LESSON PLAN
GENETIC AND ENVIRONMENTAL INTERACTIONS: NEURAL TUBE DEFECTS

Aim:
To increase the student's knowledge and awareness of the interactions that occur between genetic instructions and environmental factors and how this knowledge can be used in the prevention of problems in growth, development or health.

Objectives:
At the end of this lesson the student should be able to:
- List at least three genetic conditions which are due to interactions between environmental factors and our genes
- List these factors in the environment which may interact with our genetic makeup
- Describe the effects of these factors
- Discuss possible interventions aimed at reducing the effects of these factors

Directions and Notes:
Genetic conditions are family health problems. Many conditions run in families because the information for how we grow, develop and how our bodies work is contained in our genes. Changes in genes passed down from parents to children can result in family members having health problems. Some of these health problems require an environmental trigger to be present for symptoms to develop. For example:
- Melanomas and ultraviolet radiation
- Heart disease and diet
- Spina bifida and folic acid deficiency in the mother in pregnancy

Students can be assigned one of the above to research according to the objectives. This lesson plan details folic acid as an example of an environmental factor which interacts with a person's genetic makeup.

What is spina bifida?
When a baby is conceived the fertilised egg divides to produce two cells and then four and then eight and so on, producing various organs and structures. The structure that will develop into the baby's brain and spinal cord is called the neural tube. This has developed by about two weeks of age. It lies along the back of the embryo, quite exposed. Over the next week the skin folds over the tube and 'zips up' to cover the spine and brain, forming the spinal cord.

Sometimes this closure is not correct and parts of the spinal cord or brain 'gape' out through the vertebrae or skin, exposing the nerves to damage. Since the brain and spinal cord of a baby develop from part of the embryo called the 'neural tube', any problems in this closure are called 'neural tube defects'.

The two most common neural tube defects are anencephaly and spina bifida.
When the mistake in closure leaves the brain exposed, the babies do not live. This problem is called anencephaly.

Spina bifida or 'open spine' occurs when there is an opening somewhere on the spine which exposed the spinal cord. These babies can have various disabilities.
This can be an opportunity to discuss perceptions of disability.

FACT SHEET: NEURAL TUBE DEFECTS
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Spina bifida runs in families

Many health and developmental problems run in families. In the general population, the chance that a woman will have a baby affected with spina bifida is about 1 in 500. However, spina bifida is known to run in families and therefore some people have more chance of having a baby with spina bifida than others because of the genetic information that is being passed down through the family. The information to tell a baby's spine to close is contained in its genes. If the genetic information for correct spinal closure passed down through the generations is changed, the spine will not close properly.

Because babies are mixtures of the genetic information from both its mother and father, a couple will have a higher chance of having a baby with spina bifida if they have already had an affected baby.

Is spina bifida only caused by faults in the genetic information?

No. Scientists now know that the mother must have the right amount of a particular vitamin, folic acid, to enable her baby's spine to close properly. The genetic instructions interact with the vitamin to tell the baby's spine to 'zip up' correctly. If there is not enough folic acid present in the baby's environment, the baby will be affected with spina bifida. But this is not the only answer. If it was, we could prevent all cases of spina bifida by providing women who are at risk with folic acid. But we can only prevent about 70% of cases of spina bifida so for some women some other factor must be operating.

It is important to note that having a genetic susceptibility to having a baby with spina bifida can largely be overcome if the folic acid deficiency is addressed. The genetic condition is due to an interaction between the genetic information and an environmental factor.

FACT SHEET: ENVIRONMENTAL AND GENETIC INTERACTIONS

What is folic acid (folate)?

Folic acid (also called folate) is a vitamin. Vitamins are substances that we need to maintain our healthy bodies. Vitamins are divided into groups called A, B, C, D & E. Folic acid is one of the B group vitamins and is found in leafy green vegetables, cereals and legumes (peas, dried beans and lentils).

Should everyone have enough folate?

A folate rich diet can help prevent heart disease, some cancers, diabetes and other diseases, including spina bifida in babies. So while it is important for everyone to have folate every day, it is particularly important for women at all times because many pregnancies are unplanned. Taking folic acid prior to being pregnant, as well as early in pregnancy, reduces the chance of the baby being affected with spina bifida. The folic acid has to be taken before pregnancy because the closure of the spinal cord takes place even before a woman realises she is pregnant.

How much folate do you need?

For most women as a rule, it is necessary to have about 0.4mg of folate each day. This can be obtained by taking a low dose folic acid tablet or by eating a folate rich diet. Women who have a family history of spina bifida or anencephaly must have more folate that the average woman because she will be genetically more susceptible to having an affected baby than the average woman. She should discuss this with her doctor.

FACT SHEET: FOLATE BEFORE AND DURING PREGNANCY

How can you tell if the baby is affected with spina bifida?

Tests are available in pregnancy to determine if the baby has a neural tube defect. These tests include blood tests and ultrasound.

FACT SHEET: PRENATAL TESTING OVERVIEW