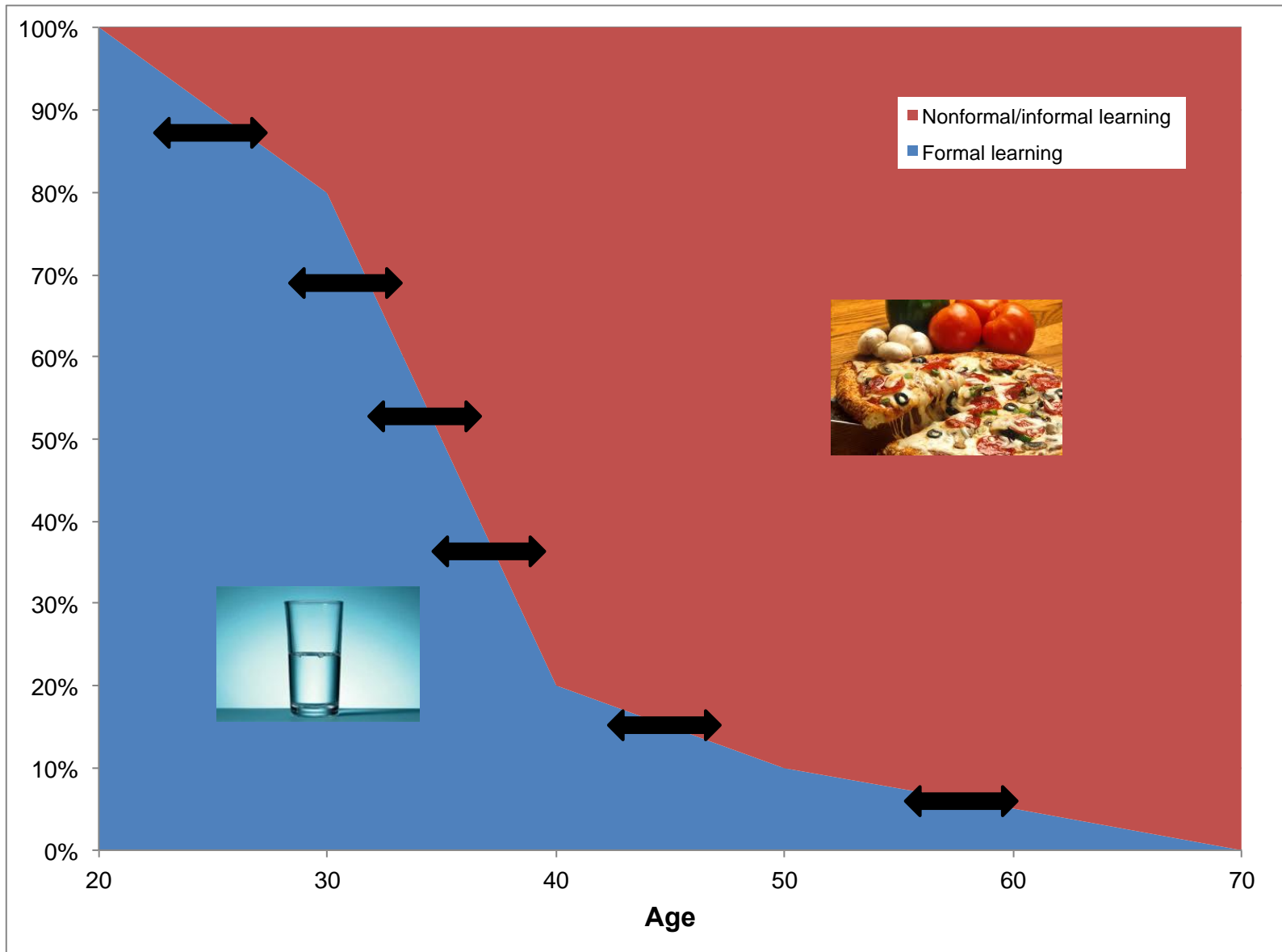


Why core competencies?

