’ has been denoted to various terms including alternative conceptions (Bahar 2003), limited or inappropriate propositional hierarchies (LIPHs) (Novak 2002), alternative framework (Taber 1998), non-scientific ideas (Özmen 2004) or cognitive illusions (Groves and Pugh 2002). These lists are in no way extensive with other definitions and terms alike in use. However, for the purpose of this study the term ‘misconception’ will be broadly defined as strongly held, stable cognitive structures which differ from expert conceptions and fundamentally affect student understanding (Hammer 1996). It is important to highlight that misconceptions should not be regarded as a ‘bad thing’. For an educator they can expose how learners think and acquire understanding of complex concepts, as well as being useful discussion points to begin a lesson with (Cockburn and Littler 2008).

**Where do misconceptions originate from?**

There are many different sources of student misconceptions cited throughout the literature including to health (Drumm 1992), science (Munson 1994), maths (Rakes 2010), history (Harris 2007), cultural stereotypes (Mantle-Bromley 1994) and human rights (Syed 2008). Learners with misconceptions are the norm rather than the exception (van den Broek and Kendeou 2008).

From a formal educational setting, misconceptions have been found to arise from interactions with teachers who may or may not hold their own misconceptions. Such misconceptions can arise from a teacher’s teaching strategy unknowingly reinforcing or propagating new misconceptions. Regarding teachers holding their own misconceptions, it is most likely that
in these cases teachers will not be able to identify their students’ misconceptions. They will not be capable of providing educational experiences to overcome pupils’ incomplete ideas or misconceptions (Burgoon et al. 2011). However, little study has been done in relation to teachers holding misconceptions in relation to health education; no teacher in the Irish Education System is specifically qualified or teaches in the area of health education, as discussed in Section 2.5.

Within the formal educational setting, it has also been found that misconceptions arise from textbooks lacking clarity about central concepts. Such texts allow pupils to build on and continue to have confidence in existing misconceptions. These are referred to as non-refutation texts (van den Broek and Kendeou 2008). They do not create the necessary cognitive conflict needed to generate dissatisfaction with a misconception; nor do they provide coherent or credible explanations (van den Broek and Kendeou 2008). The use of diagrams and analogies within textbooks has also been found to cause misconceptions for pupils as they lack the necessary explanations for these analogies and diagrams (Guler and Yagbasan 2008).

The other major source attributed to the existence of misconceptions is external to the formal educational setting; learners attempting to understand everyday life experiences (Hewson and Hewson 1988). Experiences learners encounter do not always lead to correct conclusions or result in learners seeing all possible outcomes (Thompson and Logue 2006). Each learner will have a vast amount of interaction throughout their life with health related issues through, for example from family matters and media exposure to health promotion campaigns. Considering this, it is understandable that a learner will try to make sense of what they encounter around them. Research by Bransford et al. (2000) has indicated that the process of making sense of their surroundings and experiences at a very young age, with preschool children showing sophisticated understandings of the world around them. However correct or incorrect these understandings are, they play a vital role in the integration of new concepts for
learners. Furthermore, when parents or other family members are confronted with questions from their children, rather that admitting to not knowing the answer, it is common for them to give an incorrect one. These sources are considered to be ‘trustworthy’, leading to ready acceptance by learners of what they are being taught (Thompson and Logue 2006).

2.5.3: What are the difficulties with misconceptions?

*Misconceptions operate to distort new learning*

Pupils are constantly learning, taking in new information, processing it and storing new concepts that they may draw on in the future. Misconceptions are most likely held within this stored knowledge and thus may be drawn upon when processing new information. According to Wesson (2011) the brain will try to match new information with previously stored memories. When the new information does not fit in it is refashioned to fit into the existing pattern (cited in Gooding and Metz 2011). Therefore, learners existing misconceptions will hinder future related learning; they are more likely to readjust any new knowledge to fit their own existing beliefs rather than change their existing beliefs according to the new knowledge they are being presented with (Gooding and Metz 2011). Before new concepts can be understood, misconceptions must be dispelled. This is reiterated throughout the literature with findings indicating that misconceptions interfere with the acquisition of new, related knowledge from texts (van den Broek and Kendeou 2008).

*Misconceptions are resistant to change*

Misconceptions are generally held to be very resistant to change within existing literature. This is accounted to the fact that learners have spent time and energy constructing these concepts and theories from their own personal experiences. They are rational and reasonable to those who constructed them. As learners are so committed to their personal understandings, it is difficult to achieve the conceptual change necessary to overcome the misconceptions (van den Broek and Kendeou 2008; Cakir 2008). The resilience of misconceptions and the difficulty with achieving the conceptual change has been identified using neuroscience
techniques. Experiments have observed the neural networks in the brain associated with learning and error detection. The aim of this was to uncover if people presented with information that differs from their preferred theories (or misconceptions) treat new information as errors or learn from the new information. In these circumstances, the findings indicate that the neural network associated with error detection shows a higher level of activation than those associated with learning. These findings demonstrate the resilient nature of misconceptions (Lovett and Shah 2012).

Misconceptions have been found to be prevalent throughout scientific disciplines; Hammer (2000) found that misconceptions provide many obstacles in the teaching of physics. Studies by Özmen (2004) and Taber (1998) showed that misconceptions are prevalent for chemistry students; similarly Groves and Pugh (2002) found that students hold “cognitive illusions” for biological issues. Not only have studies shown that misconceptions are prevalent throughout all of the science disciplines, but research also indicates that misconceptions are held throughout formal education from second level, through to undergraduate and graduate level (Ahtee and Varjola 1998). A study by Tekkaya et al. (2007) found a high level of misconceptions in pre-service science teachers across all scientific disciplines. The mean score on the Science Concepts Test used in this research was 16.96 out of a possible 40; the participants responded correctly to less than 50% of the questions indicating a low level of conceptual understanding in sciences. It may also indicate that science teachers, as graduates of undergraduate science education courses, have not managed to overcome the same misconceptions they held in second level education throughout their undergraduate careers (Cakir 2008; Bahar 2003). This further supports the difficulties with overcoming misconceptions; they cannot be overcome by traditional teaching methods.

**Misconceptions are difficult to diagnose using traditional methods**

Before misconceptions can be corrected it is necessary that they are identified. According to the literature, a teacher must identify the learner’s misconceptions; help the learner create
dissatisfaction with the misconception; and finally provide opportunity to practice the goal conception (Brehm et al. 1986). Studies have constantly shown, across the three main science disciplines, students who are involved in traditional, lecture-style learning environments are less likely to detect their misconceptions (Physics - Hake 2002; Biology - Sundberg 2003; Chemistry - Nakiboglu 2003). Furthermore, with a strong focus on assessment of learning techniques within the Irish Education System (Hall 2000), misconceptions will continue to remain unearthe. Assessment that focuses on rote learning and recall of information often fails to unearth misconceptions in pupils (Novak and Canas 2010). The task of identifying pupils’ misconceptions requires planning and effort on behalf of the teacher. The Committee on Undergraduate Science Education (1997) suggests that teachers should review possible misconceptions prior to teaching a class new material; they should use probing, essay style assignments and discussions and laboratory exercise in attempting to identify pupils’ misconceptions. Without a deeper focus on the issue of misconceptions in teacher education such deliberately planned activities and strategies to over misconceptions would not be possible. Currently, the literature points towards novice (first year of teaching) teachers having little awareness of their pupils’ misconceptions or misconceptions in general (Yip 1998).

Misconceptions are affected by motivation

Motivation is described as “as internal state that arouses, directs and maintains behaviour” (Woolfolk et al. 2007). It is generally classified into two categories, intrinsic and extrinsic motivation; the former referring to internal motivation, the latter referring to external motivational factors (Child 2004). Motivation is included within the affective domain of Bloom’s Taxonomy; this is the domain of emotional response (Krathwohl et al. 1973). Studies have shown that a pupil’s motivation level towards a specific subject area will directly affect their ability to achieve conceptual change, or in other words overcome their scientific misconceptions. In Taiwan, a national study assessing students’ conceptual
understanding in science found that junior high school students who liked biology scored higher on a questionnaire assessing their understanding of biological concepts than those who liked other scientific disciplines such as physics or chemistry. This highlights the high premium of motivation for learners in accurately understanding scientific concepts. However it also highlights another difficulty for the issue of overcoming misconceptions; pupils’ personal motivation levels will affect their desire to challenge their currently held conceptions (Wang et al. 2007).

2.5.4: Overcoming misconceptions through conceptual change

In order to overcome misconceptions it is widely accepted that a learner must achieve conceptual change. Conceptual change refers to the theories of educational psychologists on the “complex cognitive processes involved in the modification of misconceptions” (van den Broek and Kendeou 2008). The educational conditions considered necessary to achieve conceptual change are:

- The student must be dissatisfied with their current understanding (Smith 1991). Without this, students tend to integrate conflicting information into a widening web of misconceptions rather than achieve conceptual change (Anderson and Smith 1987; Perkins and Simmons 1998).

- An alternative intelligible understanding must be available to the student (Smith 1991). If not, the learner will internalize the conception through rote memorization, which means, no cross-linkages occurs between new information and existing schema (Windschitl and Andre 1998).

- The alternative understanding must be plausible to the student (Smith 1991).

- The alternative understanding must seem usable to the student. The candidate conception should have the power to solve problems or predict phenomena more decisively than the conception it will replace (Windschitl and Andre 1998).
Conceptual change generally involves exposing a learner’s knowledge structure to identify misconceptions, then modifying it to correct these misconceptions (Windschitl and Andre 1998). It fundamentally changes the concepts that make up the learners belief structure (diSessa and Sherin 1998). This realisation results in a responsibility for the teacher to engage learners in teaching practices that can facilitate conceptual change. The stages in conceptual change teaching can include:

- **Diagnosis or Elicitation**: Using any diagnostic techniques to elicit students’ existing conceptions.

- **Status Change**: Strategies designed to help students lower the status of existing, problematic knowledge, and raise the status of other, competing ideas. For example, finding other application sites where the new conception can be used.

- **Evidence of outcome**: Gathering evidence that students’ learning outcomes are based, in part, on an explicit consideration of their prior knowledge.

(Hewson 1992)

Specific strategies proven to facilitate conceptual change in learners are numerous. Such methods can be referred to as conceptual change strategies (Bahar 2003). The Committee on Undergraduate Science Education (1997) state that bridging and interactive demonstration strategies are effective in overcoming misconceptions. Bridging involves the use of intermediate analogous situations to bridge from pupils’ correct beliefs to their misconceptions (Bransford et al. 2000). Concept mapping is widely viewed as a successful conceptual change strategy as it offers an awareness of ideas lodged in a student’s cognitive structure (Bahar 2003; Novak and Gowin 1984; Ross and Munby 1991; Sungur 2000; Yilmaz 1998). Diagnostic Tree Testing, used by Johnstone et al. (1986), uses a route of true or false questions to indicate where a pupil has mislinkages. The use of refutation texts, that is texts that detail misconceptions and explain correct ideas, is valued as a conceptual change strategy by van den Broek and Kendeou (2008).
2.5.5: Misconceptions versus Mistakes

Mistakes differ considerably from misconceptions. Mistakes are considered to be errors, blunders or slip-ups made by pupils because of some oversight. These are easily corrected or revised and typically a pupil can become aware of the mistake straightforwardly (Hare and Graber 2007). According to Hare; “*when an inaccurate conception is easy for a student to change, most likely it was not a true misconception because misconceptions are deeply-seated and strongly embedded in the schema of the learner*” (Hare and Graber 2007). Misconceptions largely differ from mistakes as learners will cling tenaciously to their personal explanation that helps them to understand scientific phenomena (Bransford et al. 2000). They are resistant to change; whereas mistakes may be acknowledged by the learner.

*Misconceptions versus naïve knowledge or knowledge gaps*

As discussed in Section 2.11.2 students often enter learning environments with naïve knowledge; this is incorrect or overly simplistic knowledge that can impede further learning. However, this naïve knowledge can be sub-divided in two sections; misconceptions and preconceptions. Preconceptions are naïve knowledge that is readily revised through instruction. Preconceptions differ from misconceptions in that they are much less resistant to change (Chi and Roscoe 2002).

It is also necessary to be able to differentiate between misconceptions and information which is simply missing from pupils’ prior information. This missing information can be referred to as knowledge gaps (Fawole et al. 1999). Previous studies have detected self-identified knowledge gaps in base-line surveys by including an “I don’t know” option for each question participants answered (Sullivan et al. 2007).

2.5.6: Preconceptions and Conceptual Reorganisation

All naïve knowledge, whether preconceptions or misconceptions, needs to be repaired in order to promote deep understanding (Chi and Roscoe 2002). Therefore, it is necessary to
consider not only misconceptions, but also preconceptions in terms of health education. Preconceptions, naïve knowledge readily revised through instruction, consist of both incorrect beliefs and alternative beliefs. Incorrect beliefs are beliefs which are replaced by correct knowledge after instruction. In contrast, alternative beliefs are inaccurate beliefs remaining after instruction. These may be mistaken for misconceptions; however they differ from misconceptions in that they only remain in the mind of a learner as they were not addressed during instruction (De Leeuw 1993). Therefore the distinction between incorrect beliefs and alternative beliefs is dependent on the ability of the educator to contend with the preconceptions of a student. Both incorrect beliefs and alternative beliefs can be categorised in the domain of preconceptions are they can be removed with instruction and remain if not addressed by instruction (Chi and Roscoe 2002). This makes a teacher an invaluable resource in the task of overcoming preconceptions, emphasising the importance of the teacher’s ability to expose student preconceptions.

Addressing preconceptions is therefore an important pedagogical tool for teachers. The term conceptual change is generally used to describe the strategies which are effective in overcoming misconceptions. Strategies to repair non-robust preconceptions have been referred to as belief revision (Carey 1991) or conceptual reorganisation (Chi and Roscoe 2002). The term conceptual reorganisation will be used to describe the process of repairing preconceptions. Methods of achieving conceptual reorganisation include questioning to elicit student preconceptions. This method allows learners to become aware of their preconceptions and allows educators to ask clarifying questions to address preconceptions (Lam 2011).

Mental models have also been explored as conceptual reorganisation strategies. Mental models refer to a learners mental thought process about how something works. A mental model is a dynamic structure which is created on the spot for the purpose of answering questions, solving problems, or dealing with other situations. Mental models are generated from and constrained by an individual’s existing conceptual structures (Vosniadou and
Brewer 1992). A learner’s mental model can be flawed; it is a coherent structure which is organised around a set of beliefs which are incorrect. Mental models can also be fragmented; information is not connected in a systematic way. Learners with fragmented mental models are more often aware of their misunderstandings, whereas learners with flawed mental models will not be (Chi and Roscoe 2002). Students illustrating model drawings of the concept being addressed can be used to assess students’ mental models and where their preconceptions lie (Barke et al. 2009).

2.6: **Misconceptions cited in the literature**

Misconceptions in relation to the field of health education with particular focus on cancer, cited from reviewing the available literature (Table 2.7 – 2.12), have been subcategorised below. A particular emphasis was placed on misconceptions relating to cancers, although general health issues were also addressed. The effect of diet, obesity and physical activity is a prevalent theme throughout each subcategory as these conditions are relevant to most health issues. Misconceptions were classified as such in accordance with the criteria discussed in Section 2.11. Preconceptions and knowledge gaps will be discussed separately in Section 2.14 and 2.15.

