

Teaching/Learning Strategies to Integrate Genetics and Genomics into Undergraduate Nursing Education

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Leighsa Sharoff, EdD, RN, NPP, AHN-BC
Hunter College

Disclosure

- Author: Leighsa Sharoff, EdD, RN, NPP, AHN-BC
- There is no conflict of interest to declare
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Objectives

- Discuss educating the educator first
- Explore innovative and creative formats for genetics and genomics integration into their nursing education curriculum
- Explore diverse strategies for group work to enhance students application of genetics and genomics
- Discuss different teaching/learning strategies to provide a basic genetic literacy level

BACKGROUND

- The acquisition of knowledge with the human genome mapping and sequencing in 2003 has led to numerous enhancements in our understanding of the importance of genetic and genomic education for nurses
- The identification of genetics and genomics as a learning need for nurses and nursing students led to the establishment of the National Coalition for Health Professional Education in Genetics which developed specific core competencies for the integration of genetics into healthcare education in 2001
- These were revised in 2004 providing more detailed requirements about the principles of genetics (NCHPEG 2001, 2004)
 - Detailed references are listed at end of presentation material

- Prominent nursing organizations developed specific documents providing guidelines for the integration of contemporary genetic knowledge related to nursing
- It is necessary for the nursing profession and nurse educators, specifically, to enhance their overall knowledge foundation, skills and attitude about genetics and genomics to prepare for the transformation in healthcare that is already underway
 - Next 3 slides has a lot of resources...

National Coalition for Health Professional Education in Genetics		http://www.nchpeg.org/index.php?option=com_content&view=article&id=237&Itemid=84
Essentials of Genetic and Genomic Nursing: Competences, Curricula Guidelines, and Outcome Indicators	Consensus Panel on Genetic/Genomic Nursing Competencies, 2008	http://www.genome.gov/pages/careers/healthprofessionaleducation/geneticscompetency.pdf
Essentials of Baccalaureate Education for Professional Nursing Practice	American Association of Colleges of Nursing, 2008	http://www.aacn.nche.edu/education-resources/BaccEssentials08.pdf
Essential Genetic and Genomic Competencies for Nurses With Graduate Degrees	Consensus Panel on Genetic/Genomic Nursing & the American Nurses Association, 2011	http://www.genome.gov/Pages/Health/HealthCareProvidersInfo/GradGen_Comp.pdf
Bringing Science to Life: NINR Strategic Plan	National Institute for Nursing Research (NINR)	https://www.ninr.nih.gov/sites/www.ninr.nih.gov/files/ninr-strategic-plan-2011.pdf

Fit for Practice in the
Genetic/Genomics Era

National Genetics
Education and
Development Centre
United Kingdom

http://www.tellingstories.nhs.uk/downloads/FitforPractice_Extended_summary.pdf

[http://www.geneticseducation.nhs.uk/downloads/0049Fit for Practice %20PreLim Report.pdf](http://www.geneticseducation.nhs.uk/downloads/0049Fit_for_Practice_%20PreLim_Report.pdf)

<http://genomics.research.southwales.ac.uk/media/files/documents/2013-09-05/ffpgge-nursing-learning-outcomes.pdf>

Additional Resources regarding G/G Competencies

- Refer to these articles:

- Kirk, M., Calzone, K., Arimori, N. Tonkin, E. (2011). Genetics-Genomics Competencies and Nursing Regulation. *Journal of Nursing Scholarship*, 43:2, 107–116.
 - <http://onlinelibrary.wiley.com/doi/10.1111/j.1547-5069.2011.01388.x/pdf>
- Arimori, N., Nakagomi, S., Mizoguchi, M., Morita, M., Ando, H., Mori, A. Holzemer, W. (2007). Competencies of genetic nursing practise in Japan: A comparison between basic and advanced levels. *Japan Journal of Nursing Science*, 4(1), 45-55. DOI: 10.1111/j.1742-7924.2007.00075.x
 - Or can find in: *Journal of Japan Academy of Nursing Science*, 2004, 24 (2): 13-23.
- **Journal of Nursing Scholarship Genomic Nursing Series**
 - <http://www.genome.gov/27552093>

