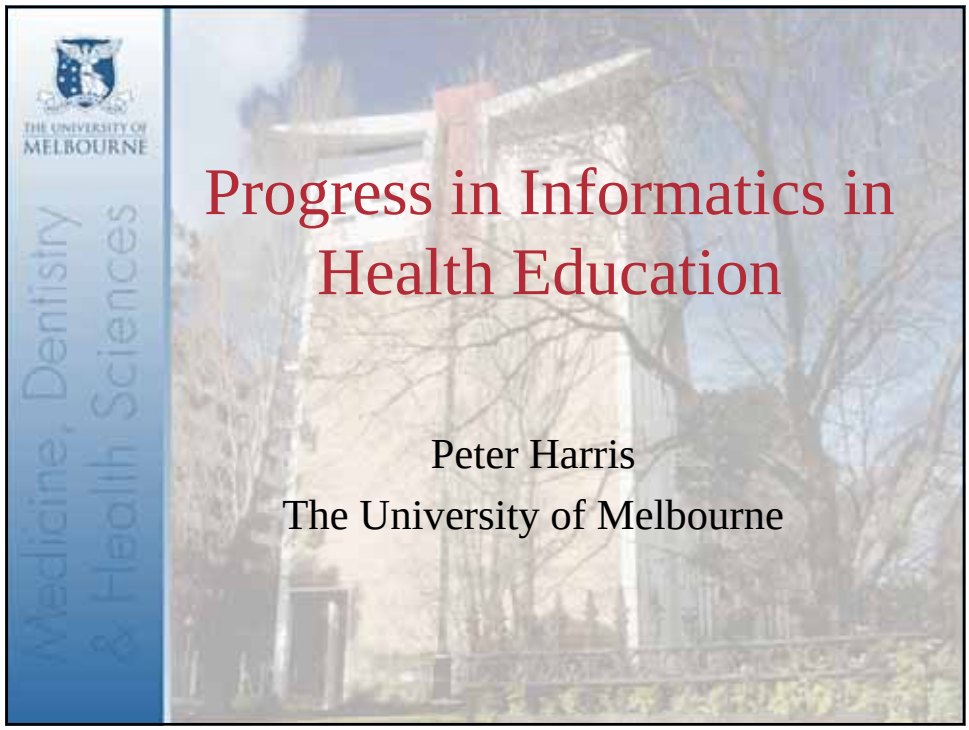


Progress in Informatics in Health Education

Peter Harris
The University of Melbourne

What is Health Informatics?

"Use of computers and communications technology to acquire, store, analyse, communicate and display medical and health information and knowledge to facilitate understanding and improve the accuracy, timeliness and reliability of decision-making"

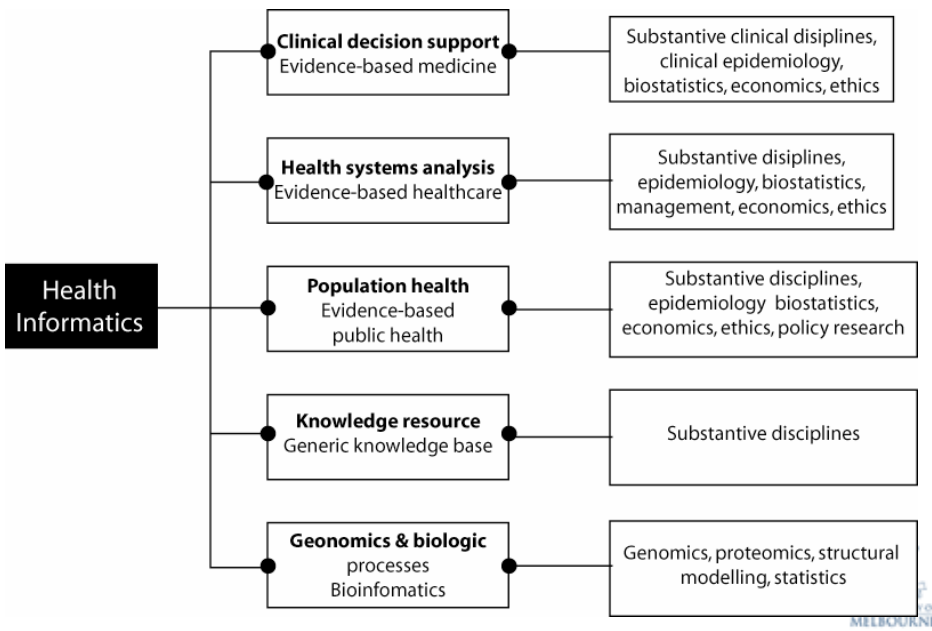
Terry Nolan 2001 (School of Population Health, University of Melbourne)