*Cath Brooksbank
Head of Training, EMBL-EBI
cath@ebi.ac.uk*



A journey through lifelong learning



Competency

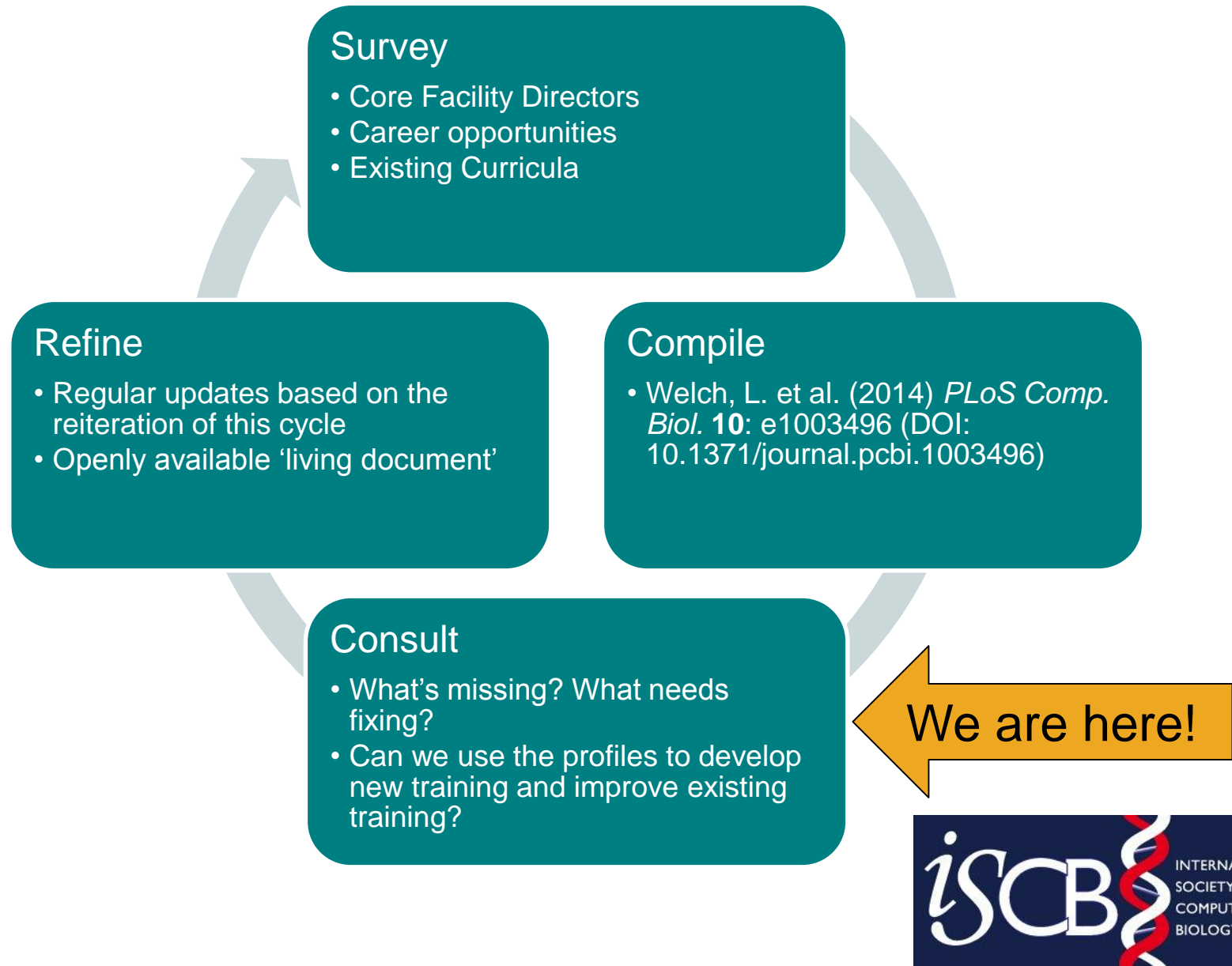
Competency is ‘an observable ability of any professional, integrating multiple components such as knowledge, skills, values and attitudes’.

- Acquisition can be validated objectively.
- Shared ‘currency’ applicable to learning of all types and at all career stages

Competency profile

- Defines the competencies required to fulfil a particular role
- Typically defined by professional bodies / learned societies in collaboration with employers