Competency of Nurse Educators to Educate

- The gap between nurses' genetic aptitude and genetic/genomic (G/G) research has gradually expanded over the last decade, leading to nurse educators feeling ill-prepared and under-educated to teach this topic
- Formidable barriers to implementing the guidelines for genetic/genomic content inclusion comprise {to name but a few}:
 - Finding faculty who are able (and willing) to teach genetic content
 - Faculty's lack of confidence in their own level of genetic/genomic literacy with limited foundational knowledge
 - An already crowded curriculum and nursing faculty shortage with overloaded full-time faculty

Educating the Educator

- There are several exceptional G/G education programs that are geared towards for the healthcare professional:
 - Cincinnati Children's Hospital, Genetics Education Program/Web-based Genetics Education Institute (WBGI) (<http://www.cincinnatichildrens.org/education/clinical/nursing/genetics/cont/default/>)
 - Summer Genetics Institute offered by the National Institute of Nursing Research (<https://www.ninr.nih.gov/training/trainingopportunitiesinternational/summergeneticsinstitute#.UsWwBrRIUXc>) provide the knowledge and skills required to bring this competency to undergraduate (and graduate) education
 - In addition, Duke University/Duke Center for Human Genetics (<http://www.chg.duke.edu/education/online.html>) offers free online course material
 - See Next slide for more sites...

- National Genetics and Genomics Education Centre
 - <http://www.geneticseducation.nhs.uk/>
- International Society of Nurses in Genetics
 - <http://www.isong.org/index.php>
- **Clinical Genetic Education Resources (*Courses and Lectures*)**
 - <http://www.kumc.edu/gec/prof/genecour.html>
- The Japan Society of Human Genetics
 - <http://www.jshg.jp/e/introduction/index.html>
- Genetic Nursing in Japan
 - <http://www.kango-net.jp/en/project/01/>
- World Health Organization Continuing Education/Genomic Resource Centre
 - <http://www.who.int/genomics/professionals/education/en/>

How to Include Genetics/Genomics Content

- Once the identified genetic nurse educator has their own educational basis to draw upon, deciding if the G/G content will be a pre-requisite, stand-alone course or become an integrated part of the curriculum must be decided (threaded throughout curriculum)
 - Pre-requisite to starting the nursing curriculum
 - Several accelerated (second degree) programs require genetic/genomic content as a pre-requisite. The course is often taught by the biology department
 - This route provides the basic knowledge necessary however it does not include nursing implications or perspectives.

Threading Content Throughout Curriculum

- Requires majority of faculty have a basic level of G/G literacy to supplement this content to their already demanding courses, with identification of courses to incorporate the content
- Guidelines to assist nurse educators in how to create a curriculum thread focused on G/G was developed, thus providing an excellent checklist (Hetteberg & Prows, 2004)
- Incorporating G/G into existing courses in more workable and feasible formats can meet the required competency, providing faculty can integrate additional learning resources for students' involvement

- Foundational sciences (biology; anatomy and physiology; pathophysiology) can provide basic understanding of DNA concepts (including polymorphisms; penetrance; epigenetics; frameshift mutations and modes of inheritance)
- Health assessment courses can introduce concepts of gathering patient histories; construction of a 3-generation pedigree; and explanations of genetic testing and screening and basic genetic terminology (such as genotype, phenotype and allelic expression)
- Nursing ethic courses can effortlessly introduce the ethic, legal and social implications to genetic conditions and genetic testing and screening, including prenatal screening and testing
- Pharmacology courses can integrate concepts of pharmacogenomics and pharmacogenetics, including aspects of genetic differences that influence drug metabolism, leading to more individualized and personalized care

- Specific didactic courses (medical/surgical; maternal-child; mental health nursing) can integrate precise genetic aspects:
 - Respiratory system discussion that focuses on the autosomal recessive genetic condition of Cystic Fibrosis and gene therapy
 - oncology discussions focusing on BRCA 1 and BRCA 2 mutations and their inherent patterns of breast cancer
 - Discussions of Down Syndrome {Trisomy 21} in maternal-child nursing and the importance of prenatal testing and patient education
- Clinical specialty areas can infuse genetic concepts and expand on students' genetic literacy by providing additional opportunities for assessments and exploration of genetic conditions; including discussions on dysmorphology
- Clinical experiences can provide for discussions on:
 - Newborn testing for PKU (phenylketonuria)
 - Sickle cell anemia and patient education (AR)
 - Familial hypercholesterolemia