Computers in Medical Informatics

"Medical informatics is as much about computers as cardiology is about stethoscopes"

Enrico Coeira, UNSW

Health Informatics



Telehealth

Remote delivery of healthcare services

- Teleconsultation
- Telemonitoring
- Telesurgury

Tele-education (Continuing professional education)

Electronic health records

Record of patient's medical history

Features:

- Standardisation (structure, content, interoperability)
- Security and privacy
- Quality (data monitoring, error checking)
- Stability (storage of paper/digital records)
- Access (search strategies, knowledge extraction)

Clinical decision support

Clinical:
(Diagnosis and treatment using expert systems)

Administrative:
(Organisational/logistical support; therapeutics)

Management:
(Costs; resources;clinical protocols)

Evolution

of **(IT) Information Technology**

through **(IM) Information Management**

to **(KM) Knowledge Management**

Knowledge Management (input/classification)

- Construction of knowledgebases
- Meta-data systems
- Content management and document management
- Detection and capture of external intelligence

- Discovery, mining, and conversion of content resources
- Enterprise-wide information integration
- Intellectual property management and protection

Knowledge Management (analysis/output)

- Content analysis and abstraction
- Knowledge-flow discovery and analysis
- Learning enhancement and acceleration
- Qualitative and quantitative analysis of relationships
- Visualization of knowledgebases

Structured vs unstructured data

Structured (20%of available data)

- Keywords (eg MESH)
- Meta-data “tags” (eg IMS in U21 Learning Resource Catalogue)
- Relational databases
- Requires prior determination of classification/taxonomy

Unstructured (80% of data)

- Text documents
- Images/graphics

Unstructured data mining (UDM) - example from ClearForest

(Thanks to Ronen Feldman!)

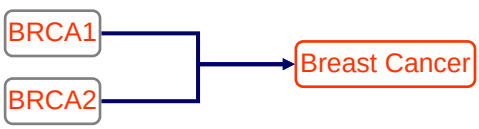
While Search Engines return documents for **USERS** to read, ClearForest reads documents and digests them for the user.

Text mining & bio informatics

- Much of the relevant data is in textual format
  - Thousands of publications / Tens of millions of articles
  - Medline alone has 11 million citations
- Currently only basic keyword based search is available

Current tools are insufficient for amount of data to be mined for critical information

BRCA - Functions and Interactions (1 of 9)



Hum Mol Genet 2001 Apr;10(7):705-13

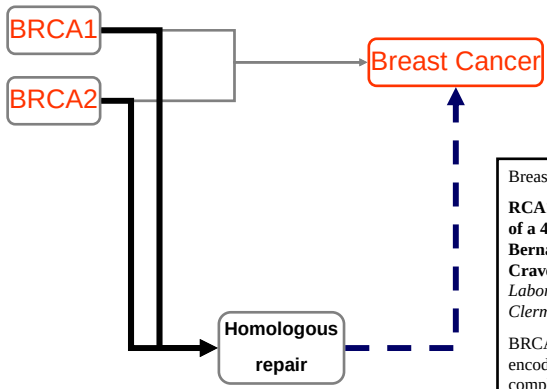
BRCA1 and BRCA2 and the genetics of breast and ovarian cancer.