The ISCB Curriculum Taskforce's approach



Current draft



Competency	Bioinformatics user	Bioinformatics scientist	Bioinformatics engineer
Examples of professionals in this role	Biocurator, physician, lab technician, ethicist	Computational biologist; molecular life scientist	Software developer, software engineer
Apply knowledge of computing appropriate to the discipline (e.g., effectively utilize bioinformatics tools).	Awareness	Awareness to working knowledge	Awareness to specialist knowledge
Apply knowledge of biology appropriate to the discipline.	Working knowledge to specialist knowledge	Awareness to working knowledge	Awareness to working knowledge
Analyze a problem and identify and define the computing requirements appropriate to its solution (e.g., define algorithmic time and space complexities and hardware resources required to solve a problem).	Awareness	Awareness to working knowledge	Awareness to working knowledge
Use a computer-based system, process, component, or program to meet desired needs in scientific environments.	Working knowledge	Working knowledge	Working knowledge
Design and implement a computer-based system, process, component, or program to meet desired needs in scientific environments.	N/A	N/A	Working knowledge
Evaluate the ability of a computer-based system, process, component, or	N/A	Working knowledge	Awareness

Clinical bioinformatics competenc framework (a work in progress...)



Health Education England

Role	Clinical bioinformatician	Other bioinformatician	Specialist clinician with genetics/genomics expertise	Other specialist clinician	Other clinician	Clinical genetic Scientist	Other healthcare scientist	Specialist nurse/counsellor	Nurses and other allied health professionals	IT specialist	Data specialist
No. responses	11	6	5	5	6	8	6	6	5	7	7
Example	NHS diagnostic bioinformatician [1]	Academic bioinformatician, industry bioinformatician	Clinical geneticist or pathologist, haematologist, microbiologist with leadership responsibility in clinical lab	Cardiologist, neurologist, oncologist, paediatrician	General Practitioner	NHS diagnostic clinical scientist, microbiologist, statistical/analytical epidemiologist	Genetic technologist, Immunologist, epidemiologist	Genetic counsellor; Preimplantation genetic diagnosis nurse; clinical nurse specialist in surgery or oncology; Genetic Diabetes Nurse	Non-specialist nurse; physiotherapist	Systems administrator	Curator, data scientist
Competency	Write computer programmes and algorithms that can analyse data	Specialist knowledge	Specialist knowledge	No knowledge required	No knowledge required	No knowledge required	Awareness	No knowledge required	No knowledge required	No knowledge required	Specialist knowledge
Analyse genomics data using pre-existing software, including linking genotype to phenotype/microbial strain comparisons	Specialist knowledge	Specialist knowledge	Specialist knowledge[2]	Awareness	No knowledge required	Specialist knowledge	Awareness	No knowledge required[3]	No knowledge required	Awareness	Working knowledge
Employ good software development practice	Working knowledge	Specialist knowledge	No knowledge required	No knowledge required	No knowledge required	No knowledge required	No knowledge required	No knowledge required	No knowledge required	Working knowledge	Specialist knowledge
Apply computer science theory to computer system design	Working knowledge	Working knowledge	No knowledge required	No knowledge required	No knowledge required	No knowledge required	No knowledge required	No knowledge required	No knowledge required	Specialist knowledge	Working knowledge
Manage and organise genomics data and results	Specialist knowledge	Specialist knowledge	Awareness[2]	No knowledge required	No knowledge required	Working knowledge	Awareness	Awareness[3]	No knowledge required	Awareness	Specialist knowledge
Apply statistical research methods to genomics, medical, and population genetics	Working knowledge	Specialist knowledge	Working knowledge	No knowledge required	No knowledge required	Awareness[4]	Awareness	No knowledge required	No knowledge required	Awareness	Awareness
Use health informatics systems and understand their relevance to clinical genomics	Working knowledge	Awareness	Specialist knowledge	Awareness	Awareness	Awareness	Awareness	Working knowledge	No knowledge required	Working knowledge	Specialist knowledge
Principles of genetics, genomics and genome-sequencing technology	Specialist knowledge	Specialist knowledge	Specialist knowledge	Awareness	Awareness	Specialist knowledge	Working knowledge	Specialist knowledge	Awareness	No knowledge required	Awareness
Principles of genetic disease	Working knowledge	Working knowledge	Specialist knowledge	Working knowledge	Working knowledge	Specialist knowledge	Working knowledge	Specialist knowledge	Awareness	No knowledge required	No knowledge required
Principles of systems biology	Working knowledge	Working knowledge	Awareness	No knowledge required	Awareness	Awareness	Awareness	No knowledge required	Awareness	No knowledge required	No knowledge required
Principles of next-generation sequencing	Specialist knowledge	Specialist knowledge	Awareness	Awareness	Awareness	Specialist knowledge	Awareness[6]	Awareness	No knowledge required	No knowledge required	Awareness
Ethical, legal and social implications of clinical use of genomic data (including issues surrounding identification of patients, clinical benefits and risks, patient consent, incidental findings and ethical implications of unexpected clinically actionable findings)	Working knowledge	Working knowledge	Specialist knowledge	Working knowledge	Working knowledge	Specialist knowledge	Awareness	Specialist knowledge	Awareness	Awareness	Awareness
Interpret genetic variation in a clinical context, including understanding limitations of analysis, assessing quality and evidence for clinical interpretation	Specialist knowledge	Working knowledge	Specialist knowledge	Working knowledge	Awareness	Specialist knowledge	Awareness[5]	Specialist knowledge	No knowledge required	No knowledge required	No knowledge required
The role of various types of healthcare professional in genomic medicine	Working knowledge	Awareness	Specialist knowledge	Working knowledge	Working knowledge	Working knowledge	Awareness	Specialist knowledge	Awareness	Working knowledge	Awareness
The scientific discovery process and of the role of bioinformatics in it	Specialist knowledge	Specialist knowledge	Working knowledge	Awareness	No knowledge required	Working knowledge	Awareness	Awareness	No knowledge required	No knowledge required	Awareness
The risks (and benefits) to patients and their families arising from the prediction of causal variants	Specialist knowledge	Awareness	Specialist knowledge	Working knowledge	Working knowledge	Specialist knowledge	Awareness	Specialist knowledge	Awareness	No knowledge required	Awareness
Integrate and jointly analyse genomic and other data						[7]	[7]				