- Capstone courses can provide an opportunity for students' to discuss complex multifactorial polygenetic conditions:
 - Diabetes mellitus
 - Bipolar disorders and schizophrenia,
 - Familial retinoblastoma and familial adenomatous polyposis {exploring the concept of two-hit theory in cancer}
 - Implications of pharmacogenomics and environmental substances (ecogenetics)
- Threading G/G through curriculum can provide students' with comprehensive overview of the content, nursing implications and nursing involvement
- Faculty must be able and willing to teach the content, must collaborate with each other, and explore innovative ways to creatively introduce the material
 - Such as with simulation; case studies; exploring their own student population for genetic diversity and cultural background differences

Stand-Alone Required Course

- Introducing G/G early in the program, students will glean a strong understanding of basic elements, which can then provide for more detailed and inclusive application of the content as students' progress through the nursing program
- However, adding a required course to an already heavy course load limits other requirements
 - 2-credit course may lead to a message that this content is not as important as other courses {i.e.: 3 credit course}
- The expectation that there will be further G/G discussions may be unattainable, as other faculty may not be able (and willing) to build upon the content nor have time to allow for further deliberations
- Offering a stand-alone elective G/G course is also impractical as not all students would elect to take the course

Creating Assignments for Enhancing Student Learning Outcomes

- Any of the following assignments can be assimilated into a curriculum-thread focused on G/G
- Being conscious to make this an application course, ensuring that students' gained an appreciation for the content, while being creative and innovative for the 21st century student, was the challenge
- Course development incorporated creating learning modules for topics (total of 9 modules), over 25 {URL} hyperlinks (directs the user to the entire document):
 - Essential Nursing Competencies and Curricula Guidelines for Genetics and Genomics
<http://www.genome.gov/pages/careers/healthprofessionaleducation/geneticscompetency.pdf>
 - Human Genetic Variation Fact Sheet <http://archive.is/9cws>
 - Cancer Predisposition Genetic Testing and Risk Assessment Counseling
<http://www.ons.org/Publications/Positions/Predisposition/>

Making a Large Class Smaller

- **66 first semester sophomores**
 - 13 groups, with 5-6 students in each group
- **Assignments built upon one another**
 - Complete certification; individual paper
 - Group Wiki assignment
 - Group presentation with paper
 - Rubrics developed for each assignment
- **First individual assignment**
 - Certificate completion of the Cincinnati Children's Hospital Medical Center/Genetic Education Program: *Genetics is Relevant Now: Nurses' Views and Patient Stories*
<http://www.cincinnatichildrens.org/education/clinical/nursing/genetics/instruction/now/>
 - Expected 80% or better; correctly upload the certificate in the assigned folder in Blackboard
 - Screen shot of the actual online website page was provided as well as instructions on various formats to upload the certificate

Group Assignments

- The first group assignment was to select a genetic condition from a provided list
- Via a Wiki page, which was created for them on Blackboard, the group was expected to answer specific questions to provide information and references on their chosen condition
- The format for the Wiki assignment was based on the concept of the Genetics Home Reference/Conditions <http://ghr.nlm.nih.gov/BrowseConditions>
- Information on how to read and post to Wikis in Blackboard and Instructions for adding links and images to a Blackboard wiki was provided

Please Choose One of These Conditions

- Sickle Cell Anemia/Disease
- Tay-Sachs Disease
- Cystic Fibrosis
- Autism
- Breast Cancer
- Alzheimer Disease
- Down Syndrome
- Bipolar/Depression
- Gout
- Type 2 Diabetes Mellitus
- Substance Abuse
- Klinefelter Syndrome
- Duchenne Muscular Dystrophy
- Marfan Syndrome
- Huntington Disease (HD)

Wiki Assignment Questions

- What is the condition you are discussing?
- Write a brief overview of this resource?
- Describe the resource site?
 - What information does this site provide?
 - Was this information useful to you as a healthcare professional? Why/Why not?
 - How does this sites' information add to your understanding of this condition?
 - Who validates this site? In other words, is this a reliable resource? Explain
- How common is this condition?
- What genes are related to this condition?
- How do people inherit this condition? {Explain the Mendelian relationship}
- What is the genetic testing for this condition?
- Where can the patient find information on diagnosis and management of it? Or treatment providers?
- Is there pharmacogenetic testing (PGx) for this condition and medications? If so, what?
- Where can the patient find additional information about this condition?
- What other names do people use for this condition?
- What if the patient still has specific questions about this condition? Where can they go to find out more information? {In other words, patient education sites}
- Where can the patient find general information about genetic conditions?
- What glossary definitions help with understanding this condition?
- How can patient find a genetics' professional in my area?
- Where can a patient find information regarding support group for others who have this condition?