2.6.1: **Misconceptions relating to causes and prevention of skin cancer**

Skin cancer is the most common type of cancer in Ireland (Irish Cancer Society 2011b). The causes of skin cancer are discussed in Section 2.1.2.2. The literature implies that many learners hold misconceptions in his area (Table 2.7). These misconceptions mainly seem to point to a general lack of understanding of how UV rays (from any source) damage human cells.
Table 2.8: Misconceptions relating to causes and prevention of skin cancer

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Accurate Conception</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Only fair skinned people need to be concerned about overexposure to the sun.</td>
<td>Darker skin has more protective melanin pigment, and the incidence of skin cancer is lower in dark skinned people. However, skin cancers do occur with this group and unfortunately they are often detected at a later, more dangerous stage.</td>
<td>(World Health Organisation 2003)</td>
</tr>
<tr>
<td>2. Protecting yourself from the sun is only important when you’re young as this is when you can do the most damage to your skin.</td>
<td>The damage to a person’s skin is typically spread out over the course of a lifetime. It is important to be diligent about sun protection at every age.</td>
<td>(Skin Cancer Foundation 2008)</td>
</tr>
<tr>
<td>3. Sun beds are a safer way of getting a tan than lying out in the sun.</td>
<td>Using a sunbed is not a safer way of getting a tan than from the sun (Berwick 2008). It exposes your skin to UVA and UVB rays that damage your skin cells and can lead to skin cancer. People who have used a sunbed (even just once) have a 15% increased risk of melanoma. Using a sunbed once a month or more, increases the risk of skin cancer by more than half.</td>
<td>(Irish Cancer Society 2011d)</td>
</tr>
<tr>
<td>4. As the ozone hole resides over Australia, and the ozone hole occurs during the Australian summer, supports the idea that ozone depletion is responsible for Australia’s high rate of skin cancer.</td>
<td>The formation of the ozone hole occurs each spring over the Antarctic. This phenomenon is largely restricted to the area over Antarctica. The occurrence of low ozone air over Australia is rare because of prevailing meteorological conditions that normally shield Australia from Antarctica’s low ozone air.</td>
<td>(Cordero 2000)</td>
</tr>
</tbody>
</table>

2.6.2: Misconceptions relating to environmental causes of cancer

It has been previously found that environmental causes of cancer, such as environmental pollutants and food additives, have been overestimated by the public (Wold et al. 2005). These environmental causes of cancer are discussed in Section 2.1.2.1. The literature implies that many learners consider these to be major causes of cancer (Table 2.8).
Table 2.9: Misconceptions relating to environmental causes of cancer

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Accurate Conception</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Environmental synthetic chemicals are an important cause of human cancer.</td>
<td>Neither epidemiology nor toxicology supports the idea that exposures to environmental levels of synthetic industrial chemicals are important as a cause of human cancer. Some epidemiological studies have found weak associations between cancer and low levels of industrial pollutants, but the studies do not account for potentially large confounding factors such as diet.</td>
<td>(Gold et al. 2002)</td>
</tr>
<tr>
<td>2. Reducing pesticide residues is an effective way to prevent diet-related cancer.</td>
<td>Reductions in synthetic pesticide-use will not effectively prevent diet-related cancer. Fruits and vegetables, which are the source of most pesticide residue exposures to humans, are of major importance for reducing cancer; moreover, pesticide residues in food are low and frequently not detected. Less use of synthetic pesticides would increase costs of fruits and vegetables and thus reduce consumption, especially among people with low incomes, who eat fewer fruits and vegetables and spend a higher percentage of their income on food.</td>
<td>(Gold et al. 2002)</td>
</tr>
<tr>
<td>3. Synthetic chemicals pose greater carcinogenic hazards than natural chemicals.</td>
<td>The assumption that synthetic chemicals are hazardous, even at very low levels of human exposure to pollutants in the environment, has led to a bias in testing so that synthetic chemicals account for 76% of the chemicals tested in both rats and mice. This is despite the fact that the vast proportion of human exposures are to naturally-occurring chemicals. The background of natural chemicals has never been systematically tested for carcinogenicity.</td>
<td>(Gold et al. 2002)</td>
</tr>
</tbody>
</table>

2.6.3: Misconceptions relating to causes and prevention of breast cancer

Breast cancer is the second most common type of cancer in Ireland (Irish Cancer Society 2011a). Some causes of breast cancer include obesity (Section 2.1.1.2), smoking (Section 2.1.3.1), alcohol (Section 2.1.3.3) and genetic susceptibility (Section 2.1.5.1). The literature implies that many learners hold misconceptions relating to the link between breast cancer and genetic susceptibility (Table 2.9). These misconceptions mainly seem to point to a general lack of understanding of the causes of cancer.
### Table 2.10: Misconceptions relating to causes and prevention of breast cancer

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Accurate Conception</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. For women assessing their genetic risk of developing breast cancer, only their mother's family history of breast cancer is important.</td>
<td>A woman's father's family history is just as important, especially the women on his side of the family. Other cancers in men, like early-onset prostate or colon cancers should be considered when assessing your risk, too.</td>
<td>(National Women's Health Resource Center 2011)</td>
</tr>
<tr>
<td>2. A woman with no family history of breast cancer isn't likely to develop it.</td>
<td>Having a family history of breast cancer does increase a woman's risk of developing it. However only one in five women who develops breast cancer has a known family history of the disease.</td>
<td>(Drumm 1992)</td>
</tr>
<tr>
<td>3. Underwire bras cause breast cancer</td>
<td>The claim that wearing tight-fitting bras all day, every day, inhibits women’s lymphatic drainage, thus causing toxins to become trapped in breast tissue has been discounted by scientists. When investigated confounding variables were excluded such as the presence in some women of known risk factors for breast cancer such as family history, hormones, age, weight, exercise levels, giving birth over the age of 30 or not having had children.</td>
<td>(National Women's Health Resource Center 2011)</td>
</tr>
<tr>
<td>4. A lump is the only sign of breast cancer.</td>
<td>While a lump may indicate breast cancer or other benign breast conditions, there are other changes that could indicate cancer, like skin irritation or dimpling; swelling, nipple retraction or discharge (other than breast milk); redness, scaliness, or thickening of the nipple or breast skin. Lymph nodes under the arm might swell if the cancer has already spread before a tumour in the breast is even large enough to be felt. And a mammogram can pick up a cancer before any symptom is felt or seen at all.</td>
<td>(National Women's Health Resource Center 2011)</td>
</tr>
</tbody>
</table>

#### 2.6.4: Misconceptions relating to causes and prevention of lung cancer

The principle cause of lung cancer is smoking (Section 2.1.3.1). Misconceptions in this area suggest a lack of awareness and comprehension of the effect of smoking (Table 2.7).
Table 2.11: Misconceptions relating to causes and prevention of lung cancer

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Accurate Conception</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Smoking lower tar products reduces their risk of lung cancer and other tobacco-related diseases and is a good alternative to quitting smoking.</td>
<td>Low tar cigarettes fail to reduce lung cancer risk because they do not reduce a smoker's exposure to tobacco carcinogens. When smokers switch to lower tar cigarettes, they alter their smoking pattern to maintain a desired nicotine intake, a phenomenon known as compensation. For example, they may smoke more cigarettes per day, inhale more deeply, or decrease the time between puffs. Because of compensation, smokers of light and ultra-light cigarettes can actually be exposed to equivalent or even higher doses of tar and other tobacco smoke carcinogens than smokers of medium tar cigarettes.</td>
<td>(Rigotti and Tindle 2004)</td>
</tr>
<tr>
<td>2. A non-smoker living in a heavily polluted city has the same chance of getting lung cancer as a smoker living in a city with little or no pollution.</td>
<td>Being exposed to diesel exhausts and air pollution does raise the risk of lung cancer; however, the risk is small in comparison to smoking.</td>
<td>(Lindsey 2004; Berkeley Wellness Reports 2012)</td>
</tr>
<tr>
<td>3. There is a widespread misconception in the general population, and even among some epidemiologists, that the incidence rate of lung cancer declines in ex-smokers.</td>
<td>When smoking ceases, the rate stops increasing steeply and remains almost constantly.</td>
<td>(Peto 2011)</td>
</tr>
</tbody>
</table>

2.6.5: General Cancer Misconceptions

The general cancer misconceptions collected in Table 2.11 suggest an overall lack of knowledge and understanding for how cells become cancerous. They also suggest that there is fundamental lack of awareness of the preventative measures for cancer development.
<table>
<thead>
<tr>
<th>Misconception</th>
<th>Accurate Conception</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Chronic diseases such as cancer cannot be prevented.</td>
<td>40% of all cancers are preventable through healthy diet, physical activity and not smoking.</td>
<td>(World Health Organisation 2006)</td>
</tr>
<tr>
<td><strong>2.</strong> It is now proven that certain types of cancer can be cured with homeopathic drugs.</td>
<td>Homeopathy is highly controversial as there is no plausible mode of action for these highly diluted remedies (Milazzo et al. 2006).</td>
<td>(Carlsson 1996)</td>
</tr>
<tr>
<td><strong>3.</strong> Cancer is a contagious disease.</td>
<td>A healthy person cannot “catch” cancer from someone by close contact. Cancer cells from one person are generally unable to live in the body of another healthy person. A healthy person’s immune system recognises foreign cells and destroys them, including cancer cells from another person (American Cancer Society 2012).</td>
<td>(Carlsson 1996)</td>
</tr>
<tr>
<td><strong>4.</strong> Cancer is often induced by physical injury (an accident or a hard blow to the body).</td>
<td>Cancer cannot be caused by a physical injury. Cancer is often diagnosed soon after a physical injury - but this is because the exam or test for the injury leads to the discovery of a cancer. For example, a bone that is weak from a cancerous tumour is more likely to break if hit, and treating the broken bone leads to the discovery of the cancer (Canadian Cancer Society 2011).</td>
<td>(Carlsson 1996)</td>
</tr>
<tr>
<td><strong>5.</strong> It has now been definitely proven that emotional/mental disturbances give rise to cancer.</td>
<td>The hypothesis that there is a casual link between psychosocial factors and cancer has been widely debated in the scientific literature. A study by Dalton et al. (2002) failed to support the hypothesis that major life events are a risk factor for cancer.</td>
<td>(Carlsson 1996)</td>
</tr>
<tr>
<td><strong>6.</strong> A common characteristic of all cancer tumours is that they are rapidly growing.</td>
<td>The rate of cell division in a tumour can be rapid, allowing it to grow quickly in size or the cells may divide more slowly, and therefore the tumour growth will be slower (National Cancer Institute 2012b).</td>
<td>(Carlsson 1996)</td>
</tr>
<tr>
<td><strong>7.</strong> Cancer cannot be caused by poor diet.</td>
<td>The World Health Organisation reported that dietary factors are estimated to account for approximately 30% of cancers in western countries, making diet second only to tobacco as a preventable cause of cancer.</td>
<td>(York Against Cancer 2012)</td>
</tr>
<tr>
<td><strong>8.</strong> Viruses are never linked to cancer.</td>
<td>Some viruses are directly linked to cancer. Infections from viruses, bacteria and trematodes account for 30% of all cancers worldwide (NOT in Europe). There are 6 viruses that have a direct link to cancers and HIV an indirect as this lowers the immune system allowing cancers to happen. But it also depends on genetic make-up and how a person responds to a virus as to whether it will have an adverse effect.</td>
<td>(York Against Cancer 2012)</td>
</tr>
<tr>
<td><strong>9.</strong> If cancer is in your family there is nothing you can do to reduce personal risk.</td>
<td>At least one-third of all cancers are preventable according to the WHO (2011). Life-style factors such as smoking tobacco, physical inactivity, dietary factors, obesity and being overweight can increase the risk of</td>
<td>(Breakthrough Cancer Research 2012)</td>
</tr>
</tbody>
</table>
The risk of cancer does not increase with age. Age is the single most important (unpreventable) determinant of developing cancer. (Breakthrough Cancer Research 2012)

Cancer is inevitable; there’s not much you can do to lower your risk. At least one-third of all cancers are preventable according to the WHO (2011). Life-style factors such as smoking tobacco, physical inactivity, dietary factors, obesity and being overweight can increase the risk of developing cancer. (Berkeley Wellness Reports 2012)

Everyone has cancer in their bodies and it just takes something to trigger it. (Scanlon et al. 2006)

What someone does as a young adult has little effect on their chance of getting cancer later in life. Many things people do in their youth can have an impact on their future cancer risk. For instance, young people may start smoking, making it more likely that they continue smoking into adulthood. Likewise, young people tend to be less concerned about sun exposure even though getting sunburned is known to raise the risk of developing skin cancer later in life. (American Cancer Society 2007)

There are no warning signs with cancer; illness tends to come on suddenly. There are some symptoms that may indicate cancer, though they could also be symptoms of other diseases. These include change in a wart or mole; a sore that doesn’t heal; persistent cough or hoarseness; change in bowel or bladder habits; chronic indigestion or difficulty swallowing; unusual bleeding or discharge; unexplained loss of weight or appetite; persistent fatigue, low-grade temperature, nausea, vomiting, headache or bone pain; thickening or lumps in the tissue; and repeat infections. (Boots WebMD 2012)

The location of fat on the body is not important for cancer prevention. The location of fat on the body is important for cancer prevention (apple shape increases risk). Scientific evidence states that this is the most important risk factor associated with obesity and being overweight. (Breakthrough Cancer Research 2012)

2.6.6: General Health Misconceptions

General health misconceptions considered relevant to furthering the health education of adolescents are outlined in Table 2.12.
Table 2.13: General Health Misconceptions

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Accurate Conception</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Thyroid deficiencies account for the majority of the cases of obesity.</td>
<td>According to the Irish Heart Foundation (2012) overwhelming influences of obesity in 99% of the population are environmental and include marketing, advertising, increasing portion sizes, accessibility and availability of foods and facilities, increased automation and increased car use among other factors.</td>
<td>(Stephens 1973)</td>
</tr>
<tr>
<td>2. Being overweight results from having a slow metabolism.</td>
<td>Studies have shown that resting metabolism - the number of calories used by the body at rest – actually increases as people become heavier. In other words, the larger you are the more calories you use to keep your body going. Being fit and increasing your lean muscle tissue is one way to increase your metabolism. Essentially, the fitter you are, and the more lean muscle mass you have, the more calories you burn both at rest and during exercise – thus making weight maintenance and weight control easier.</td>
<td>(More Life (UK) 2011)</td>
</tr>
<tr>
<td>3. People with diabetes can’t participate in athletics.</td>
<td>Physical exercise is important for everyone’s health, and especially important for people with diabetes. Regular exercise helps lower blood sugar levels and keeps them in the target range.</td>
<td>(JDRF 2006)</td>
</tr>
<tr>
<td>4. Diabetes cannot be prevented.</td>
<td>Up to 80% of type 2 diabetes is preventable by changing diet, increasing physical activity and improving the living environment.</td>
<td>(Unite for diabetes 2012)</td>
</tr>
<tr>
<td>5. Diabetes only affects old people.</td>
<td>In reality, diabetes affects all age groups. By 2007, 230 million people between the ages of 20 and 79 will have diabetes. In developing countries diabetes will affect about 30 million people between ages 20-39; roughly 70 million between ages 40-59 and over 40 million between ages 60-79. In developed countries, diabetes will affect some 5 million people between ages 20-39; roughly 30 million between ages 40-59 and over 40 million between ages 60-79.</td>
<td>(Unite for diabetes 2012)</td>
</tr>
<tr>
<td>6. Diabetes is not a killer disease.</td>
<td>In fact, diabetes is a global killer, rivalling HIV/AIDS in its deadly reach. The disease kills more than 3 million people a year. Every 10 seconds a person dies from diabetes-related causes.</td>
<td>(Unite for diabetes 2012)</td>
</tr>
<tr>
<td>7. Taking insulin cures diabetes.</td>
<td>Taking insulin keeps people with Type 1 diabetes alive, but it does not cure the disease. No cure has yet been discovered for diabetes.</td>
<td>(JDRF 2006)</td>
</tr>
<tr>
<td>8. Young people don’t need to worry about heart disease.</td>
<td>How you live now affects your risk for cardiovascular diseases later in life. As early as childhood and adolescence, plaque can start accumulating in the arteries and later lead to clogged arteries.</td>
<td>(American Heart Association 2012)</td>
</tr>
<tr>
<td>9. If heart disease runs in your family there is nothing you can do to prevent it.</td>
<td>Although people with a family history of heart disease are at a higher risk, steps can be taken to dramatically reduce risks. Staying active, controlling cholesterol, eating healthily, managing blood pressure, maintaining healthy weight and not smoking all reduce risks.</td>
<td>(American Heart Association 2012)</td>
</tr>
</tbody>
</table>
2.6.7: Preconceptions cited in the literature

Preconceptions in relation to the field of health education, cited from reviewing the available literature (Table 2.13), have been listed below. Each preconception listed in Table 2.13 is considered to be naïve knowledge which would be readily revised through instruction.