LifeTrain's collection of competency profiles

www.lifetrain.eu



Home | About | Join us | Framework | Competencies | News | Register as a signatory | Sign in

Course providers Professional bodies Employers Individuals

Competency profiles

A competency profile defines the competencies required to fulfil a particular role. Competency profiles are typically defined by professional bodies or learned societies in collaboration with employers.

In the biomedical sciences, a number of professional bodies and learned societies have begun to take this approach. LifeTrain is collecting these to make it easier for our stakeholders to identify and use competency profiles.

Examples of competency profiles

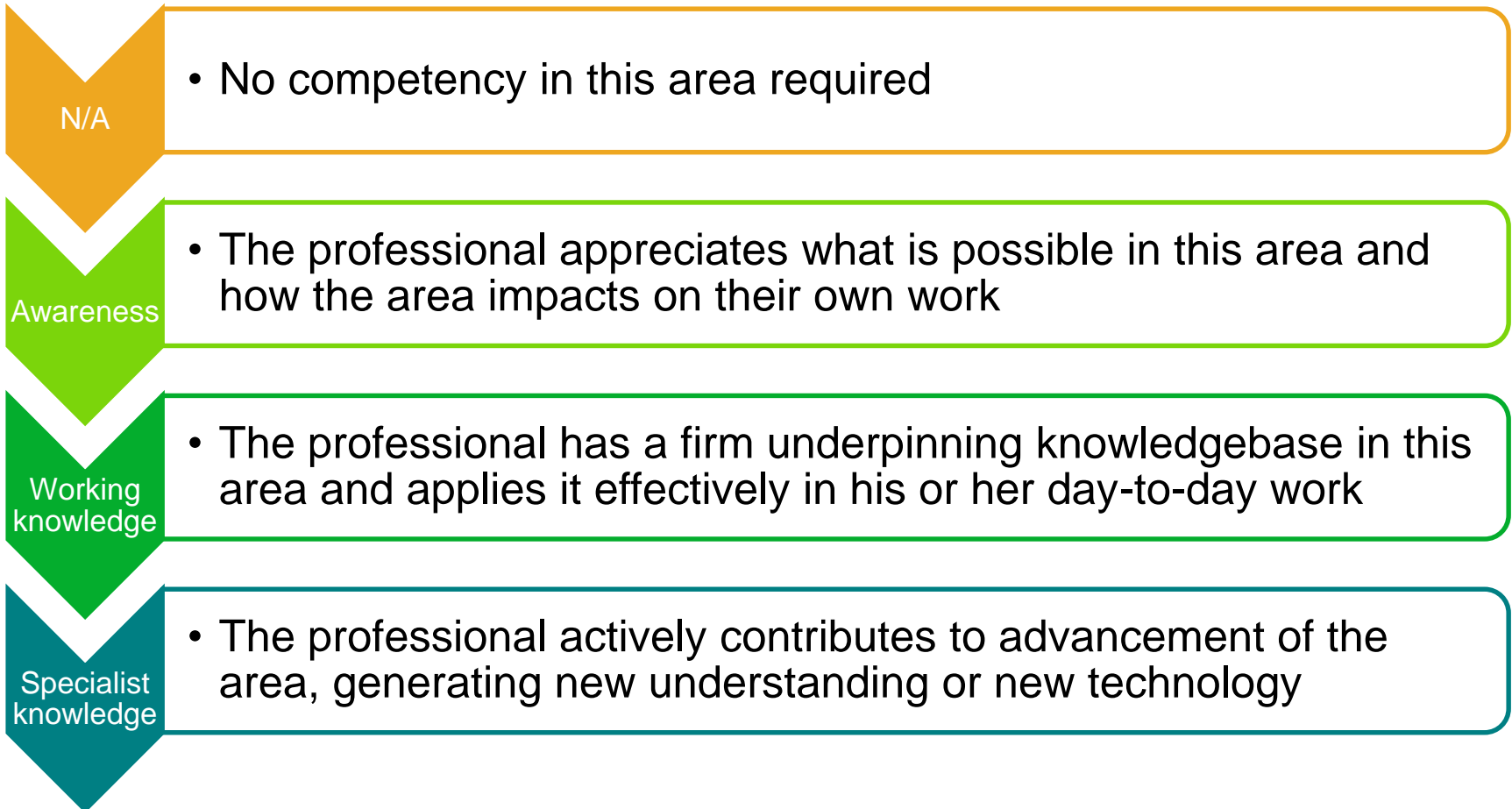
- Specialist in Medicines Development – developed by PharmaTrain and IFAPP
- Bioinformatics core competencies – developed by the International Society of Computational Biology
- Researcher Development Framework (all disciplines) – developed by Vitae
- Regulatory Affairs competencies – developed by The Organisation for Professionals in Regulatory Affairs (TOPRA)
- Competency areas for Medical Information Professionals – developed by The Pharmaceutical Information and Pharmacovigilance Association (PIPA)
- Competency areas for Pharmacovigilance Professionals – developed by The Pharmaceutical Information and Pharmacovigilance Association (PIPA)
- Guidance on CPD for Qualified Persons – developed by European Industrial Pharmacists Group (EIPG)
- Core Competencies in Clinical and Translational Research – developed by Clinical and Translational Science Award (USA)