Welcsh PL, King MC.

Departments of Medicine and Genetics, Box 357720, University of Washington, Seattle, WA 98195-7720, USA. piri@u.washington.edu

Germline mutations in the tumor suppressor genes **BRCA1 and BRCA2 predispose individuals to breast and ovarian cancers**. Progress in determining the function of BRCA1 and BRCA2 suggests that they are involved in two fundamental cellular processes: DNA damage repair and transcriptional regulation.

BRCA - Functions and Interactions (2 of 9)

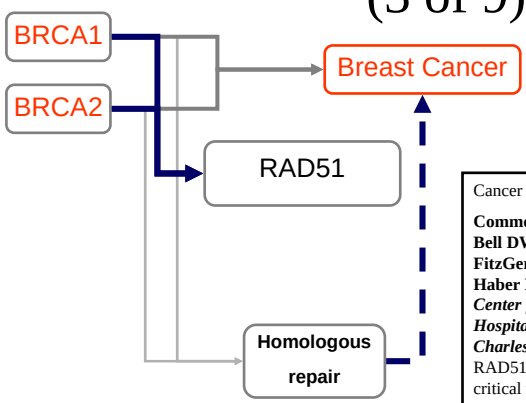


Breast Cancer Res 2001;3(1):61-5

RCA1 and BRCA2 protein expressions in an ovotestis of a 46, XX true hermaphrodite.
Bernard-Gallon DJ, Dechelotte P, Vissac C, Aunoble B, Cravello L, Malpuech G, Bignon YJ.
Laboratoire d'Oncologie Moleculaire, Centre Jean Perrin, Clermont-Ferrand, France.

BRCA1 and BRCA2 breast cancer susceptibility genes encode proteins, the normal cellular functions of which are complex and multiple, and germ-line mutations in individuals predispose both to breast and to ovarian cancer. There is nevertheless substantial evidence **linking BRCA1 and BRCA2 to homologous recombination and DNA repair**, to transcriptional control and to tissue proliferation. There is controversy regarding the …..

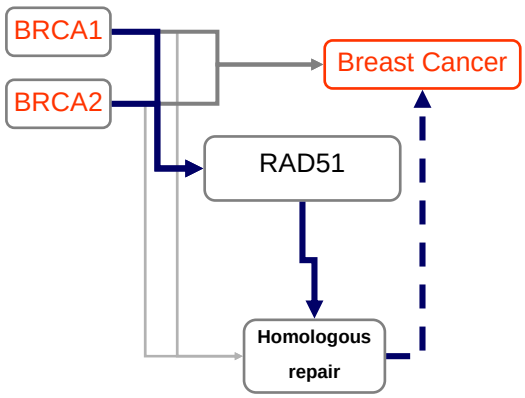
BRCA - Functions and Interactions (3 of 9)



Cancer Res 1999 Aug 15;59(16):3883-8

Common nonsense mutations in RAD52.
Bell DW, Wahrer DC, Kang DH, MacMahon MS, FitzGerald MG, Ishioka C, Isselbacher KJ, Krainer M, Haber DA.
Center for Cancer Risk Analysis, Massachusetts General Hospital Cancer Center, and Harvard Medical School, Charlestown 02129, USA.
RAD51, RAD52, and RAD54 encode proteins that are critical to the repair of double-strand DNA breaks by homologous recombination. The physical **interactions among the products of RAD51, BRCA1, and BRCA2** have suggested that the BRCA1 and BRCA2 breast cancer susceptibility genes may function, at least in part, in this DNA damage repair pathway. Given the observation that different genes within a common functional pathway may be targeted by mutations in human cancers, ….