**Table 2.14: Preconceptions Relating to Cancer and Other Health Issues**

<table>
<thead>
<tr>
<th>Preconceptions</th>
<th>Accurate Conceptions</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chronic diseases, like cancer, affect mainly high income countries.</td>
<td>80% of the estimated 35 million chronic disease deaths in 2005 occurred in low and middle income countries; an estimated 70% of all cancer deaths occurred in low and middle income countries in 2005.</td>
<td>(World Health Organisation 2006)</td>
</tr>
<tr>
<td>2. There is only one type of cancer. It is a single disease that could develop in any part of the body.</td>
<td>Cancer is not a single disease; it is a group of more than 200 diseases arising from different cells in the body, characterised by uncontrolled cellular growth (Shaw 2011; World Cancer Research Fund 2007)</td>
<td>(York Against Cancer 2012)</td>
</tr>
<tr>
<td>3. Women under the age of 35 don't really have to worry about breast cancer.</td>
<td>Only a small percentage of women under 35 get breast cancer. But because there's no fool proof way to know who is in the minority; every woman should be considered to be at risk.</td>
<td>(Drumm 1992)</td>
</tr>
<tr>
<td>4. Only women get breast cancer.</td>
<td>Although women do account for the vast majority of breast cancers, men are susceptible, too. With men, their cancers are usually linked to a strong family history or genetic causes and are usually seen in later stages, since men are not typically screened for breast cancer.</td>
<td>(National Women's Health Resource Center 2011)</td>
</tr>
</tbody>
</table>

2.6.8: Possible Knowledge Gaps cited in the literature

Knowledge gaps, unlike misconceptions and preconceptions, simply arise from a facts and information missing from pupils’ prior knowledge. Possible knowledge gaps obtained from the literature are listed in Table 2.14 – 2.16. Knowledge gaps have been divided into three categories and mainly focus on preventative measures for cancer and other chronic diseases.
Possible knowledge gaps relating to diet and physical activity are outlined in Table 2.14.

Table 2.15: Knowledge Gaps Relating to Diet and Physical Activity

<table>
<thead>
<tr>
<th>Knowledge Gap</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Two-thirds of cancer deaths are related to lifestyle and other controllable risk factors. However, 74% of people do not know that one-third of cancers are related to diet.</td>
<td>(Health Resources Publishing 2002)</td>
</tr>
<tr>
<td>2. Fat cells can secrete substances that cause cancer.</td>
<td>(Breakthrough Cancer Research 2012)</td>
</tr>
<tr>
<td>3. Remaining physically active throughout life can protect against cancer</td>
<td>(Breakthrough Cancer Research 2012)</td>
</tr>
<tr>
<td>4. Maintenance of a healthy body weight throughout life may be one of the most important ways to protect against cancer.</td>
<td>(Breakthrough Cancer Research 2012)</td>
</tr>
<tr>
<td>5. Research shows that eating allium vegetables, such as onions and leeks, probably protect against stomach cancer.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>6. Being overweight is a cause of cancers of the: oesphagus, pancreas, endometrium(womb), kidney, breast (post-menopausal), bowel</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>7. Evidence shows that eating a wide range of fruit probably protects against cancers of the mouth, pharynx and larynx, oesophagus, lung, stomach</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>8. The evidence shows that foods containing dietary fibre probably protect against bowel cancer.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>9. Physical Activity: The evidence is convincing that physical activity protects against colorectal cancer, while it also probably protects against post-menopausal breast cancer and cancer of the endometrium. The evidence is also convincing that physical activity protects against weight gain and obesity, which are both closely linked to cancer.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>10. Processed Meats: The evidence is convincing that processed meat is a cause of bowel cancer. Processed meat refers to any meat that is preserved by salting, curing, smoking or adding chemical preservatives. This means meat such as ham, bacon and hot dogs, and some sausages.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>11. Read Meat: The evidence is convincing that red meat, such as beef, lamb and pork, is a cause of bowel cancer.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>12. The evidence suggests that salt and salty foods are probably a cause of stomach cancer.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>13. The evidence shows that eating plenty of a variety of non-starchy vegetables probably protects against cancer of the mouth, pharynx and larynx, oesophagus, stomach. Non-starchy vegetables do not include peas, potatoes, squashes and corn.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
</tbody>
</table>
2.6.10: Knowledge Gaps relating to Alcohol & Tobacco consumption

Knowledge gaps relating to alcohol and tobacco consumption are outlined in Table 2.15.

Table 2.16: Knowledge Gaps Relating to Alcohol and Tobacco Consumption

<table>
<thead>
<tr>
<th>Knowledge Gaps</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Smoking or using tobacco in any form increases the risk of cancer and other diseases.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>2. Alcoholic Drinks are a cause of cancers of the mouth, pharynx, larynx, oesophagus and breast.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
<tr>
<td>3. The evidence shows that alcohol is also probably a cause of liver cancer.</td>
<td>(World Cancer Research Fund 2011)</td>
</tr>
</tbody>
</table>

2.6.11: Other Knowledge Gaps

Other knowledge gaps obtained from the literature are outlined in Table 2.16.

Table 2.17: Other Knowledge Gaps

<table>
<thead>
<tr>
<th>Other knowledge gaps</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Men are at a higher lifetime risk of developing cancer in general than women.</td>
<td>(Health Resources Publishing 2002)</td>
</tr>
<tr>
<td>2. Only 3-5% of all cancers are inherited.</td>
<td>(Breakthrough Cancer Research 2012)</td>
</tr>
<tr>
<td>3. Breast feeding: There is convincing evidence that breastfeeding protects the mother against breast cancer, and it also probably protects the child against obesity later in life, which is in turn linked to a higher cancer risk.</td>
<td>(Breakthrough Cancer Research 2012)</td>
</tr>
<tr>
<td>4. The lifetime risk of developing cancer is about 30%.</td>
<td>(Carlsson 1996)</td>
</tr>
<tr>
<td>5. In most cases cancer is caused by external factors (diet, smoking, sunbathing and so on) not internal factors (heredity, immune system and so on).</td>
<td>(Carlsson 1996)</td>
</tr>
</tbody>
</table>
2.7: Conclusion

The study of this literature has highlighted a low level of health and disease prevention awareness in adolescents.

The existence of misconceptions within the area of health education was confirmed; the quantity of these misconceptions was found to be numerous. Examining the literature in relation to how pupils acquire knowledge highlighted how misconceptions can develop. Pupils use their existing knowledge to process new information and thus incorrect existing knowledge can affect pupils understanding of new information. Misconceptions are resistant to change and difficult to assess. They can arise from teacher instruction and have been found to be held by teachers as well as pupils. Teacher’s awareness of misconceptions has also found to be limited.

From studying the available literature, a lack of research into the area health awareness held by Irish pupils was identified. Further research into these misconceptions, preconceptions and knowledge gaps from second level pupils up to pre-service teachers would therefore be valuable.
Chapter 3: Methodology

3.1: Introduction

The purpose of this chapter is to detail the design of this study. To that end, it presents the design of the study, the design of the diagnostic instrument, the selection of the participants, and the collection and analysis of the data (see Figure 3.1).

Figure 3.1: Schematic representation of Methodology

3.2: Design of Study

Health knowledge and awareness has the potential to play an intricate role in the Junior Certificate Science syllabus. At present second level subject syllabi indicates that Health Education plays a minimal role in school subjects (National Council for Curriculum and Assessment 2006). This study is designed in order to ascertain the base-line / pre-existing level of health knowledge and awareness pupils and science teachers hold.
In addition to assessing pre-existing knowledge, this study is designed to identify participants’ misconceptions and knowledge gaps relating to health education, with a particular focus on cancer. The first step in the design of this study was to review the misconceptions and possible knowledge gaps within the literature. The results of this review were reported in Chapter Two (Literature Review). These were then used in the design of the instrument.

**Identification of misconceptions within the literature**

The misconceptions identified and reported in Chapter Two were identified by carrying out an extensive literature review. Relevant science education and health education databases (ERIC - Educational Resource Information Centre, International ERIC, Sage, Jstor, Bridgeman Education and Education Research Abstracts) were searched using key words such as ‘Health’, ‘Education’, ‘Misconceptions’, ‘Preconceptions’ and ‘Science Education’. These misconceptions were reviewed by a panel of experts.

**Identification of knowledge gaps within the literature**

Knowledge gaps in the area of health education were searched for by reading information widely available to the public in pamphlets, webpages, and television and radio advertisements. Knowledge gaps relating to cancer was the main focus of this search. These sources of information were published by organisations such as the Irish Cancer Society, The Department of Health and Cancer Research UK. Information which was suspected to not be widely known in society was included in the literature review for eventual testing in the diagnostic instrument. These knowledge gaps were reviewed by a panel of experts. Examples of some knowledge gaps which were identified include “The evidence is convincing that red meat, such as beef, lamb and pork is a cause of bowel cancer” (Cancer Research UK 2013) and “Only 3 to 5% of cancers are inherited” (Cancer Research UK 2013). A full list of suspected knowledge gaps can be found in Chapter 2, Section 2.16.2.
Design of Instrumentation

The primary purpose of this study was to develop an instrument to assess pre-existing knowledge, misconceptions and knowledge gaps relating to health education in participants (Section 3.3). In order to obtain data to answer the aforementioned research questions (see Section 1.3) relating to health education; it was decided to design a paper and pen diagnostic instrument.

Numerous different methods of identifying pupils misconceptions are cited throughout the literature; each claiming different advantages. The use of clinical interviews is valued in the identification of misconceptions as they allow for the use of open-ended questions and probing (Kaczmarczyk et al. 2010). Interviews provide the flexibility for interviewers and participants to respond to emerging ideas and seek clarification (Rosenthal and Sanger 2012). However this method requires the researcher to have expert skills in this area to be successfully administered (Yip 1998). With the large scale of this study, interviews were deemed unsuitable.

Concept maps have been used in numerous studies as they allow the researchers to view how pupils link and organise concepts together. Concepts maps can assist teachers identifying misconceptions and missing concepts (Stoica et al. 2011). Tasdere and Ercan (2011) used structured communication grids which present students with a grid representing scientific situations. Students were given questions related to these situations and were asked to find correct boxes. Students answers were analysed to categorise misconceptions. Interactive essay writing has also been used to identify student misconceptions and improve scientific knowledge. This is done by analysing student essays for misconceptions and recommending science web pages that help correct those misconceptions (Bethard et al. 2012).

Paper and pen style diagnostic instruments have been widely used and proven effective in the identification of misconceptions (Burgon et al. 2011; Keeley et al. 2005, 2007, 2008;
Gronlund 2003). Using a blend of multiple choice questions, two-tiered questions and open ended items has proven effective in the diagnosis of misconceptions as it allows the participants sufficient freedom to express opinions, while also allowing for a large sample group (Burgon et al 2011). Additionally, a paper and pen style diagnostic instrument was deemed most appropriate for this study as its use in a classroom setting does not require teachers who administer the test to have any training to be affective; unlike interviews (Peterson and Treagust 1989).

Section A of the diagnostic instrument (see Appendix 2) was designed in order to obtain quantitative data relating to participants. There were three groups of participants and appropriate quantitative data was collected for each group. Table 3.1 displays the quantitative data for each group of participants.

<table>
<thead>
<tr>
<th>Junior Certificate Students</th>
<th>Pre-service Teachers</th>
<th>Qualified Science Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Age</td>
<td>• Year of Study</td>
<td>• Years of teaching experience</td>
</tr>
<tr>
<td>• Level of Study (higher / ordinary)</td>
<td>• University</td>
<td>• Type of school currently teaching in</td>
</tr>
<tr>
<td></td>
<td>• Degree Programme</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Information about school subjects</td>
<td></td>
</tr>
</tbody>
</table>

The purpose of including these questions was to determine if any of these factors linked to the level of misconceptions and knowledge gaps held by participants.

Section B of the instrument was created by considering and utilising the misconceptions and possible knowledge gaps found within the literature. The instrument was designed in order to determine not only participants pre-existing knowledge but also their misconceptions and knowledge gaps in relation to health education. For that reason a blend of quantitative and qualitative methodologies were applied to this instrument with the aim of achieving a deeper
understanding of participants’ level of knowledge while allowing for a large sample group. This was done by using a blend of open ended questions (Section 3.2.2.4) and a number of types of closed questions (Section 3.2.2.2). The survey was designed not only to allow participants to answer factual questions but also to express their attitudes, ideas and opinions towards health education, with a particular focus on cancer.

**Quantitative Research**

Quantitative research methods attempt to gather data by objective methods to provide information about relations, comparisons and predictions and attempts to remove the investigation from the investigation (Smith 1983). Quantitative research methods are used in the diagnostic instrument in the form of closed ended questions.

**Types of closed ended questions**

A number of types of closed ended questions were included in this diagnostic instrument. These included true or false questions, choosing the correct statement questions, categorisation questions, and two-tiered multiple choice questions. Each question or sub-part of a question aims at identifying a particular misconception, preconception or knowledge gap. Each of these questions was designed by the researcher exclusively for this study.

The true or false questions were designed using knowledge gaps as correct statements and misconceptions or preconceptions as incorrect statements. Categorisation questions were used to identify knowledge gaps relating to dietary awareness. Participants were asked to classify a number of food types into categories depending on the risk they pose for the development of a particular type of cancer. Multiple choice questions were all formatted as two tiered multiple choice questions. These questions required the participants to select a response in the first tier and then justify the response in the second tier. These questions were preferred over traditional multiple-choice questions as they reduce the likelihood of participants guessing the correct answer.
Qualitative Research

Research has been defined as an investigative methodological approach that allows the participants to express their feelings and opinions on certain occurrences that have unfurled naturally. This was gathered through open ended questions in the diagnostic instrument.

Types of open ended questions

Open ended questions were designed to gather qualitative data and gain a deeper understanding of participants thought process than would be possible from closed ended questions alone. Participants were asked to give their responses to statements and answer questions relating to health education. Open ended questions were also used in two tiered multiple choice questions as the second tier to allow pupils to justify their answers without being restricted to particular responses in closed ended questions.

3.3: Participation selection and profiles

Three groups of participants were selected to take part in this research. These groups are Junior Certificate science pupils, pre-service science teachers and in-service (or practicing) science teachers. These participants were selected in order to fulfil the research questions identified in the literature review (see Section 1.3). The breakdown of participants who took part in this study is described in Table 3.2.