- The next group assignment was a brief online discussion of Healthy People 2020/Genomics
<http://www.healthypeople.gov/2020/topicsobjectives2020/default.aspx>
 - Specific questions for a facilitated online discussion was provided
 - A summary of each group's discussion was posted on Discussion Board
- The final group assignment consisted of a group presentation and paper, based on the same condition the Wiki assignment was on
 - Consisted of:
 - Genetic inheritance explanation
 - Pathophysiology of the condition (including manifestations)
 - Nursing implications, nursing counseling and screening/tests
 - Patient and healthcare professional resources
 - Pamphlet for the patient/family (to be uploaded to Blackboard)
 - Complemented Wiki assignment, whereby a significant amount of information from Wiki assignment would be utilized for the group presentation

Individual Paper Assignment

- 3-generation pedigree (using standard pedigree symbols) on their own family, a friend's family or a patient
 - Provided with numerous resources for pedigree construction and detailed legend
 - Expected to write brief narrative of relationships found in family history
- Instructed to select one individual in the family history; evaluate that individual for specific risk factors, including medical conditions and possible genetic inheritance based on the family pedigree
 - Inclusion of Healthy People 2020 Genomics
 - 2-3 learning resource websites that would be beneficial for this individual were to be included
 - Aspects of what nurse can teach this individual/family on preventive healthcare based on the pedigree
 - Reminded to review rubric for this assignment, as it provided a detailed description of each criterion that was to be included

In-Class Group Work

- Vocabulary definition games were developed
- Pedigree analysis and construction questions and patterns of inheritance questions were provided
- Assessments r/t genetics were developed
- Online tutorials/learning experiences, such as:
 - Genetics Practice Problems
<http://biology.clc.uc.edu/courses/bio105/geneprob.htm>
 - Khan Academy/Hereditary & Genetics
<https://www.khanacademy.org/science/biology/heredity-and-genetics/v/punnett-square-fun>

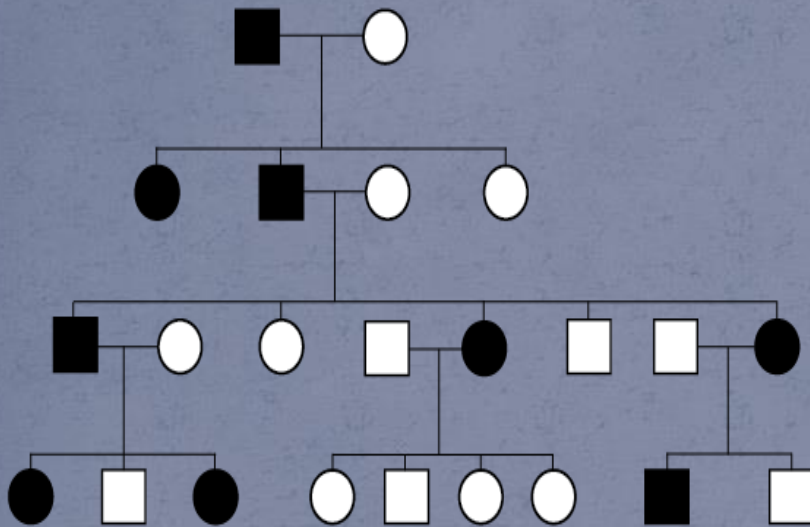
Examples of Questions...

- As the nurse, you should know that the Genetic Competencies include all of the following except:
 - a . Identify credible, accurate, appropriate & current genetics and genomics information, resources, services and/or technologies specific to given clients
 - b. Facilitates referrals for specialized genetics and genomics services for clients as needed
 - c. Recognize when one's own attitudes & values related to genetic and genomics science may affect care provided to client
 - d. Encourages client to seek genetic counseling immediately and have immediate treatment and pharmacological support

What is this Condition?

(Marfan Syndrome {AD})

<https://www.flickr.com/photos/nationalmarfanfoundation/sets/72157612643340384/>



- As the nurse, you should know that one of the uses of genetic testing is to do which of the following? To:
 - A. totally prevent the transmission of genetic conditions
 - B. provide information to individuals so they can make decisions about their personal health
 - C. tell clients how to lead healthy lives
 - D. help clients focus on the genetic basis of all illness

Punnett Square Question...