BRCA - Functions and Interactions (4 of 9)



Cancer Res 2001 Jun 15;61(12):4842-50

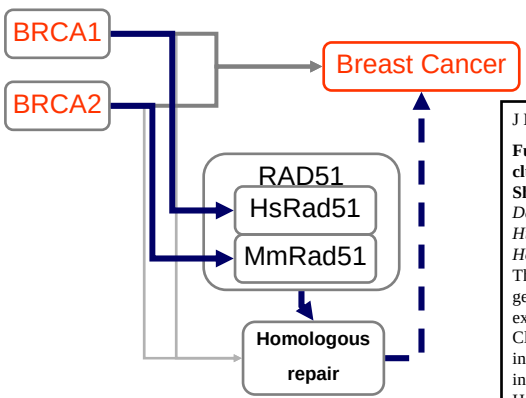
Homology-directed dna repair, mitomycin-c resistance, and chromosome stability is restored with correction of a Brca1 mutation.

Moynahan ME, Cui TY, Jasin M.

Memorial Sloan-Kettering Cancer Center, New York, New York 10021, USA.

Chromosomal breaks occur spontaneously as a result of normal DNA metabolism and after exposure to DNA-damaging agents. A major pathway involved in chromosomal double-strand break repair is homologous recombination. In this pathway, a DNA sequence with similarity to a damaged chromosome directs the repair of the damage. The protein products of the hereditary breast cancer susceptibility genes, BRCA1 and BRCA2, interact with the **Rad51 protein, a central component of homologous repair pathways**. We have recently shown that this interaction is significant by demonstrating that Brca1- and BRCA2-deficient cells are defective in homology-directed chromosomal break repair. ….

BRCA - Functions and Interactions (5 of 9)



J Mammary Gland Biol Neoplasia 1998 Oct;3(4):413-21

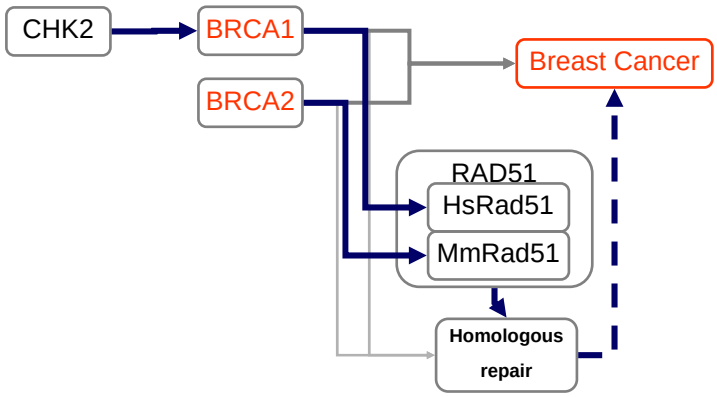
Functional characterization of BRCA1 and BRCA2: clues from their interacting proteins.

Sharan SK, Bradley A.

Department of Molecular and Human Genetics, Howard Hughes Medical Institute, Baylor College of Medicine, Houston, Texas 77030, USA.