<table>
<thead>
<tr>
<th>Group of Participants</th>
<th>Male</th>
<th>Female</th>
<th>Total Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior Certificate students</td>
<td>541</td>
<td>469</td>
<td>1010</td>
</tr>
<tr>
<td>Junior Certificate students by age:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age: 13.......................</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>14.........................</td>
<td>379</td>
<td>293</td>
<td></td>
</tr>
<tr>
<td>15.........................</td>
<td>150</td>
<td>176</td>
<td></td>
</tr>
<tr>
<td>16.........................</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pre-service teacher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-service teachers</td>
<td>17</td>
<td>24</td>
<td>41</td>
</tr>
</tbody>
</table>
Junior Certificate science pupils are the main focus of this study and they were recruited in the largest numbers for identification of misconceptions and knowledge gaps. Pupils were recruited from all types of post primary schools around the Republic of Ireland. The types of schools include vocational schools (VEC’s), community and comprehension schools and voluntary secondary schools. The breakdown of the Junior Certificate science pupils based on type of school is shown in Table 3.3.

Table 3.3: Junior Certificate science students categorised by type of school

<table>
<thead>
<tr>
<th>Type of School</th>
<th>Number of Junior Certificate science pupils</th>
<th>Percentage of Junior Certificate science pupils</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEC</td>
<td>312</td>
<td>30.89%</td>
</tr>
<tr>
<td>Community / comprehensive secondary school</td>
<td>408</td>
<td>40.39%</td>
</tr>
<tr>
<td>Voluntary secondary school</td>
<td>290</td>
<td>20.69%</td>
</tr>
</tbody>
</table>

Pre-service and in-service science teachers were also chosen for participation in this study in order to ascertain the level of pre-existing knowledge, both accurate and inaccurate in relation to Health Education.

The information gathered for the three categories of participants was statistically analysed to see if any links exist between the data obtained for each group (Section 3.5.1).

Pilot Study

A pilot study was carried out by administering the Identification Instrument to one class of Junior Certificate Science pupils. The researcher was present for the administration of the
diagnostic instrument to this class. Pupils were firstly shown a PowerPoint presentation on how to complete the survey. This PowerPoint contained examples of the types of questions included in the instrument and how pupils should approach answering the questions (see Appendix 2).

The pupils were then given the diagnostic instrument to complete. Pupils were encouraged to ask the researcher questions if any part of the instrument was unclear or if they didn’t understand any of the language used in the instrument.

Following the completion and collection of the instrument from all students, the researcher displayed the survey on the overhead projector and facilitated a class discussion on what the pupils believed they were being asked in each question and what the language being asked in each question meant. Difficulties relating to the language used and instructions given in the instrument were noted by the researcher.

Information gathered from the pilot study lead the researcher to make slight adjustments to the format of the study. The term ‘bowel cancer’ was clarified by including a brief description in the survey. The instructions given in Section A of the survey were also adjusted to make sure participants were clear on which part of the Section A they were required to complete.

**Administration of Diagnostic Instrument**

Post-primary secondary schools were contacted via letter (See Appendix 3) and asked to participate in the study. Schools who agreed to participate were contacted by telephone to discuss the logistics of taking part in the study. Most often the researcher communicated with the head of the science department in the school. Where possible the researcher visited the school to deliver the diagnostic instruments accompanied by a C.D. with the PowerPoint instructions (Appendix 4) on how to complete the instrument, information sheets (Appendix
5) and consent forms (Appendix 6). However due to the large scale of the study meant it was not possible for the researcher to visit all schools. The diagnostic instruments and accompanying material was posted to schools where necessary.

Once the diagnostic instrument had been completed by both Junior Certificate science pupils and in-service science teachers they were collected by the researcher or returned to the University of Limerick by post.

Course directors of undergraduate science education degrees in Universities around the Republic of Ireland were contacted by email (Appendix 7) to recruit pre-service science teachers to participate in the study.

**Analysis of collected data**

Section B of the instrument was corrected manually by the researcher and categorised according to the information obtained from Section A.

The diagnostic instrument was comprised of 15 questions in Section B. The response rate to each answer was input into and analysed using SPSS. The most frequently arising misconceptions within the sample group were analysed.

**Ethics**

An application for ethical approval was submitted to the Science and Engineering Research Ethics Committee in the University of Limerick in February 2013. The full research ethics application form was submitted as the study was to involve individuals under the age of 18. Attached to the application form for review by the ethics committee was the diagnostic instrument, and information sheets and consent forms for participants.

Ethical approval was received in March 2013. The ethical procedures outlined by the University of Limerick were followed in the collection and use of the data obtained.
Chapter 4: Results

4.1 Introduction:

The results of the data analysis are presented in this chapter. The focus of the chapter will be to resolve the research questions outlined in Chapter 1, Section 1.3. The quantitative data collected in Section B of the Identification Instrument will constitute the main emphasis of this chapter. This will facilitate the identification of the presence or absence of misconceptions and knowledge gaps in the second level pupils, pre-service teachers and qualified teachers. The data collected from Section A of the Identification Instrument included age, gender, type of school and group of individuals (i.e. level of study). As analysis of age, gender and type of school was deemed insignificant, the results presented here are solely based on group of individuals. The full extend of the data collected can be seen in Appendix 8.

Question 1 of the Identification Instrument aimed at determining a baseline for the presence of many misconceptions and knowledge gaps in participants. Therefore this question will be analysed individually in Section 4.2. All other data will be analysed based on the topics outlined in Section 2.2.

4.2: Participants responses to commonly cited risk factors of cancer

Question 1 on the Identification Instrument was used as a baseline to determine how aware participants are of the commonly cited risk factors of cancer such as “being overweight / obese” and “smoking”. This question also attempts to assess the presence of misconceptions such as “receiving a hard blow to some part of the body” and “using mobile phones” in individuals. Participants’ were presented with eleven possible risk factors for developing cancer. They were asked to tick true for those they believe to be genuine risk factors in
developing cancer and false for those they believe aren’t. The results of this question were firstly analysed as a whole.

Table 4.1: Analysis of participants overall responses to Question 1

<table>
<thead>
<tr>
<th>Group of Individuals</th>
<th>Second Level Pupils</th>
<th>Pre-service Teachers</th>
<th>Qualified Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>69.64</td>
<td>71.49</td>
<td>71.38</td>
</tr>
<tr>
<td>95% Confidence Interval for mean:</td>
<td>Lower Bound</td>
<td>68.65</td>
<td>67.33</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
<td>70.62</td>
<td>75.66</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>15.67</td>
<td>15.97</td>
<td>17.59</td>
</tr>
<tr>
<td>Minimum</td>
<td>18.18</td>
<td>18.18</td>
<td>27.27</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>18.18</td>
<td>18.18</td>
<td>18.18</td>
</tr>
</tbody>
</table>

Table 4.1 of results shows that second-level pupils achieved a mean result of 69.64% correct responses. Pre-service teachers and qualified teacher received mean results of 71.49% and 71.38% respectively.

Figure 4.1: Box plot comparing overall responses to Question 1
The box plot suggests that no difference exists between the three groups of participants. A one-way ANOVA was used to determine whether or not a statistically significant difference exists between at least two of the groups. This resulted in $p=0.588$. Hence there is no statistically significant difference between groups.

4.2.1: Responses to “Being overweight / obese being a risk factor for developing cancer”:

Table 4.1 looks directly at participants’ beliefs about whether or not being overweight / obese is a risk factor for developing cancer. Participants were asked to communicate if they believed that the statement “Being overweight / obese is a risk factor for developing cancer” is true or false. In the case of this statement participants who answered true were correct and those who answered false were incorrect.

**Table 4.1: Analysis of participants’ responses “Being overweight / obese being a risk factor for developing cancer”**

| Response to being overweight / obese being a possible risk factor for developing cancer: | Group of Individuals |
|---|---|---|---|
| | Second Level Pupils | Pre-service Teachers | Qualified Teachers |
| **True** | % within group of individuals | 72.2% | 80.3% | 85.2% |
| **False** | % within group of individuals | 27.8% | 19.7% | 14.8% |
| **Total** | % within group of individuals | 100.0% | 100.0% | 100.0% |

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.132$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

The data is also presented in Figure 4.2 below.
Figure 4.2: Participants responses to “Being overweight / obese being a risk factor for developing cancer”

4.2.2: Responses to “Smoking being a risk factor for developing cancer”:

Table 4.2 looks directly at participants beliefs about whether or not smoking is a risk factor for developing cancer. In this True or False formatted question, participants ticked to indicated their beliefs in relation to the statement “smoking is a risk factor for developing cancer”. Participants who answered true were correct and those who answered false were incorrect.

Table 4.2: Analysis of participants’ responses “Smoking being a risk factor for developing cancer”

<table>
<thead>
<tr>
<th>Response to smoking being a possible risk factor for developing cancer:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>True</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>False</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Total</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.657$. As $p \geq 0.005$, it
can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

4.2.3: Responses to “Poor diet being a risk factor for developing cancer”:

Table 4.3 looks directly at participants’ beliefs about whether or not poor diet is a risk factor for developing cancer. Participants who answered true were correct and those who answered false were incorrect.

Table 4.3: Analysis of participants’ responses “Poor diet being a risk factor for developing cancer”

| Response to poor diet being a possible risk factor for developing cancer: | Group of Individuals |  |
|---|---|---|---|
|  | Second Level Pupils | Pre-service Teachers | Qualified Teachers |
| True | % within group of individuals | 63.4% | 70.0% | 70.4% |
| False | % within group of individuals | 36.6% | 30.0% | 29.6% |
| Total | % within group of individuals | 100.0% | 100.0% | 100.0% |

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that \( p = 0.455 \). As \( p \geq 0.005 \), it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

The data is also presented in Figure 4.3 below.
4.2.4: Responses to “Mobile phones being a risk factor for developing cancer”: Table 4.4 looks directly at participants beliefs about whether or not use of mobile phones is a risk factor for developing cancer. Participants were asked to reveal if they believed that the statement “Using mobile phones is a risk factor for developing cancer” is true or false. In the case of this statement participants who answered true were incorrect and those how answered false were correct.

Table 4.4: Analysis of participants’ responses “Mobile phones is a risk factor for developing cancer”

<table>
<thead>
<tr>
<th>Response to mobile phones being a possible risk factor for developing cancer:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>True</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>False</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Total</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>
A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.781$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

4.2.5: Responses to “Inheritance being a risk factor for developing cancer”:

Table 4.5 looks directly at participants beliefs about whether or not inheritance is a risk factor for developing cancer. In this True or False formatted question, participants ticked to indicated their beliefs in relation to the statement “Inheritance is a risk factor for developing cancer”. Participants who answered true were correct and those who answered false were incorrect. This extent to which inheritance poses a risk factor will be further discussed in Section 4.6.

Table 4.5: Analysis of participants’ responses “Inheritance is a risk factor for developing cancer”

<table>
<thead>
<tr>
<th>Response to inheritance being a possible risk factor for developing cancer:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>True % within group of individuals</td>
<td>81.8%</td>
</tr>
<tr>
<td>False % within group of individuals</td>
<td>18.2%</td>
</tr>
<tr>
<td>Total % within group of individuals</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.781$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.
4.2.6: Responses to “exposure to U.V. light being a risk factor for developing cancer”:

Table 4.5 looks directly at participants beliefs about whether or not exposure to U.V. light is a risk factor for developing cancer. Participants who answered true were correct and those how answered false were incorrect.

Table 4.6: Analysis of participants’ responses “Exposure to U.V. light is a risk factor for developing cancer”

<table>
<thead>
<tr>
<th>Response to exposure to U.V. light being a possible risk factor for developing cancer:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>True % within group of individuals</td>
<td>93.2%</td>
</tr>
<tr>
<td>False % within group of individuals</td>
<td>6.8%</td>
</tr>
<tr>
<td>Total % within group of individuals</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that p = 0.989. As p ≥ 0.005, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

4.2.7: Responses to “using cleaning agents being a risk factor for developing cancer”:

Table 4.7 looks directly at participants beliefs about whether or not using cleaning agents is a risk factor for developing cancer. Participants who answered true were incorrect and those how answered false were correct.
Table 4.7: Analysis of participants’ responses “using cleaning agents is a risk factor for developing cancer”

| Response to using cleaning agents being a possible risk factor for developing cancer: | Group of Individuals |
|---|---|---|
|  | Second Level Pupils | Pre-service Teachers | Qualified Teachers |
| True | % within group of individuals | 93.2% | 93.4% | 92.6% |
| False | % within group of individuals | 6.8% | 6.6% | 7.4% |
| Total | % within group of individuals | 100.0% | 100.0% | 100.0% |

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.119$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

The data is also presented in Figure 4.4 below.

![Participants' responses to using cleaning agents being a risk for developing cancer](image)

Figure 4.4: Participants responses to using cleaning agents being a risk for developing cancer
4.3: Participants responses relating to diet

Two questions on the Identification Instrument, question 4 and question 11, specifically related to participants knowledge of diet and foods which have been found to pose risk factors for the development of cancer.

Question 4 on the Identification Instrument was used to determine how aware participants are of the foods commonly cited as being risk factors of bowel cancer and those believed to reduce an individual’s risk of developing bowel cancer. Participants’ were presented with nine different foods and asked to classify them as “increases risk of bowel cancer”, “reduces risk of bowel cancer” and “no known risk to bowel cancer”. The results of this question were firstly analysed as a whole.

<table>
<thead>
<tr>
<th></th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Mean</td>
<td>50.15</td>
</tr>
<tr>
<td>95% Confidence Interval for mean:</td>
<td>Lower Bound</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>22.95</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>33.33</td>
</tr>
</tbody>
</table>

Table 4.8: Analysis of participants overall responses to Question 4

Table 4.7 of results shows that second-level pupils achieved a mean result of 50.15% correct responses. Pre-service teachers and qualified teacher received mean results of 46.81% and 47.33% respectively.
Figure 4.5:  Box plot comparing overall responses to Question 4

The box plot suggests that no difference exists between the three groups of participants. A one-way ANOVA was used to determine whether or not a statistically significant difference exists between at least two of the groups. This resulted in p=0.462. Hence there is no statistically significant difference between groups.

Question 11 on the Identification Instrument was used to determine how aware participants are of the foods commonly cited as being risk factors of breast cancer and those believed to reduce an individual’s risk of developing breast cancer. Participants’ were presented with nine different foods and asked to classify them as “increases risk of breast cancer”, “reduces risk of breast cancer” and “no known risk to breast cancer”. The results of this question were firstly analysed as a whole.
Table 4.9: Analysis of participants overall responses to Question 11

<table>
<thead>
<tr>
<th>Group of Individuals</th>
<th>Mean</th>
<th>95% Confidence Interval for mean:</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Interquartile range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower Bound Upper Bound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Level Pupils</td>
<td>40.11</td>
<td>38.28 - 41.94</td>
<td>29.62</td>
<td>0.00</td>
<td>100.00</td>
<td>66.67</td>
</tr>
<tr>
<td>Pre-service Teachers</td>
<td>33.52</td>
<td>25.44 - 41.59</td>
<td>31.52</td>
<td>0.00</td>
<td>88.89</td>
<td>66.67</td>
</tr>
<tr>
<td>Qualified Teachers</td>
<td>39.92</td>
<td>28.0 - 51.82</td>
<td>30.077</td>
<td>0.00</td>
<td>100.00</td>
<td>66.67</td>
</tr>
</tbody>
</table>

Table 4.7 of results shows that second-level pupils achieved a mean result of 40.12% correct responses. Pre-service teachers and qualified teacher received mean results of 33.52% and 39.92% respectively.

Figure 4.6: Box plot comparing overall responses to Question 11

The box plot suggests that no difference exists between the three groups of participants. A one-way ANOVA was used to determine whether or not a statistically significant difference
exists between at least two of the groups. This resulted in \( p=0.244 \). Hence there is no statistically significant difference between groups.