- **Brown eyes (B) are fully dominant over blue eyes (b)**
 - a. A 3:1 phenotypic ratio of F₁ progeny indicates that the parents are of what genotype?
 - b. A 1:1 phenotypic ratio of F₁ progeny indicates that the parents are of what genotype?
 - a. Bb & Bb 3:1 ratio

	B	b
B	BB	Bb
b	Bb	bb

- b. Bb & bb 1:1 ratio

	B	b
b	Bb	bb
b	bb	bb

- Think about this carefully.:
- Albinism and hair color are determined by different genes. A recessively inherited form of albinism causes affected individuals to lack pigment in their skin, hair & eyes. Hair color itself is determined by a gene where red hair is inherited as a recessive trait & brown hair is inherited as a dominant trait. A woman with albinism whose parents both have red hair has 2 children with a man who is normally pigmented & has brown hair. The partner with brown hair has 1 parent who has red hair. The first child is normally pigmented & has brown hair. The second child has albinism.
 - a. What is the hair color (phenotype) of the parent with albinism?
 - b. What is the genotype of the parent with albinism for hair color?
 - c. What is the genotype of the parent with brown hair for hair color? skin pigmentation?
 - d. What is the genotype of the first child for hair color? skin pigmentation?
 - e. What are the possible genotypes of the second child for hair color? What is the phenotype of the second child for hair color? Can you explain this?

Answers:

- **a. white - lacks pigment**
- **b. rr**
- **c. Br Aa**
- **d. Br Aa**
- **e. Br rr; phenotype for second child is white – individuals with albinism lack pigment, therefore, the genotype that determines the color of pigment cannot be expressed (epistasis)**
- **Woman - aa rr Man – Aa Br**

- Inclusion of numerous Mashups via YouTube videos provided basic G/G 101 content: {course was developed on Blackboard 9.1}
 - Genetics 101 Part 1: What are genes?
https://www.youtube.com/watch?v=ubq4eu_TDFc
 - This video has 3 parts
 - The Genomic Landscape circa 2012 – Eric Green:
<https://www.youtube.com/watch?v=GLwCs37oIGI>
 - Genomics 101 <https://www.youtube.com/watch?v=MBVpTAFx-sQ>
 - Integrating specific YouTube videos allows students to develop a deeper appreciation of the subject and presents an opportunity for experiential learning, facilitating dialogue about the content and exposing students to new insights and skills (Sharoff, 2011)
 - Provided over 10 YouTube videos for self-directed viewing

Lessons Learnt

- **Assignments were well received**
 - Students felt that they were fair and appreciated that they did provide information for subsequent assignments
 - Enjoyed in class group assignments 😊
- **I felt that there was significant lack of in-class participation**
 - Gave several warnings that quizzes would be implemented if participation did not increase
- **Felt compelled to have three separate quizzes**
 - Module content evenly divided among the three quizzes, 20 multiple choice questions per quiz
 - Interestingly, the grades for the three quizzes were impressive, with only a small percentage receiving less than passing grades
- **The students themselves apologized for not engaging in the discussions, stating that they felt 'overwhelmed' with their first semester of nursing courses.**
- **I also felt that the group paper based on the group presentation was unnecessary**

Conclusion...

- An informed nurse begets an informed workforce who can understand basic genetic and genomic concepts, pharmacogenomics, provide patient education and make referrals when necessary
- This is the future of the nursing profession and these are the essential elements for a 21st century nurse
- The goal to increase genetic and genomic understanding, awareness and appreciation (Seibert, Edwards & Maradiegue, 2007) is the requirement of all nurse educators, nurses and healthcare providers
- Nurse educators and students must be prepared to be active participants with effective roles in genetic and genomic healthcare
- With millennial nursing students, is it necessary for nurse educators to provide a variety of learning strategies, engaging students intellectually as well as motivationally

- Thank you so much...
- I hope you enjoyed this presentation
 - If anyone has any questions, please do not hesitate to contact me
 - lsharoff@hunter.cuny.edu
 - 917.842.7902

Excellent Resources/Articles

- If you go to this site, there are numerous articles on G/G:
 - <http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291547-5069/homepage/MostAccessed.html>
 - <http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291547-5069/homepage/MostCited.html>
- Godino, L. & Skirton, H. (2012). A systematic review of nurses' knowledge of genetics. *Journal of Nursing Education and Practice*, 2(1), 173-184.
 - This article has an excellent table that summarizes papers related to G/G

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