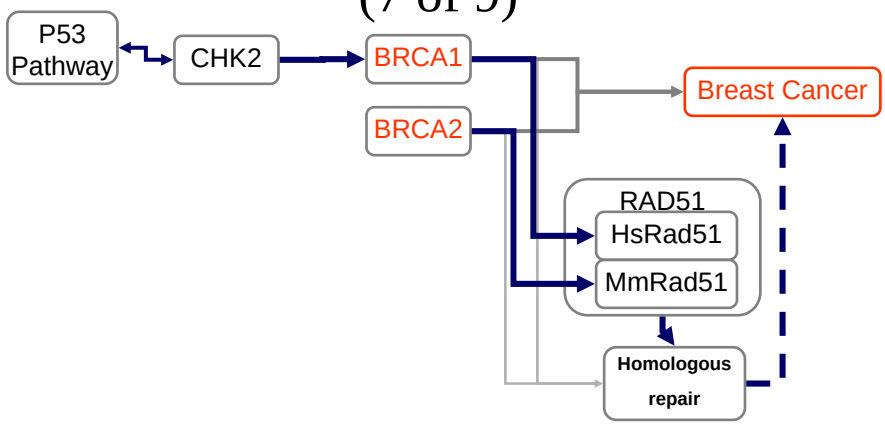
The familial breast and ovarian cancer susceptibility genes, BRCA1 and BRCA2 have been the subject of extensive functional analysis studies since their cloning. Clues to their biological role in maintaining the genomic integrity were provided by studies that revealed their interaction with the recombination repair protein HsRad51. The first clue of an **interaction between HsRad51 and BRCA1** came from the colocalization of the characteristic nuclear foci formed by these two proteins during S phase of the cell cycle. An **interaction between murine Brca2 and MmRad51** was detected by the yeast two hybrid system. Utilizing the yeast two hybrid system and other techniques several other Brca1 and Brca2 interacting proteins have been identified …

BRCA - Functions and Interactions (6 of 9)



Br J Cancer 2001 Aug;85(2):209-12
Mutation analysis of the CHK2 gene in families with hereditary breast cancer.
Allinen M, Huusko P, Mantyniemi S, Launonen V, Winqvist R.
Department of Clinical Genetics, University of Oulu/Oulu University Hospital, Oulu, Finland
Recently CHK2 was functionally linked to the p53 pathway, and mutations in these two genes seem to result in a similar Li-Fraumeni syndrome (LFS) or Li-Fraumeni-like syndrome (LFL) multi-cancer phenotype frequently including breast cancer. As **CHK2 has been found to bind and regulate BRCA1**, the product of …

BRCA - Functions and Interactions (7 of 9)



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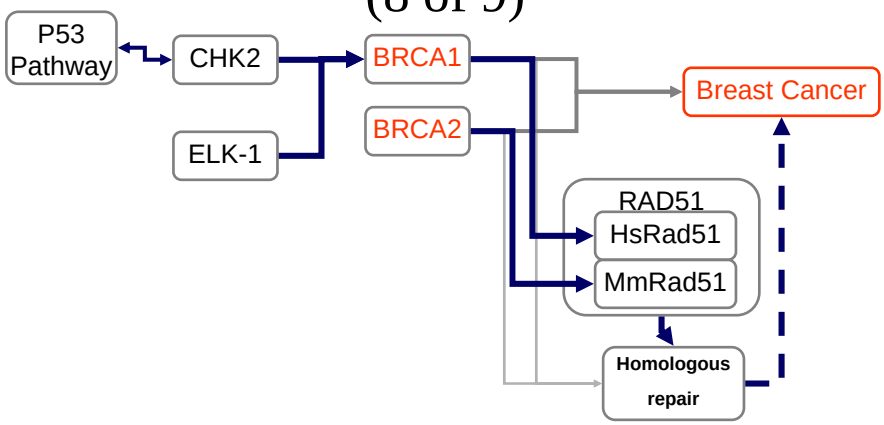
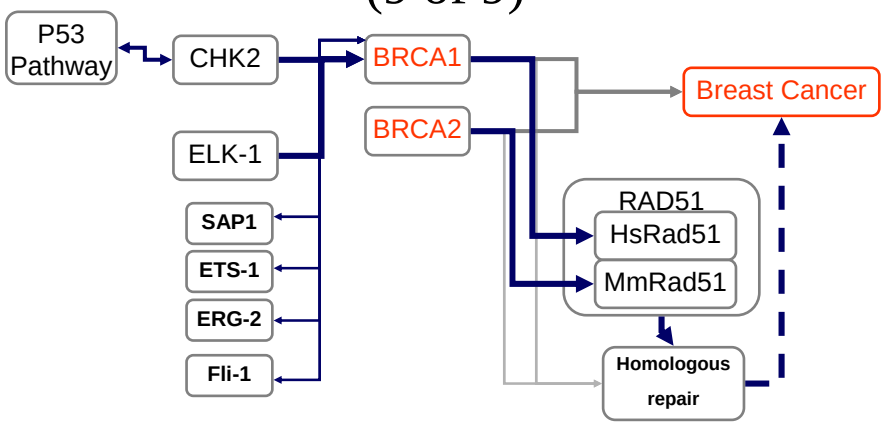
BRCA - Functions and Interactions (8 of 9)