### 4.4: Participants responses relating to exposure to U.V. rays and skin cancer

Two questions on the Identification Instrument, question 8 and question 9, specifically related to participants knowledge of the risk factors associated with overexposure to U.V. rays and other known risk factors for skin cancer.

Question 8 on the Identification Instrument was used to determine how aware participants are that exposure to U.V. rays poses an equal risk regardless of your age. This question was formatted in response to the misconception “Protecting yourself from the sun is only important when you’re young as this is when you can do the most damage to your skin” (Skin Cancer Foundation 2008). This question was presented in a two-tiered approach. Participants were firstly presented with four statements questioning which time of their lives they believed it most important to protect their skin. They were then asked to explain their answer by choosing one of four options in the second tier of the question. Correct responses to this question indicated that participants were aware that it is equally important to protect your skin at all ages. The full list of option statements can be seen in Appendix 2, question 8.

**Table 4.10:** Analysis of participants’ overall responses to Question 8

<table>
<thead>
<tr>
<th>% within group of individuals incorrectly answering both tiers</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td></td>
<td>29.6%</td>
</tr>
<tr>
<td>% within group of individuals correctly answering one tiers</td>
<td>23.4%</td>
</tr>
<tr>
<td>% within group of individuals correctly answering both tiers</td>
<td>47.0%</td>
</tr>
</tbody>
</table>
A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.889$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

Question 9 on the Identification Instrument relates directly to participants knowledge of skin cancer. This question was composed of three sections; (i), (ii) and (iii). In each section two statements were presented. Participants were asked to circle the statement they believed to be true. Part i of question 8 aims at assessing if participants are aware of the high frequency of skin cancer in Ireland. Part ii aims at assessing misconceptions relating to sunbeds. Part iii assesses the misconception that “only fair skinned people need to be concerned about overexposure to the sun” (World Health Organisation 2003).

<table>
<thead>
<tr>
<th>Response to Question 9, part i (awareness of skin cancer prevalence):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 9, part ii (risk of sunbeds):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 9, part iii (fair-skinned v’s dark skinned risks):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

Table 4.11: Analysis of participants’ responses to Question 9
A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. For part i, it was determined that \( p = 0.001 \). As \( p \leq 0.005 \), it can be concluded that a statistically significant association exists between groups. In other words, there is a difference in beliefs between the three groups of participants.

For part ii, it was determined that \( p = 0.264 \). As \( p \geq 0.005 \), it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part iii, it was determined that \( p = 0.204 \). As \( p \geq 0.005 \), it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

4.5: Participants responses relating to body weight

Two questions on the Identification Instrument, question 10 and question 12, are specifically related to participants’ knowledge of the risk factors for developing cancer that have been associated with body weight.

Question 10 on the Identification Instrument was delivered as a True or False style question. It presented four statements to identify as either True or False. All statements were designed to directly assess misconceptions or knowledge gaps relating to body weight. Overall performance in this question will firstly be analysed. Responses to individual statements will then be examined.
### Table 4.1: Analysis of participants overall responses to Question 10

<table>
<thead>
<tr>
<th>Group of Individuals</th>
<th>Second Level Pupils</th>
<th>Pre-service Teachers</th>
<th>Qualified Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>55.20</td>
<td>55.42</td>
<td>49.07</td>
</tr>
<tr>
<td>95% Confidence Interval for mean:</td>
<td>Lower Bound</td>
<td>53.83</td>
<td>49.11</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
<td>56.58</td>
<td>61.72</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>22.24</td>
<td>24.40</td>
<td>24.50</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>25.00</td>
<td>25.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>

Table 4.10 of results shows that second-level pupils achieved a mean result of 55.20% correct responses. Pre-service teachers and qualified teacher received mean results of 55.42% and 49.07% respectively.

![Box plot comparing overall responses to Question 10](image)

**Figure 4.7**: Box plot comparing overall responses to Question 10
The box plot suggests that no difference exists between the three groups of participants. A one-way ANOVA was used to determine whether or not a statistically significant difference exists between at least two of the groups. This resulted in $p=0.372$. Hence there is no statistically significant difference between groups. Crosstabulations were also carried out in order to analyse individuals’ responses to the four statements presented for analysis in question 10. The statements and response levels are presented in Table 4.13. It should be noted that statement A is false, B is true, C is true and D is true.

Table 4.13: Analysis of participants’ responses to individual parts of Question 10

<table>
<thead>
<tr>
<th>Response to Question 10, part A (Excess fat is equally dangerous for causing cancer wherever it is located on the body):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 10, part B (Excess fat is most dangerous for causing cancer when located around the middle of the body):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 10, part C (Having a healthy body weight throughout life is one of the most important ways to prevent against cancer):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 10, part D (Fat cells produce substances which can cause cancer):</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>
Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. For part A, it was determined that $p = 0.378$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part B, it was determined that $p = 0.864$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants. For part C, it was determined that $p = 0.980$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants. For part D, it was determined that $p = 0.200$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

Question 12 assesses the presence of the knowledge gap relating to BMI as a risk factor for developing cancer. The question firstly presented a description of BMI and then questions which category of BMI poses the greatest risk for the development of cancer. The correct response to this statement was that obese is the BMI category which poses the greatest risk for the development of cancer. The use of BMI in the Identification Instrument was discussed in Section 2.2.1.

<table>
<thead>
<tr>
<th>Table 4.14: Analysis of participants’ responses to Question 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group of Individuals</td>
</tr>
<tr>
<td>$\text{Second Level Pupils}$        $\text{Pre-service Teachers}$ $\text{Qualified Teachers}$</td>
</tr>
<tr>
<td>Correct % within group of individuals</td>
</tr>
<tr>
<td>Incorrect % within group of individuals</td>
</tr>
</tbody>
</table>
Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.688$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

### 4.6: Participants responses relating to inheritance of cancer

Question 7, specifically related to participants knowledge of the percentages of cancers that are directly linked to inheritance. This question was presented in a two-tiered approach. Participants were asked what percentage of cancers they believe are inherited and were presented with five categories of percentages to choose from; less than 5%, 5 to 20%, 20 to 40%, 40 to 60% and 60 to 80%. The correct response to this question is less than 5%. The second tier of the question provided participants with the opportunity to explain why they thought this in an open-ended style question.

Cross-tabulations were carried out to analyse the percentage of correct and incorrect answers in each group of participants.

#### Table 4.15: Analysis of participants’ responses to Question 7, part 1

<table>
<thead>
<tr>
<th></th>
<th>Group of Individuals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Second Level Pupils</td>
<td>Pre-service Teachers</td>
<td>Qualified Teachers</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
<td>19.2%</td>
<td>17.5%</td>
<td>15.4%</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
<td>80.8%</td>
<td>82.5%</td>
<td>84.6%</td>
</tr>
</tbody>
</table>

Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.846$. As $p \geq 0.005$, it
can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

Participants responses to the five categories of percentages to choose from was also analysed in the bar chart below.

![Bar chart comparing responses to Question 7, part 1](image)

**Figure 4.8: Bar chart comparing responses to Question 7, part 1**

The responses to the open-ended component of this question were statistically analysed by grouping participants’ responses into categories. The categories were “Believes that it is entirely to do with genetics”, “Believes that it is sometimes related to genetics”, “Misunderstands that inheritance means contagious”, “Believes that cancer is not at all or is rarely related to family inheritance” and “Other”.
Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.132$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

### 4.7: Participants responses relating to stress as a risk factor for cancer

One question on the Identification Instrument, question 14, specifically related to participants knowledge of the risk factors associated with stress for cancer. This question was used to determine if participants are aware that stress is not known to directly cause cancer. It can however be linked indirectly to cancer as it can lead to unhealthy behaviours such as smoking or over-eating. This question was presented in a two-tiered approach. Participants were firstly presented with two statements questioning if they believe stress is known to directly cause cancer or not. They were then asked to explain their answer by choosing one of four options in the second tier of the question: “Stress causes hormone changes in the body”,

![Bar chart representing participants’ main beliefs expressed in Question 7, part 2](image)

**Figure 4.9: Bar chart representing participants’ main beliefs expressed in Question 7, part 2**

- **Believes that it is entirely to do with genetics**
- **Believes that it is sometimes related to genetics**
- **Misunderstands that inheritance means contagious**
- **Believes that cancer is not at all or is rarely related to family inheritance**
- **Other**

<table>
<thead>
<tr>
<th>Participants responses (%)</th>
<th>Second Level Pupils</th>
<th>Pre-service teachers</th>
<th>Qualified teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Believes that it is entirely to do with genetics</td>
<td>10%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Believes that it is sometimes related to genetics</td>
<td>40%</td>
<td>50%</td>
<td>30%</td>
</tr>
<tr>
<td>Misunderstands that inheritance means contagious</td>
<td>30%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Believes that cancer is not at all or is rarely related to family inheritance</td>
<td>10%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>10%</td>
<td>5%</td>
<td>10%</td>
</tr>
</tbody>
</table>
“Stress can lead to unhealthy behaviours such as smoking, over-eating or heavy drinking” and “Stress has no known physical effects on the body”.

**Table 4.16:** Analysis of participants’ overall responses to Question 14

<table>
<thead>
<tr>
<th>Group of Individuals</th>
<th>Second Level Pupils</th>
<th>Pre-service Teachers</th>
<th>Qualified Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within group of individuals incorrectly answering both tiers</td>
<td>24.1%</td>
<td>16.9%</td>
<td>22.2%</td>
</tr>
<tr>
<td>% within group of individuals correctly answering one tiers</td>
<td>44.7%</td>
<td>42.4%</td>
<td>40.7%</td>
</tr>
<tr>
<td>% within group of individuals correctly answering both tiers</td>
<td>31.2%</td>
<td>40.7%</td>
<td>37.0%</td>
</tr>
</tbody>
</table>

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.532$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

### 4.8: Participants responses relating to smoking as a risk factor for cancer

One question on the Identification Instrument, question 3, specifically related to participants knowledge of the high risk factor of smoking for the development of cancers. This question was presented in a two-tiered approach. The first tier was presented as a scenario style question. Participants were asked to choose which individual they think would be most likely to develop lung cancer, a smoker living in the country side or a non-smoker living in a heavily polluted city. The second tier of the question provided participants with the opportunity to explain why they thought this in an open-ended style question. The correct response for this question was the identification of the smoker as the individual most likely to develop lung cancer.
Cross-tabulations were carried out to analyse the percentage of correct and incorrect answers in each group of participants.

**Table 4.17: Analysis of participants’ responses to Question 3, part 1**

<table>
<thead>
<tr>
<th>Group of Individuals</th>
<th>Second Level Pupils</th>
<th>Pre-service Teachers</th>
<th>Qualified Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correct</strong> % within group of individuals</td>
<td>80.9%</td>
<td>80.3%</td>
<td>92.6%</td>
</tr>
<tr>
<td><strong>Incorrect</strong> % within group of individuals</td>
<td>19.1%</td>
<td>19.7%</td>
<td>7.4%</td>
</tr>
</tbody>
</table>

Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.303$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

The responses to the open-ended component of this question were statistically analysed by grouping participants’ responses into categories. The categories were “Simply states smoking is worse”, “Shows awareness that smoking has a more concentrated effect than pollution”, “Simply states pollution is worse”, “Attributes belief that pollution is worse to the fact that it contains second hand smoke and other fumes” and “Other”.
Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.188$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

4.9: Analysis of participants open-ended responses

Three questions on the Identification Instrument, question 2, question 5 and question 13, were open-ended questions all designed to encourage participants to discuss their opinions and beliefs about the risk factors relating to cancer. The responses to the open-ended component of this question were statistically analysed by grouping participants’ responses into categories.
Question two asked participants what they believe is the biggest risk factor for developing cancer. The categories of participant responses were smoking, U.V. rays, inheritance, diet, sunbeds, BMI and other.

Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.785$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

Question five asked participants to give their response to the statement “My lifestyle factors in my teenage years won’t affect my future health when I get older”. The categories of participants responses were “Awareness of smoking only”, “Awareness of alcohol only”, “Awareness of smoking and alcohol”, “Agrees with statement with explanation”, “Aware of development of addiction”, “Aware of dietary factors”, “Aware of exercise requirements”, “Disagrees with statement without reasoning”, and “Good overall understanding of meaning”.

![Bar chart representing participants’ main beliefs expressed in Question 2](image-url)
Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that \( p = 0.016 \). As \( p \geq 0.005 \), it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

Question 13 asked participants to discuss what they think causes cancer. The categories of participants responses were “Indication that age is the main cause”, “Smoking”, “Awareness of specifics of one type of cancer”, “Incorrect BMI”, “Immune system”, “Alcohol”, “Sunbeds / Sun damage”, “Genetics”, “Diet” and “Other”.

Figure 4.12: Bar chart representing participants’ main beliefs expressed in Question 5
Chi squared tests were used to determine whether or not a statistically significant association exists between responses from individuals. It was determined that $p = 0.166$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

4.10: **Analysis of the presence of knowledge gaps of the link between lifestyle factors and cancer development.**

The two remaining questions in the Identification Instrument aimed at addressing some of the knowledge gaps identified in the literature review relating to how an individual’s lifestyle factors can influence their likelihood of developing cancer. These questions were question 6 and question 15. Both questions were subdivided into four sections; i, ii, iii and iv. In each section two statements were presented. Participants were asked to circle the statement they believed to be true.
Each sub-section in question 6 and 15 addresses a separate knowledge gap. Results were analysed using cross tabulations.

Part i of question 6 aims at assessing if participants are aware that they can reduce their own personal risk of developing cancer. Part ii aims at assessing the knowledge gap that lifestyle factors play a large part in the risk of developing many cancers. Part iii assesses the misconception that cancer is contagious. Part iv assess the knowledge gap that diet can influence many cancers, not just through its effect on BMI.

Table 4.18: Analysis of participants’ responses to Question 6

<table>
<thead>
<tr>
<th>Response to Question 6, part i:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 6, part ii:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 6, part iii:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 6, part iv:</th>
<th>Group of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
</tr>
</tbody>
</table>

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. For part i, it was determined that $p = 0.036$. As $p$
≥ 0.005, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part ii, it was determined that p = 0.900. As p ≥ 0.005, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part iii, it was determined that p = 0.911. As p ≥ 0.005, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part iv, it was determined that p = 0.637. As p ≥ 0.005, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

Part i of question 15 aims at assessing the misconception that chemicals found in plastic containers can cause cancer. Part ii aims at assessing the knowledge gap that lifestyle factors play a large part in the risk of developing many cancers. Part iii assesses the misconception that cancer is a single disease that can develop in many parts of the body. Part iv assess the knowledge gap that physical activity can influence many cancers, not just through its effect on BMI.
Table 4.19: Analysis of participants’ responses to Question 15

<table>
<thead>
<tr>
<th>Response to Question 15, part i:</th>
<th>Group of Individuals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
<td>Pre-service Teachers</td>
<td>Qualified Teachers</td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
<td>53.5%</td>
<td>53.4%</td>
<td>59.3%</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
<td>46.5%</td>
<td>46.6%</td>
<td>40.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 15, part ii:</th>
<th>Group of Individuals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
<td>Pre-service Teachers</td>
<td>Qualified Teachers</td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
<td>75.8%</td>
<td>74.6%</td>
<td>85.2%</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
<td>24.2%</td>
<td>25.4%</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 15, part iii:</th>
<th>Group of Individuals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
<td>Pre-service Teachers</td>
<td>Qualified Teachers</td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
<td>19.5%</td>
<td>20.3%</td>
<td>29.6%</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
<td>80.5%</td>
<td>79.7%</td>
<td>70.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response to Question 15, part iv:</th>
<th>Group of Individuals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
<td>Pre-service Teachers</td>
<td>Qualified Teachers</td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>% within group of individuals</td>
<td>78.6%</td>
<td>79.7%</td>
<td>92.6%</td>
</tr>
<tr>
<td>Incorrect</td>
<td>% within group of individuals</td>
<td>21.4%</td>
<td>20.3%</td>
<td>7.4%</td>
</tr>
</tbody>
</table>

A chi squared test was used to determine whether or not a statistically significant association exists between responses from individuals. For part i, it was determined that $p = 0.841$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part ii, it was determined that $p = 0.513$. As $p \geq 0.005$, it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.
For part iii, it was determined that \( p = 0.423 \). As \( p \geq 0.005 \), it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

For part iv, it was determined that \( p = 0.211 \). As \( p \geq 0.005 \), it can be concluded that no statistically significant association exists between groups. In other words, there is no difference in beliefs between the three groups of participants.