- Competencies for academia-industry drug development (pages 6-7) – developed by Clinical and Translational Science Award (USA)
- Clinical Research Nurse Competency Framework – developed by Royal College of Nursing
- Core content for Pharmacoepidemiology – developed by The International Society for Pharmacoepidemiology
- Competencies for Industrial Pharmacists: graduate, specialist and advanced levels – developed by PHARMINE (Pharmacy Education in Europe)
- Guidelines for the European Registration of Toxicologists – developed by EUROTOX
- Core Competencies for Clinical Research Professionals (Investigators, Clinical Research Monitors, Clinical Research Project Managers, Clinical Research Training Managers) – developed by IAOCR Taskforce
- Competences for Chartered Scientist (all disciplines) – developed by the Science Council
- Skills for Drug Discovery for Biochemistry, Chemistry, Pharmacology and Toxicology – developed by the Drug Discovery Pathways Group
- Core Competency Framework for the Clinical Research Professional – developed by the Joint Task Force for Clinical Trial Competency
- Employability competencies (all disciplines) – developed by Vitae (Employability Lens of the Vitae Research Development Framework)

lifetrain.eu
Set up and run by the EMTRAIN consortium on behalf of the Innovative Medicines Initiative's education and training projects.

Social Media
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Different phases of competency



Bioinformatics user

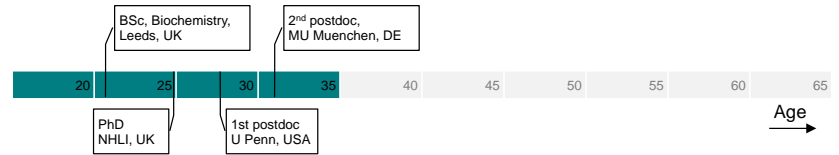
- Access data resources and bioinformatics tools to perform job duties in specific application domains:
 - Biocurator
 - Cytogeneticist
 - Genetic counsellor
 - Ethicist

Leon (bioinformatics user)