Oncogene 2001 Mar 15;20(11):1357-67
c-Fos oncogene regulator Elk-1 interacts with BRCA1 splice variants BRCA1a/1b and enhances BRCA1a/1b-mediated growth suppression in breast cancer cells.
Chai Y, Chipitsyna G, Cui J, Liao B, Liu S, Aysola K, Yezdani M, Reddy ES, Rao VN.
Department of Medicine, Program of Cancer Genetics, Cancer Center, MCP Hahnemann University, 245 North 15th Street, New College Building, M.S. 481, Philadelphia, Pennsylvania 19102, USA.
Elk-1, a c-Fos protooncogene regulator, which belongs to the ETS-domain family of transcriptional factors…

BRCA - Functions and Interactions (9 of 9)



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Department of Medicine, Program of Cancer Genetics, Cancer Center, MCP Hahnemann University, 245 North 15th Street, New College Building, M.S. 481, Philadelphia, Pennsylvania 19102, USA.
….. **We also observed binding of BRCA1 proteins to other ETS-domain transcription factors SAP1, ETS-1, ERG-2**…..

Factors determining success of text mining

Precision vs recall

- High precision yields only relationships or data of interest - but may be incomplete
- High recall yields complete set of data but may include irrelevant data/relationships
- Precision and recall indices can be improved concurrently by refining search criteria - ie developing specific taxonomies

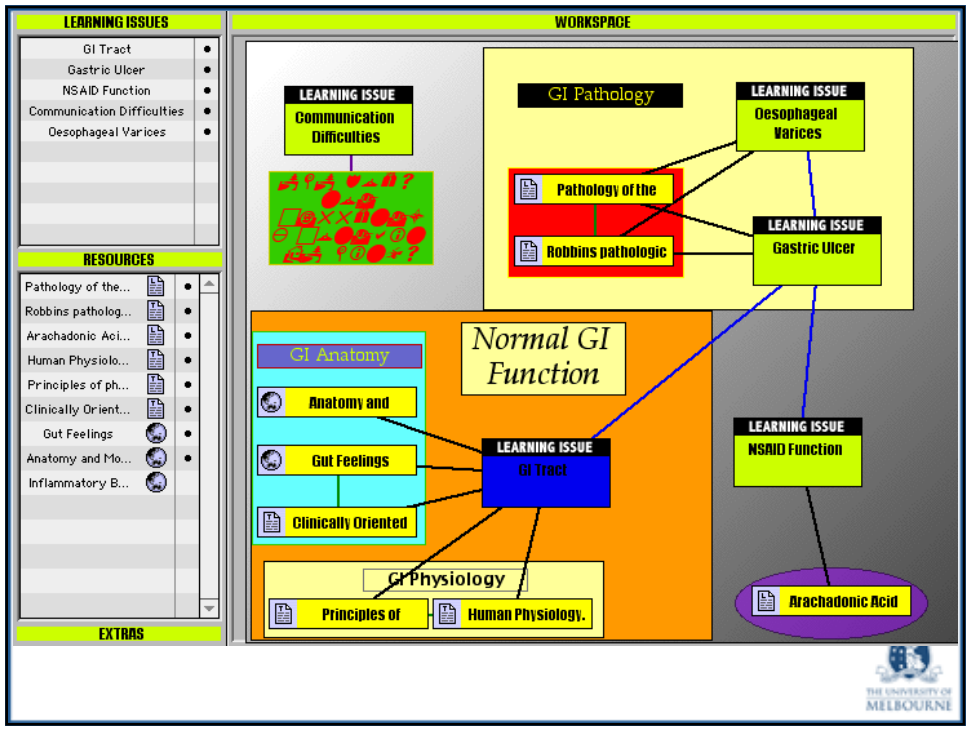
Knowledge representation - word relationships shown using "Think Map"