### 4.11: Participants overall performance in Identification Instrument

The overall performance the three groups of participants were obtained only in relation to quantitative data obtained from the survey. Performances in all open-ended questions were excluded from this analysis.

**Table 4.20: Analysis of participants overall performance in Identification Instrument**

<table>
<thead>
<tr>
<th></th>
<th>Group of Individuals</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Second Level Pupils</td>
<td>Pre-service Teachers</td>
<td>Qualified Teachers</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>59.81</td>
<td>59.54</td>
<td>62.38</td>
<td></td>
</tr>
<tr>
<td>95% Confidence Interval for mean:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Bound</td>
<td>59.10</td>
<td>56.18</td>
<td>57.57</td>
<td></td>
</tr>
<tr>
<td>Upper Bound</td>
<td>60.51</td>
<td>62.91</td>
<td>57.19</td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>10.92</td>
<td>12.21</td>
<td>11.91</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>28.00</td>
<td>30.00</td>
<td>42.00</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>86.00</td>
<td>86.00</td>
<td>84.00</td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>16.00</td>
<td>17.00</td>
<td>20.50</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.19 of results shows that second-level pupils achieved an overall mean result of 59.81% correct responses. Pre-service teachers and qualified teacher received mean results of 59.54% and 62.38% respectively.

![Box plot](image)

**Figure 4.14: Box plot comparing overall performance in Identification Instrument**

The box plot suggests that no difference exists between the three groups of participants. A one-way ANOVA was used to determine whether or not a statistically significant difference exists between at least two of the groups. This resulted in $p=0.490$. Hence there is no statistically significant difference between groups.
Chapter 5: Discussion and Conclusions

5.1: Introduction

The rationale behind this research aimed at determining and quantitatively analysing the presence of misconceptions and knowledge gaps relating to health education in second level science pupil, pre-service science teachers and qualified science teachers. Cancer was the main focus of this study into health education. From the data obtained, the aim was to ascertain if there was any link between the misconceptions and knowledge gaps held by the three groups of individuals or if there are any provisions for addressing health education within the Irish education system. Following an extensive literature review, the null hypothesis formed was that no significant difference would be found between the knowledge base of all three groups of participants as there is currently no significant provision for health education at any stage of the Irish education system. A detailed list of the research questions was outlined in Section 1.3. In this chapter the results obtained from the research will be discussed with the intention of answering these questions as well as establishing the general significance and consequences of the findings. Answers to individual questions in the Identification Instrument will be discussed in detail. All questions in the Identification Instrument can be viewed in Appendix 2.

5.2: Quantity of misconceptions held by second level pupils

From analysing the results of second level pupils in the Identification Instrument, it was found that the mean overall score for all quantitative questions in the Identification Instrument was 59.81%. This signifies a dearth of health-related knowledge amongst Irish adolescents. Studies carried out in the area of health related misconceptions and knowledge gaps in Irish pupils are thus far limited. No similar study in relation to identifying second level pupils’ specific health related misconceptions or knowledge gaps were identified in the thorough review of the available literature. Despite this, an extensive amount of literature was
found relating to the deteriorating health status of Irish adolescents. The incidence of overweight and obesity in Irish school children is high, increasing steadily and is growing public health problem (O’Neill et al. 2007). In 2009 the Tobacco Atlas placed Irish youths in the second worst tier for smoking; according to their statistics 16 to 29.9% of teenage boys and girls have started smoking (cited in O'Regan 2009). Despite the apparent focus on health status of adolescents’ within the literature, the results of this study suggest that health education or lack thereof could be at the route of the problem.

The fifteen questions included in the identification instrument incorporated 25 misconceptions and knowledge gaps cited from the literature (listed in Section 2.14). 17 of these misconceptions were found to be indisputably present, with 20% or more of population of second level pupils tested believing them to be true. A further 5 misconceptions were considered to be accurate by between 10 and 19.99% of the population of second level pupils tested. Overall, this is evidently a worrying trend which suggests that Irish second level pupils have insufficient levels of knowledge relating to their health and the prevention of cancer. Similar results were found for students in Eastern Europe who were also found to be unaware of the relationship between lifestyle factors and the development of chronic diseases (Steptoe and Wardle, 2001). It should be noted that all second level pupils partaking in the research had completed the Junior Certificate Science course as well as three years of scheduled class time in second level physical education and SPHE classes. This suggests that none of these three courses, despite the ample scope within their syllabi guidelines, are addressing the area of health education in sufficient detail.

5.3: Quantity of misconceptions held by pre-service teachers and qualified teachers

From analysing the results of pre-service teachers in the Identification Instrument, it was found that the mean overall score was 59.54%. Similarly, qualified teachers were found to
have an average score 62.38% in the Identification Instrument. This is a notably similar to those results achieved by second level pupils. The Chi-square test carried out when calculating these figures obtained a p-value of 0.49, thus statistically proving that no significant difference exists between the overall results obtained in each of the three groups. A European study carried out across 23 countries found comparable results with only 40 to 60% of participants be aware of the links between lifestyle factors and chronic diseases (Haase et al. 2004).

This goes towards proving the null hypothesis; all three groups’ knowledge on this area is at similar levels despite varying ages and levels of study. This is a worrying trend considering the obvious need for the provision of increased health education in Irish secondary schools. The scope for including this within the Junior Certificate Science course which was identified within the Literature Review (Section 2.6) is only plausible if the level of education and knowledge of our current and future teachers is to be improved. Very few studies which directly relate to the area of teachers proficiency in health education were found within the literature. Kickbusch (2001) acknowledged that health literacy is a discrete form of literacy which is increasingly important for social, economic and health development. Darling-Hammond (2006) identified that the “21st century teacher” needs to be able to address contemporary dilemmas that arise in their students’ lives but are currently not being prepared for this need in teacher training programmes.

In a review of the available literature no similar study was found in relation to Irish pre-service or qualified science teachers. A study carried out on the general public found that the public lack basic knowledge of proven cancer health threats such as obesity, age, sunlight, alcohol and lifestyle (Breakthrough Cancer Research 2012). Although these findings cannot be directly compared with this study due to varying research methods and sample groups, it suggests that the level of misconceptions held by the general public tested (age 18 to 74) in
the area of health misconceptions and knowledge gaps is closely comparable with that of pre-service and qualified science teachers holding third level degrees in science.

Third level science teacher education is undeniably lacking in provision for health education. This is despite the limitless possibilities to link health education with science education (Child-to-Child Trust and UNICEF 1997). The findings of this study suggest that science teacher education is currently unsuccessful in achieving a good level of knowledge relating to health education and is failing in overcoming the misconceptions and knowledge gaps students are bringing with them from second level education.

5.4: Analysis of Misconceptions grouped by topic

The fifteen questions within the Identification Instrument centre around five main areas; diet, body weight, addictive substances (smoking and alcohol), inheritance, and U.V. exposure and sun beds. Responses to these six areas for both pre-service teachers and second level pupils will now be discussed.

5.4.1: What did our Identification Instrument tell us about participants knowledge about diet?

Questions 4 and 11 focused on participants’ level of knowledge in this area. The results of these questions were presented in Section 4.3. All three groups of individuals scored comparably in both questions with one-way ANOVA’s proving this. With no notable difference existing between all three groups, it can be inferred that the level of knowledge relating to diet and how diet can both increase and decrease an individual’s risk if developing cancer is comparable. Question 4 saw all three groups correctly categorising about half of the foods presented as either increasing risk of bowel cancer, reducing risk of bowel cancer or having no known effect on risk of bowel cancer (second level pupils: 50.15%; pre-service teachers: 46.81%; qualified teachers: 47.33%). Question 11 saw all three groups correctly categorising between 30 and 40% of the foods presented as either increasing the risk of breast
cancer, reducing the risk of breast cancer or having no known effect on the risk of breast cancer (second level pupils: 40.11%; pre-service teachers: 33.52%; qualified teachers: 39.92%).

Misconceptions and knowledge gaps identified in these questions include “The evidence shows that foods containing dietary fibre probably protect against bowel cancer”, “The evidence is convincing that processed meat is a cause of bowel cancer”, and “The evidence is convincing that red meat, such as beef, lamb and pork, is a cause of bowel cancer” (World Cancer Research Fund 2011). Surh (2003) found that it would be cost-effective to promote the awareness and consumption of foods found to reduce an individual’s risk of developing cancer to the general public as a cancer-preventing strategy.

The performance of participants in question 6, part iv is considerably notable when compared to responses to question 4 and 11. Participants here preformed to a much higher level with 81.8%, 82.0% and 89.9% of second level pupils, pre-service and qualified teachers respectively identifying that diet can influence many cancers, not just through its effect on BMI (Table 4.17). Keighley et al. (2004) found comparably results with 70% of participants in this study being aware that diet can affect colorectal cancer.

These results suggest that participants from each group were in fact aware that diet can alter their personal risk of developing cancer. They do, however, lack the specific knowledge on different food types and their proven association with the risk of developing certain cancers. This knowledge gap therefore prevents them from utilising the knowledge they displayed in question 6, part iv in their everyday lives. This suggests that the misconception that “cancer cannot be caused by poor diet” is not common in the population of participants of this study (York Against Cancer 2012). An American study found that individuals who are aware of the benefits of a healthy diet in reducing the risk factors of developing cancer are more likely to practice these strategies such as maintaining a diet high in fruit and vegetables. Therefore, it
is recommended that efforts should be made to increase public familiarity with the recommendations for cancer prevention (Hawkins et al. 2012). Similar results were also reported by Vidrine et al. (2013).

5.4.2: Participants showed good awareness of the risk factors relating to body weight

Questions 10 and 12 in particular focused on participants’ level of knowledge in this area. The results of these questions were presented in Section 4.5. All three groups of individuals scored comparably in both questions with one-way ANOVA’s proving this. With no notable difference existing between all three groups, it can be inferred that the level of knowledge relating to diet and how diet can both increase and decrease an individual’s risk of developing cancer is comparable. Question 10 assessed misconceptions and knowledge gaps such as “The location of fat on the body is not important for cancer prevention”, “Fat cells can secrete substances that cause cancer”, “Maintenance of a healthy body weight throughout life may be one of the most important ways to protect against cancer”, “Being overweight is a cause of cancers of the oesophagus, pancreas, endometrium(womb), kidney, breast (post-menopausal), bowel” (Breakthrough Cancer Research 2012). All three groups of participants achieved a mean score of about 50% (second level pupils: 55.2%; pre-service teachers: 73.3%; qualified teachers: 77.8%). On analysing Table 4.12 it is evident that the misconceptions relating to the location of excess fat (assessed in part A and B) are more prominent in participants than knowledge gaps relating to the benefits of healthy body weight (assessed in part C). Similar to the results analysed in Section 5.3.1, participants from each group were aware that healthy body weight can reduce their personal risk of developing cancer. However they lack the specific knowledge about the location of fat for the risk of developing certain cancers.

Question 12 showed more positive results in terms of participant knowledge with about 70% of participants correctly identifying obese as the BMI category with the greatest risk factor.
for developing cancer (second level pupils: 70.9%; pre-service teachers: 73.3%; qualified teachers: 77.8%). Although BMI is medically outdated, it is still commonly used and understood by the general public and so it was decided to use this measurement in the Identification Instrument. Despite this improvement, knowledge gaps have relating to healthy body weight was still proven to be present in over 20% of each of the groups of individuals tested.

5.4.3: What did the Identification Instrument reveal about participants awareness of addictive substances?

Question 1 (part h and i) and question 3 particularly focused on participants’ level of knowledge in this area. Both questions revealed positive results relating to participants level of knowledge. These questions were among the most well answered in the Identification Instrument with between 80 to 90% of participants choosing correct answers (Table 4.2 and Table 4.16).

Many of the open ended questions, which gave participants the opportunity to discuss what they believed to be major risk factors in the development of cancer, unearthed answers relating to smoking and alcohol consumption. Smoking was by far the most common answer to question 2 (“What do you think is the biggest risk factor for developing cancer?”) with 65.5%, 67.2% and 74.1% of second level pupils, pre-service teachers and qualified teachers respectively choosing this answer.

From analysis of these question the knowledge gaps “Smoking or using tobacco in any form increases the risk of cancer and other diseases” and “Alcoholic Drinks are a cause of cancers of the mouth, pharynx, larynx, oesophagus, liver and breast” (World Cancer Research Fund 2011) are not prominent in the population tested.
5.4.4: Participants knowledge of inheritance was found to be poor

Question 1 (part g) and question 7 particularly focused on participants’ level of knowledge in this area. The percentage of participants who correctly identified that “inheriting cancer causing genes from your family” was notable high at 81.8%, 83.3% and 70.4% for second level pupils, pre-service teachers and qualified teachers respectively. However when compared to the responses received to question 7, participants level of knowledge must be questioned. Only 19.2%, 17.5% and 15.4% of second level pupils, pre-service teachers and qualified teachers respectively correctly identified that less than 5% of cancers are inherited. More commonly chosen options included 5 to 20% and 20 to 40% (Figure 4.8).

The most common category of response given in the open ended question asked in the second tier of question 7 was that cancer is sometimes related to inheritance (Figure 4.9). Answers commonly included responses such as “Bowel cancer runs in my family so I think it has a lot to do with genes”. The open-ended section of this question identified another interesting source of confusion. A number of second level pupils displayed a particularly high level of confusion relating to this question in the open ended section of the question. Statements such as “I chose less than five because you can’t catch cancer from someone else”. This displayed a lack of understanding of genes and inheritance despite the description of inheritance provided in the question to prevent such confusion; “passed on in your genes from your parents”. This suggests that the already low percentage of second level pupils who correctly chose the correct percentage bracket for the percentage of cancers inherited may be inflated due to this misunderstanding. This misunderstanding was only identified in second level pupils; no pre-service teachers or qualified teachers displayed this confusion in their open ended answers (Figure 4.12).
5.4.5: What did the Identification Instrument reveal about participants knowledge relating to U.V. exposure and sunbeds?

Results of questions relating to this topic were outlined in Section 4.1. One of the most interesting knowledge gaps identified by assessing this area was that skin cancer is a very common cancer in Ireland. However, in question 9 (i), 69.1% and 72.1% of second level pupils and pre-service teachers respectively incorrectly believed that “Skin cancer is not very common in Ireland because Irish weather is not warm enough to cause any serious skin damage”. However, it should be noted that this knowledge gap was not identified to the same extent in qualified teachers with only 25.9% of these participants incorrectly choosing this option. This was one of just two times in the results where a statistically significant difference was found between the responses of the two groups. In all other instances it was proven with one-way ANOVA’s or Chi-squared tests that all three groups of individuals preformed to equal standards. Knight (2011) stresses the importance of children and young people being made aware of the risks of sunburn through effective an whole-school sun protection policy. However, mass media is widely reported as the primary source of information for the public on the effects of the sun on the skin (Scerri et al. 2002).

Participants were found to be uninformed of the possible risk factors associated with the use of sun beds. This was examined in question 9 (ii). The percentage of incorrect responses from second level pupils, pre-service teachers and qualified teachers was found to be 33.6%, 40.1% and 44.5% respectively (Table 4.10). This is worrying considering the corresponding high levels of skin cancer in Ireland; according to the National Cancer Registry there are approximately 5,740 new cases of skin cancer every year (National Cancer Registry Ireland 2010). Furthermore, the HSE have reported that 7% of the Irish population use sunbeds with 3% using them as regularly as once a week (Health Service Executive 2012). Stryker et al. (2008) found that media exposure on sun damage for skin cancer is below the required threshold to generate public knowledge about cancer prevention.
5.5: General Significance and Implications of the Research

The results of the study suggest that health related misconceptions are equally widespread among all groups of participants tested. The analysis of the extent of misconceptions dependent on gender, age and type of school all returned similar results and so were excluded from Chapters 4 and 5. The full set of data obtained over the course of this study can be seen in Appendix 8. The research indicated that the extent of participants’ misconceptions does not improve regardless of levels of education or age. All three groups of participants were seen to preform to equal levels with no statistically significant difference seen in the results obtained for all but two questions in the Identification Instrument.

Participants were found to be aware that diet can affect the risk of developing cancers, both positively and negatively. However, the participants were unable to display an understanding of the effects of specific foods. This therefore suggests they are unable to utilise this knowledge in their lifestyle choices. Participants were well informed of the effect of body weight, smoking and other addictive substance on their risk of developing cancers. However, their awareness of the percentage of cancers inherited was particularly worrying. This, in conjunction with the other findings of this study suggest a general lack of knowledge of how lifestyle choices can have a major effect on the developments of many cancers.

The overall substandard performance of pre-service and qualified teachers indicates that these teachers possess a variety of misconceptions relating to health which makes them unprepared to improve the health related knowledge of their pupils in the future. This is a significant problem considering the numerous possibilities of integrating health education in the Junior Certificate Science course identified in Chapter 2 (Section 2.5). This research suggests that our teachers and pre-service teachers are not well enough informed to carry out such tasks. The literature states that teachers holding their own misconceptions are unlikely to be able to identify their students’ misconceptions or provide educational experiences to overcome
pupils’ incomplete ideas to overcome misconceptions (Burgoon et al 2010). Furthermore, they are likely to be unaware that they possess these misconceptions as the education system has failed to make teachers aware of them. In fact, the findings of this research suggest that pre-service teachers and qualified teachers had levels of health related knowledge equivalent to Junior Certificate Science pupil. However, this is to be expected considering that the currently low level of integration of health education in any of our school syllabi (Section 2.5). The findings of this research suggest that health education is not catered for throughout secondary education as well as in science teacher training degrees.

The widespread presence of misconceptions and knowledge gaps in second level pupils further suggests that experienced, practicing science teachers are unaware or unconcerned with improving pupils’ levels of health related knowledge. The need for improving the health status of Irish adolescents is essential considering the decreasing health status of Irish adolescents identified in Chapter 2 (Section 2.7). However, in order to cater to this need, the lack of health education provided to our Science teachers must be addressed.

5.6: Limitations of the Study

5.6.1: Administration of the Instrument

A time constraint of 40 minutes was placed on all participants who completed the instrument. However, it was not possible for the researcher to be present for the administration of the instrument due to the variety of locations where it was completed. Therefore in all cases this time constraint cannot be guaranteed. Some participants may have had a reduced amount of time to consider the concepts presented in the instrument.

5.6.2: Scale of the study

This research aims at uncovering the level of misconceptions and knowledge gaps held by Junior Certificate pupils studying science. However, the method of the research merely
provides a snapshot of the misconceptions and knowledge gaps held by the students assessed at a particular period of time. A relatively large sample size of second level pupils was obtained. However it cannot be guaranteed that these results provide an accurate view of all Irish Junior Certificate pupils studying science.

In assessing pre-service and qualified teachers, the objective was to expose the level of change in health awareness with increasing age and level of study. However, the scale of the study for these groups of participants was not as large and therefore most likely less accurate.

5.7: Conclusions

The results of the Identification Instrument have been discussed in this chapter. The research questions have been answered and related to the literature where relevant; however the availability of similar studies for comparison was limited. The main conclusions of the discussion have been summarized above.

5.7.1: Recommendations arising from this study

The following are the recommendations arising from this study:

- The lack of Health Education in the Irish education system should be accounted for and targeted by integrating Health Education into Junior Certificate syllabi such as Science. The Science syllabus currently leaves a wide scope for the integration of health education. For example, genetics which was identified as a major source of cancer related misconceptions in this research, is studied on the Junior Certificate Science syllabus. Similarly nutrition, diet and exercise are all covered on the Junior Certificate syllabus and could therefore be investigated and researched by students over the course of their three year Junior Certificate syllabus in order to overcome these misconceptions.
In order to make this possible, in-service should be provided for qualified teachers to educate them on areas of Health Education and how lifestyle factors can reduce an individual’s risk of developing chronic diseases.

The theory of Health Education should be integrated into science and science pedagogy modules in Science Education degrees. Such integration should include specific reference to the misconceptions identified in this study, the location of opportunities on the Junior Certificate Science syllabus to overcome these misconceptions and strategies to overcome these misconceptions.

Conceptual change strategies should be incorporated to the subject pedagogics modules in Science Education courses in University of Limerick in order to improve pre-service teachers’ awareness of how to identify and overcome pupils’ misconceptions. Specific methods of overcoming some of the major cancer related misconceptions identified would be beneficial and could be integrated in pedagogics module assignments.

Conceptual change strategies should be integrated into continuous professional development of novice and experienced science teachers alike in order to tackle the volume of health misconceptions second level pupils hold.

5.7.2: Suggestions for further research

Following the diagnostic results obtained from this research, it would be beneficial to research appropriate materials and strategies to implement change in science education. It would be useful to integrate these strategies into teacher training programmes for use by pre-service teachers. This should be eventually expanded for use by qualified teachers in mainstream schools.

Considering the overhaul of the Junior Certificate structure, due to be phased into effect from 2015 (Section 2.4), there are many opportunities to develop a short course for inclusion in the new Junior Certificate curricula to deal with health education. This would provide an
opportunity to make health education available nationwide in a time where change in curricula is already occurring and may therefore be more widely accepted and utilised. The development of a website for use by teachers would be particularly advantageous as it is a cost effective and efficient method of making resources available to all willing teachers. The results of this research suggest that this website would need to include an interactive area for teachers to educate themselves and communicate with each other teachers, as current level of knowledge was found to be low. Ideally, an opportunity for a continuous professional development course in Education Centres across Ireland would educate teachers prior to the implementation of the short course. However, if this was not possible, an interactive website with the access to online tutors could provide a more cost effective alternative.

The development of interactive tools to teach such a course would be extremely beneficial. Creating real life scenarios concerning health education which participants can relate to is one method which has great scope for development. This has been found to be a successful teaching tool in previous studies (Hilton 2003).
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Appendices:

Appendix 1: League table of 27 European Union member states estimating new cancer cases in 2030

<table>
<thead>
<tr>
<th>Country</th>
<th>2008</th>
<th>2030</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland</td>
<td>19,454</td>
<td>33,416</td>
<td>71.8</td>
</tr>
<tr>
<td>Cyprus</td>
<td>2,282</td>
<td>3,537</td>
<td>55</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>2,426</td>
<td>3,712</td>
<td>53</td>
</tr>
<tr>
<td>Malta</td>
<td>1,490</td>
<td>2,221</td>
<td>49</td>
</tr>
<tr>
<td>Spain</td>
<td>196,902</td>
<td>288,741</td>
<td>46.6</td>
</tr>
<tr>
<td>Netherlands</td>
<td>81,798</td>
<td>116,516</td>
<td>42.4</td>
</tr>
<tr>
<td>Slovakia</td>
<td>21,348</td>
<td>30,077</td>
<td>40.9</td>
</tr>
<tr>
<td>Austria</td>
<td>35,945</td>
<td>49,602</td>
<td>38</td>
</tr>
<tr>
<td>Slovenia</td>
<td>9,642</td>
<td>13,101</td>
<td>35.9</td>
</tr>
<tr>
<td>France</td>
<td>332,701</td>
<td>448,555</td>
<td>34.8</td>
</tr>
<tr>
<td>Finland</td>
<td>25,545</td>
<td>34,175</td>
<td>33.8</td>
</tr>
<tr>
<td>Poland</td>
<td>140,778</td>
<td>187,768</td>
<td>33.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>59,272</td>
<td>78,162</td>
<td>31.9</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>53,963</td>
<td>71,131</td>
<td>31.8</td>
</tr>
<tr>
<td>Greece</td>
<td>37,089</td>
<td>48,374</td>
<td>30.4</td>
</tr>
<tr>
<td>UK</td>
<td>304,235</td>
<td>396,290</td>
<td>30.3</td>
</tr>
<tr>
<td>Portugal</td>
<td>43,284</td>
<td>55,783</td>
<td>28.9</td>
</tr>
<tr>
<td>Denmark</td>
<td>32,189</td>
<td>41,204</td>
<td>28</td>
</tr>
<tr>
<td>Sweden</td>
<td>44,551</td>
<td>56,874</td>
<td>27.7</td>
</tr>
<tr>
<td>Italy</td>
<td>340,437</td>
<td>433,411</td>
<td>27.3</td>
</tr>
<tr>
<td>Germany</td>
<td>479,861</td>
<td>605,706</td>
<td>26.2</td>
</tr>
<tr>
<td>Romania</td>
<td>70,262</td>
<td>81,858</td>
<td>16.5</td>
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<tr>
<td>Hungary</td>
<td>49,617</td>
<td>56,454</td>
<td>13.8</td>
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<tr>
<td>Estonia</td>
<td>5,556</td>
<td>6,228</td>
<td>12.1</td>
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<tr>
<td>Lithuania</td>
<td>13,949</td>
<td>15,458</td>
<td>10.8</td>
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<tr>
<td>Latvia</td>
<td>9,320</td>
<td>10,144</td>
<td>8.8</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>30,701</td>
<td>31,378</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Appendix 2: Identification Instrument

Healthy Lifestyle – How much do you know?

- This booklet will take approximately 20 minutes to complete.
- This is not a test so please attempt all questions. You will not be graded!!
- Most of the questions are multiple-choice style or true/false questions.
- Some questions ask you to write a response or give an opinion – please don't leave these blank.

Section A:

Please fill in the relevant information in the spaces provided:

Gender: Female ☐ Male ☐

In the table below fill out

- Column A if you are a Junior Certificate student
- Column B if you are a pre-service teacher
- Column C if you are a qualified science teacher.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior Certificate Student</td>
<td>Pre-service Science Teacher</td>
<td>Qualified Science Teacher</td>
</tr>
<tr>
<td>Age: _____________</td>
<td>Year of Study: ___________</td>
<td>Years of teaching experience: ___________</td>
</tr>
<tr>
<td>Are you studying science at higher (honours) or ordinary (pass) level?</td>
<td>University: ___________</td>
<td>Type of school currently teaching in: ___________</td>
</tr>
<tr>
<td></td>
<td>Degree Programme: ___________</td>
<td>Voluntary Secondary School: ☐</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VEC: ☐</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Community/Comprehensive School: ☐</td>
</tr>
<tr>
<td>Information about science subjects you took in secondary school:</td>
<td>Yes/No</td>
<td>Higher/Ordinary</td>
</tr>
<tr>
<td>JC Science:</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>LC Biology:</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Section B:

Q1. Listed below are some possible risk factors for developing cancer. Tick true for those you believe are a risk factor or false for those you believe are not.

<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Using mobile phone.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Using cleaning agents (e.g. window cleaner)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Having a poor diet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Using aerosols (e.g. deodorant sprays)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Receiving a hard blow to some part of the body.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Inheriting cancer causing genes from your family.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Wearing a tight bra.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. Consuming alcohol.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. Over exposure to the UV rays of the sun</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q2. What do you think the **biggest** risk factor for developing cancer is? (The answer doesn’t have to be listed in Q1)

Q3. Read the information given about two individuals below (A and B).

A. A middle aged male lives and works in a large city which is heavily polluted. He is a non-smoker.

B. A middle aged male lives and works in the countryside. He smokes 20 cigarettes a day.

Using this information, tick which individual you think is **most likely** to develop lung cancer?

A.  

B.  

Explain your answer:

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________
Q4. Consider the following items of food:

- Beef
- Wholegrain pasta
- Chicken
- Fish
- Lamb
- Pork
- Sausages
- Brown rice
- Corned beef

Do you think any of the foods could:

a. Increase your risk of developing **bowel cancer**?
b. Reduce your risk of developing **bowel cancer**?
c. Have no effect on your risk of **bowel cancer**?

Place the foods from above in the appropriate box below: (Each food belongs in one box below)

- **Increases risk of bowel cancer:**
- **Reduces risk of bowel cancer:**
- **No known risk to bowel cancer:**

---

Q5. "My lifestyle factors in my teenage years won't affect my future health when I get older."

Give your response to this statement.

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

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Q6. Circle the statement which you believe is true (A or B for each option)

(i) Steps can be taken in your daily life to reduce your own risk of developing cancer. OR If cancer runs in your family there is nothing you can do to reduce your own risk.

(ii) Slow developing diseases such as cancer cannot be prevented. OR Many cancers can be prevented through lifestyle factors.

(iii) Cancer is a contagious disease. OR You cannot catch cancer from somebody else.

(iv) Diet directly influences many cancers; its negative effects are not just causing obesity. OR As long as you're not overweight or obese, you don't need to worry about your diet causing cancer.

Q7. What percentage of cancers are inherited (passed on in your genes from your parents)?

a. Less than 5% □

b. 5 to 20% □

c. 20 – 40% □

d. 40 – 60% □

e. 60 – 80% □

Why do you think this?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
Q8. When is it most important to protect yourself from the sun?

A. It’s most important when you are young (under the age of 30).
B. It’s most important when you are middle aged (between 30 and 60).
C. It’s most important when you are old (over the age of 60).
D. It’s equally important at all stages of your life.

Explain your answer with one of the following options:

a. The damage is spread over this time.
b. This is when you skin is most sensitive to the sun.
c. This is the age of most of the people who get skin cancer.
d. This is when the risk to your skin begins.

Q9. Circle the statement which you believe is true (A or B for each option)

[i] Skin cancer is not very common in Ireland because Irish weather is not warm enough to cause any serious skin damage. 
OR 
Skin cancer is one of the most common cancers in Ireland.

[ii] People who have used a sunbed (even just once) have a 15% increased risk of melanoma (skin tumour). 
OR 
Sun beds are an equally dangerous way of getting a tan as lying out in the sun.

[iii] Only fair skinned people need to be concerned about overexposure to the sun. 
OR 
Darker skinned people have lower incidence of skin cancer but skin cancers do occur with this group.
Q10. Tick true or false for each of the following statements:

a. Excess fat is equally dangerous for causing cancer wherever it is located on the body. ................................................................. False
b. Excess fat is most dangerous for causing cancer when located around the middle of the body. ................................................................. False
c. Having a healthy body weight throughout life is one of the most important ways to prevent against cancer ................................................................. True
d. Fat cells produce substances which can cause cancer ................................................................. False

Q11. Consider the following items of food:

- Carrots
- Sausages
- Soya beans
- Butter
- Oranges
- Cream
- Extra virgin olive oil
- Hard cheese
- Strawberries

Do you think any of the foods could:

a. Increase your risk of developing breast cancer?

b. Reduce your risk of developing breast cancer?

c. Have no effect on your risk of breast cancer?