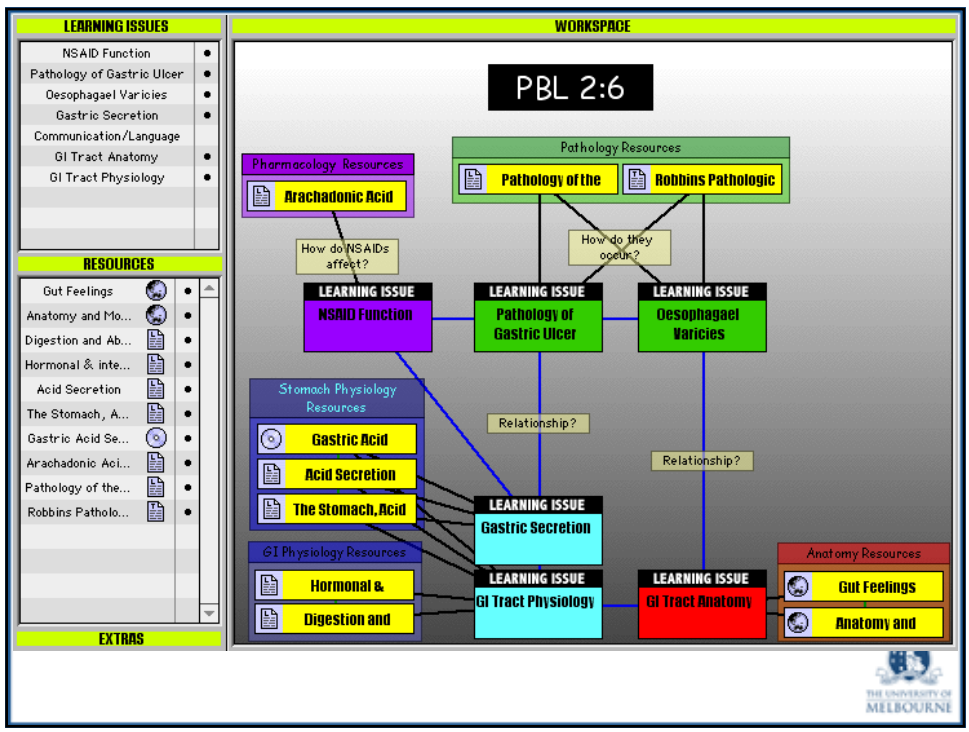
http://www.visualthesaurus.com/classic/index.html

click here to link to url

Concepts can be explored visually using “concept mapping” - based on structured database or results of unstructured data mining

Example - Personal Learning Planner


LEARNING ISSUES
GI Tract
Gastric Ulcer
NSAID Function
Communication Difficulties
Oesophageal Varices
RESOURCES
Pathology of the...
Robbins patholog...
Arachadonic Aci...
Human Physiolo...
Principles of ph...
Clinically Orient...
Gut Feelings
Anatomy and Mo...
Inflammatory B...
EXTRAS
WORKSPACE
LEARNING ISSUE
Communication Difficulties
GI Pathology
LEARNING ISSUE
Oesophageal Varices
Pathology of the
Robbins pathologic
LEARNING ISSUE
Gastric Ulcer
Normal GI Function
GI Anatomy
Anatomy and
Gut Feelings
Clinically Oriented
LEARNING ISSUE
GI Tract
LEARNING ISSUE
NSAID Function
GI Physiology
Principles of
Human Physiology.
Arachadonic Acid
THE UNIVERSITY OF MELBOURNE