Place the foods from above in the appropriate box below: (Each food belongs in one box below)

Increase risk of breast cancer:

Reduce risk of breast cancer:

No known risk to breast cancer:
Q12. Body mass index (BMI) is a way of measuring if you are at a healthy weight for your height. In general, the higher the number, the more body fat a person has.

- Underweight: BMI is less than 18.5
- Normal weight: BMI is 18.5 to 24.9
- Overweight: BMI is 25 to 29.9
- Obese: BMI is 30 or more

Which of these four categories (if any) will have the greatest risk of developing cancer?

a. Underweight  
b. Normal weight  
c. Overweight  
d. Obese  
e. BMI is not important

Q13. What do you think causes cancer?

Q14. In relation to stress, which of the following statements do you think is correct?

a. It has been proven that stress can directly cause cancer.

b. Stress is not known to directly cause cancer.

Can you explain your answer by choosing one of the following options:

A. Stress causes hormone changes in the body.

B. Stress can lead to unhealthy behaviours such as smoking, over-eating or heavy drinking.

C. Stress has no known physical effects on the body.
Q15. Circle the statement which you believe is true (A or B for each option)

(i) Cancer can be caused by:
- Freezing water in plastic bottles
- Reusing plastic bottles
- Microwaving food in plastic containers

(ii) Developing cancer is often just down to a person having bad luck.

(iii) Cancer is a group of many diseases with similar characteristics.

(iv) Other than preventing obesity, there is no evidence to suggest that physical activity can prevent cancer.

(v) Harmful chemicals are sometimes present in the plastics used to make plastic containers. However, they are not dangerous as they can only be released when the plastic is burned at extremely high temperatures.

(vi) Developing cancer is often due to a person making poor lifestyle choices.

(vii) Cancer is a single disease that can develop in many different parts of the body.

(viii) Physical activity can help prevent certain cancers in more ways than just preventing obesity.
Appendix 4: PowerPoint to accompany Identification Instrument

How much do you really know about your health?
This survey is designed to assess if you know what you need to do to lead a healthy lifestyle. It focuses mainly on the prevention of cancer.

There are six types of questions in this survey:
1. Multiple-choice questions
2. Multiple-choice questions with two parts
3. True or False questions
4. Choose the correct answer questions
5. Categorising items questions
6. Written questions

This slide show explains how to answer the questions.

How to answer multiple-choice questions:

For Example:
What is your favourite drink?
- Coca cola
- Fanta
- 7-up
- Water
- Orange Juice

If your favourite drink is Fanta place b in the box

Some multiple choice questions have two parts:

What is your favourite drink?
- Coca cola
- Fanta
- 7-up
- Water
- Orange Juice

If Fanta is your favourite because it has the nicest taste place A in the box

Why is this your favourite drink?
- It has the nicest taste
- It is the healthiest
- It is the most refreshing

True / False Questions:

For example:
Choose true or false for the following statements:

a. Up is the opposite to down. ............ True ........ False

b. 2 + 2 = 5. ............ True ........ False

c. Red is a colour. ............ True ........ False

Choose the correct statement questions:

For these questions one statement is correct, the other is incorrect. Circle the CORRECT statement.

A
People need water to live

or

B
People can live without water

Categorising items:

* Some questions will ask you to place certain items into different categories.

For example:
Q. Listed below are some items of food.

<table>
<thead>
<tr>
<th>Food</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td></td>
</tr>
<tr>
<td>Bananas</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Carrots</td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td></td>
</tr>
<tr>
<td>Apples</td>
<td></td>
</tr>
</tbody>
</table>

Place the foods in the appropriate box below:

<table>
<thead>
<tr>
<th>Fruit</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td></td>
</tr>
<tr>
<td>Bananas</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Carrots</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meat</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td></td>
</tr>
</tbody>
</table>

Written Questions:

* Some questions ask you to write down what you think about a certain topic.

* Try to write one or two sentences in this case, even if you are not sure of the answer.

For example:
Q. Why do plants produce flowers?

I think plants produce flowers because the bright colours attract insects.
Appendix 5: Information Sheets

Principal Information Sheet

“Implementation of a sustainable health framework into Science in second level schools and its integration in to Science teacher training”

Rising cancer rates coupled with a deteriorating health status among young people in Ireland is a cause for serious concern. Considering the huge role second level education plays in Irish teenager’s lives, schools present a perfect opportunity to implement change through core subjects such as Science. This research centres on a health intervention programme in second level schools that aims at overcoming serious misconceptions and changing young people’s views of their health.

This stage of the project aims at gathering the views and opinions of 3\textsuperscript{rd} year Junior Certificate science students and their teacher in order to determine if their level of understanding of health related issues. There is a particular focus of the lifestyle factors that affect cancer development as cancer rates in Ireland are expected to grow over the coming years due partly to people’s poor lifestyle choices.

A short written survey (15 questions) will be used to assess pupils understanding of these topics. The majority of questions are multiple choice, where the student will be asked to tick the answer they feel is correct. The survey should take approximately 20 minutes to complete. The survey will be completed by the student in class, under the supervision of their teacher. Teachers may complete the survey at the same time, if they are willing to participate. If any Junior Certificate science students or any science teachers agree to take part they are guaranteed full anonymity within the study; no names of schools or students will be recorded or used.

The student / teacher have the right to not answer any of the questions or to withdraw from completing the survey at any time they want to.

Thank you for taking the time to read this information sheet. Contact details are below should you have any questions regarding any of the above.

Contact Information:

Researcher: 
Name: Jennifer Butler
Email: Jennifer.Butler@ul.ie

Supervisor:
Name: Dr. Audrey O’Grady
Email: Audrey.OGrady@ul.ie
Parent / Guardian Information Sheet

“Implementation of a sustainable health framework into Science in second level schools and its integration in to Science teacher training”

Rising cancer rates coupled with a deteriorating health status among young people in Ireland is a cause for serious concern. Considering the huge role second level education plays in Irish teenager’s lives, schools present a perfect opportunity to implement change through core subjects such as Science. This research centres on a health intervention programme in second level schools that aims at overcoming serious misconceptions and changing young people’s views of their health.

This stage of the project aims at gathering the views and opinions of 3rd year Junior Certificate science students in order to determine if their level of understanding of health related issues. There is a particular focus of the lifestyle factors that affect cancer development as cancer rates in Ireland are expected to grow over the coming years due partly to people’s poor lifestyle choices.

A short written survey (15 questions) will be used to assess pupils understanding of these topics. The majority of questions are multiple choice, where the student will be asked to tick the answer they feel is correct. The survey should take approximately 20 minutes to complete. The survey will be completed by the student in class, under the supervision of their teacher. If the student agrees to take part they are guaranteed full anonymity within the study; no names of schools or students will be recorded or used.

The student has the right to not answer any of the questions or to withdraw from completing the survey at any time they want to. If you (parent / guardian) or the student has any concerns about participating in the research you can contact Prof. Thomas Waldmann, chair of the Science & Engineering Research Ethics Committee.

Thank you for taking the time to read this information sheet. Contact details are below should you have any questions regarding any of the above.

Contact Information:

Researcher:  
Name: Jennifer Butler  
Email: Jennifer.Butler@ul.ie

Supervisor:  
Name: Dr. Audrey O’Grady  
Email: Audrey.OGrady@ul.ie

Chair of Science & Engineering Research Ethics Committee:  
Name: Prof. Thomas Waldmann  
Phone No: +353 61 20 280
Participant Information Sheet

“Implementation of a sustainable health framework into Science in second level schools and its integration in to Science teacher training”

Rising cancer rates coupled with a deteriorating health status among young people in Ireland is a cause for serious concern. Considering the huge role second level education plays in Irish teenager’s lives, schools present a perfect opportunity to implement change through core subjects such as Science. This research centres on a health intervention programme in second level schools that aims at overcoming serious misconceptions and changing young people’s views of their health.

This stage of the project aims at gathering the views and opinions of pre-service science teachers in order to determine if their level of understanding of health related issues. There is a particular focus of the lifestyle factors that affect cancer development as cancer rates in Ireland are expected to grow over the coming years due partly to people’s poor lifestyle choices.

A short written survey (15 questions) will be used to assess your understanding of these topics. The majority of questions are multiple choice, where you will be asked to tick the answer you feel is correct. The survey should take approximately 20 minutes to complete. The survey will be completed by you in a lecture slot, under the supervision of their lecturer. If you, the participant, agree to take part you are guaranteed full anonymity within the study; no names of colleges or students will be recorded or used.

You have the right to not answer any of the questions or to withdraw from completing the survey at any time you want to. If you, the participant, have any concerns about participating in the research you can contact Prof. Thomas Waldmann, chair of the Science & Engineering Research Ethics Committee.

Thank you for taking the time to read this information sheet. Contact details are below should you have any questions regarding any of the above.

Contact Information:

Researcher: Name: Jennifer Butler Email: Jennifer.Butler@ul.ie

Supervisor: Name: Dr. Audrey O’Grady Email: Audrey.OGrady@ul.ie

Chair of Science & Engineering Research Ethics Committee: Name: Prof. Thomas Waldmann Phone No: +353 61 20 2802
Rising cancer rates coupled with a deteriorating health status among young people in Ireland is a cause for serious concern. Considering the huge role second level education plays in Irish teenager’s lives, schools present a perfect opportunity to implement change through core subjects such as Science. This research centres on a health intervention programme in second level schools that aims at overcoming serious misconceptions and changing young people’s views of their health.

This stage of the project aims at gathering the views and opinions of 3rd year Junior Certificate science students and their teachers in order to determine if their level of understanding of health related issues. There is a particular focus of the lifestyle factors that affect cancer development as cancer rates in Ireland are expected to grow over the coming years due partly to people’s poor lifestyle choices.

A short written survey (15 questions) will be used to assess your understanding of these topics. The majority of questions are multiple choice, where you will be asked to tick the answer you feel is correct. The survey should take approximately 20 minutes to complete. The survey will be completed by the student in class, under the supervision of you, their teacher. You may complete the survey at the same time, if you are willing to participate. If you and your students agree to take part you are guaranteed full anonymity within the study; no names of schools or students will be recorded or used.

You have the right to not answer any of the questions or to withdraw from completing the survey at any time you want to. If any student does not want to take part or hasn't produced a signed consent form they should not be made participate in the study. We would be grateful if you would therefore prepare your subject work for pupils who don't wish to take part in the survey. If you or any of your students has any concerns about participating in the research you can contact Prof. Thomas Waldmann, chair of the Science & Engineering Research Ethics Committee. Thank you for taking the time to read this information sheet. Contact details are below should you have any questions regarding any of the above.

**Contact Information:**

**Researcher:**
Name: Jennifer Butler  
Email: Jennifer.Butler@ul.ie

**Supervisor:**
Name: Dr. Audrey O’Grady  
Email: Audrey.OWGrady@ul.ie

**Chair of Science & Engineering Research Ethics Committee:**
Name: Prof. Thomas Waldmann  
Phone No: +353 61 20 280
CONSENT FORM FOR PARTICIPANTS

Consent Section:
I, the undersigned, declare that I am willing to take part in research for the project entitled “Implementation of a sustainable health framework into Science in second level schools and its integration in to Science teacher training”.

• I declare that I have been fully briefed on the nature of this study and my role in it and have been given the opportunity to ask questions before agreeing to participate.

• The nature of my participation has been explained to me and I have full knowledge of how the information collected will be used.

• I fully understand that there is no obligation on me to participate in this study.

• I fully understand that I am free to withdraw my participation at any time without having to explain or give a reason.

• I am also entitled to full confidentiality in terms of my participation and personal details.

____________________________________  ______________________
Signature of participant                      Date:

This research is funded by the Irish Research Council.
CONSENT FORM FOR PARENTS / GUARDIANS

Consent Section:
I, the undersigned, declare that I give permission for my child, ______________________, to take part in research for the project entitled “Implementation of a sustainable health framework into Science in second level schools and its integration in to Science teacher training”.

• I declare that I have been fully briefed on the nature of this study and my child’s role in it and have been given the opportunity to ask questions before agreeing to allow participation.

• The nature of my child’s participation has been explained to me and I have full knowledge of how the information collected will be used.

• I fully understand that there is no obligations on me to allow my child participate in this study.

• I fully understand that I am free to withdraw permission for my child to participate at any time without having to explain or give a reason.

• My child is also entitled to full confidentiality in terms of their participation and personal details.

____________________________________       ______________________
Signature of Parent / Guardian                Date

IRISH RESEARCH COUNCIL    This research is funded by the Irish Research Council.
CONSENT FORM FOR TEACHERS

Consent Section:

I, the undersigned, declare that I am willing to take part in research for the project entitled “Implementation of a sustainable health framework into Science in second level schools and its integration into Science teacher training”.

• I declare that I have been fully briefed on the nature of this study and my role in it and have been given the opportunity to ask questions before agreeing to participate.

• The nature of my participation has been explained to me and I have full knowledge of how the information collected will be used.

• I fully understand that there is no obligation on me to participate in this study.

• I fully understand that I am free to withdraw my participation at any time without having to explain or give a reason.

• I am also entitled to full confidentiality in terms of my participation and personal details.

____________________________________ ________________________
Signature of Teacher Date

This research is funded by the Irish Research Council.
Appendix 7: Email recruiting third level courses

Dear ______________ (name of Science Education Course Director),

I am a science education graduate carrying out research as part of a masters under the direction of Dr. Audrey O’Grady in Department of Life Sciences in the University of Limerick.

My research focuses on a health intervention programme in second level schools that aims at overcoming serious misconceptions and changing young people’s views of their health. Rising cancer rates coupled with a deteriorating health status among young people in Ireland is a cause for serious concern. Considering the huge role second level education plays in Irish teenager’s lives, schools present a perfect opportunity to implement change through core subjects such as Science. We therefore feel that educating pre-service teachers in this field is a necessity.

We would greatly appreciate if you would consider taking part in this research. The purpose of this email is to give you the information you will need to help you decide whether you want to participate or not. Participation in the study is completely voluntary.

What taking part involves?

Taking part in this research will involve filling out a short survey which focus of the lifestyle factors that affect cancer development. The survey should take approximately 20 minutes of a class period to complete. The research is being carried out by pre-service science teachers in teacher training colleges around Ireland.

By agreeing to partake in the research, you are not forcing all your pre-service teachers to take part. Participation by each individual is completely voluntary and all gathered information will be kept completely anonymous. The name of the college or the student will not be recorded at any time.

Why is this research important?

Studies examining the health of young people in Ireland have highlighted teenage obesity, low levels of physical activity, smoking and alcohol consumption as areas of concern. 11% of Irish teenagers are overweight and a further 8% are obese. Nearly nine out of 10 Irish teenagers are insufficiently active to benefit their current or future health. These lifestyle factors can greatly increase an individual’s risk of developing cancer. The World Health Organisation (WHO) has said that cancer levels in Ireland will increase by 72% by 2030. This puts our teenagers at huge risk. However, it is important to realise that one-third of all
cancers are preventable. It is therefore vital that young people are made aware of how neglecting their own personal health can have a huge impact on their future health.

By taking part in this research you are helping us to establish how much of this vital information pre-service teachers currently know and what areas need to be included in a pedagogics programme to increase their knowledge.

**What is the next step?**

If you are interested in taking part in this study please email me at Jennifer.Butler@ul.ie. I will then contact you to discuss the practicalities.

**Who do I contact if I have questions?**

If you have any questions about this study, please contact me by email (Jennifer.Butler@ul.ie).

We would be extremely grateful if you would consider taking part in this research.

Kind regards,

_________________________
Jennifer Butler
Masters student
University of Limerick
Appendix 8: Full data gathered from Identification Instrument

Please see attached disk.