LEARNING ISSUES
NSAID Function
Pathology of Gastric Ulcer
Oesophagael Varicies
Gastric Secretion
Communication/Language
GI Tract Anatomy
GI Tract Physiology
RESOURCES
Gut Feelings
Anatomy and Mo...
Digestion and Ab...
Hormonal & inte...
Acid Secretion
The Stomach, A...
Gastric Acid Se...
Arachadonic Aci...
Pathology of the...
Robbins Patholo...
EXTRAS
WORKSPACE
PBL 2:6
Pharmacology Resources
Arachadonic Acid
Pathology Resources
Pathology of the
Robbins Pathologic
How do NSAIDs affect?
How do they occur?
LEARNING ISSUE
NSAID Function
LEARNING ISSUE
Pathology of Gastric Ulcer
LEARNING ISSUE
Oesophagael Varicies
Stomach Physiology Resources
Gastric Acid
Acid Secretion
The Stomach, Acid
Relationship?
Relationship?
LEARNING ISSUE
Gastric Secretion
GI Physiology Resources
Hormonal &
Digestion and
LEARNING ISSUE
GI Tract Physiology
LEARNING ISSUE
GI Tract Anatomy
Anatomy Resources
Gut Feelings
Anatomy and
THE UNIVERSITY OF MELBOURNE

Multiple databases can be examined simultaneously

Example

- "Infofinder" in DNAexplorer

Knowledge visualisation - using anatomical interface to access numerical simulation and literature databases

Example

- "Virtual Kidney"
- http://mrb.niddk.nih.gov/cddb/
  click here to link to url

Sharing of knowledge in teaching, learning and research

- WWW enables distributed authoring (data entry) with centralised location for catalogues, repositories, exchanges
- Learning Resource Catalogue (LRC) is an example of a structured database - suitable for sharing information about learning and research “objects”
- LRC can also be used for unstructured knowledge management, analysis and generation using collaborative facilities. Interoperability with other databases is essential.

Learning objects - what are they and what determines their re-use by other teachers?

Example

- “autoregulation object”

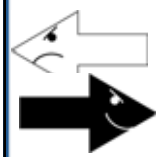
The Internet and Virtual Medical Schools

International Virtual Medical School (IVIMEDS)

50 institutions in 16 countries

- All 5 Scottish medical schools
- From USA - Brown, Wake Forest, West Virginia, Miami

– Degrees granted by enrolling University - already accredited
– Years 1 and 2 - 70% on-line, distance / 30% clinic or hospital
– Years 3,4 and 5 - 30% on-line / 70% in practice setting
– Collaborative learning + online tutors
– Use of "learning object" database and curriculum-mapping
– Presents series of "fictional patients" with computerised medical records
– Students can listen to "heartbeat" via vibrations in computer mouse



Dr Geek: "This is fantastic - a real advance in medical education"

Dr Warm N. Fuzzy: " How can you learn medicine with e-learning"

(K.S. Mangan - *Chronicle for Higher Education*, Oct 2002; Harden & Hart, *Medical Teacher*,24:261-267, 2002)

Learning Resource Catalogues

Sharing materials requires a resource database

- Consistent data entry system
- Hierarchy of "objects" and descriptions
- Search and review facility
- "Brokerage" mechanism to establish the "currency of exchange"
- Access rules (non-U21 alliances?)

Learning Resource Catalogues

"**Currency of exchange" options:**

- Free to all members
- market price
- cost of development
- value based on number of times used
- student interaction time

Informatics issues for discussion

- Multiple alliances - opportunities and tensions
- Audit of assets/capabilities (telehealth/research/teaching & learning/administration/professional)
- IP issues - ownership and payment
- "Not-made-here" syndrome - a career development issue?
- Structured vs unstructured data - agreement on taxonomies and standards
- Preferred "Knowledge interfaces"