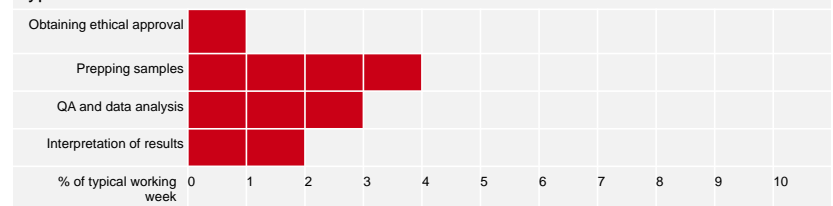


Leon is on his second postdoctoral fellowship, working on quorum sensing in bacteria. "I'm using a combination of transcriptomics, proteomics and metabolomics to understand these pathogenic changes better" he explains. "I end up with big spreadsheets of protein or gene IDs and trying to piece together which signaling pathways are involved in flipping to the pathogenic state". He has been on an introductory Unix course but is much more comfortable with GUIs than with the command line. "I just have a visual brain", he says.

Career timeline



Typical activities



Distribution of time between bench-work and computational work



Preference for using GUI vs command line



Drivers

- Understanding what makes a usually harmless bacterium pathogenic in the lungs of people with cystic fibrosis

Goals

- QA of -omics data
- Statistical analysis of data
- Data integration and pathway analysis

Pain points

- Lack of access to departmental compute farm
- Sporadic to non-existent access to bioinformatics support

Bioinformatics scientist

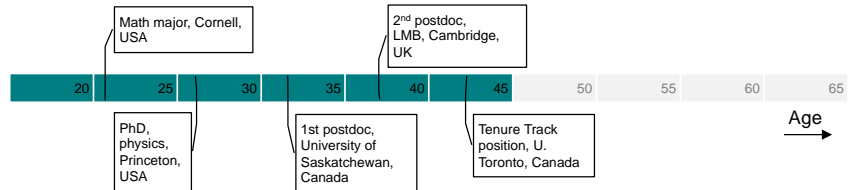
- Employ computational methods in order to advance the scientific understanding of living systems:
- Research scientist (purely computational or computational and lab-based)
- Bioinformatician (e.g. in a core facility or supporting an experimental group or department)

Martha (bioinformatics scientist)

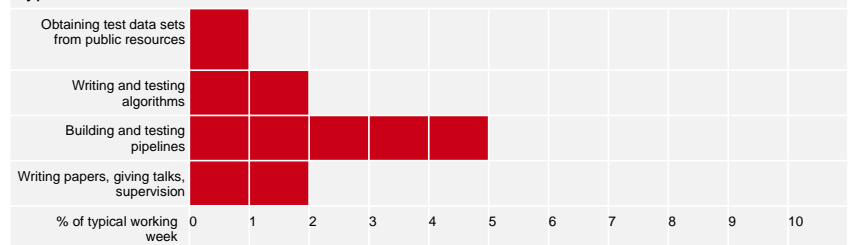


Martha is a senior bioinformatician in an international structural genomics consortium. Her biggest project is on predicting the functions of proteins whose structures have just been solved; she's building a structure-to-function prediction pipeline for the project. This is funded partly by the NIH and partly through industrial funding. She also has a fascination for predicting structure and usually has a student or two working on structural prediction projects.

Career timeline



Typical activities



Distribution of time between bench work and computational work



Preference using for GUI vs command line



Drivers

- Understanding the relationship between sequence, structure and function
- Application to target discovery and validation

Goals

- Create a structure-to-function pipeline for molecular biologists
- Predict structures de novo from models of similar, solved structures

Pain points

- Sometimes the guys in the lab expect her to fix their computers for them
- Finding students and more senior staff with adequate math

Bioinformatics engineer

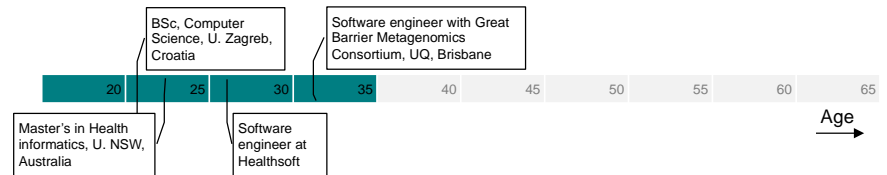
- Create novel computational methods needed by bioinformatics users and scientists
 - Software developer
 - Software engineer

Ivan (bioinformatics engineer)

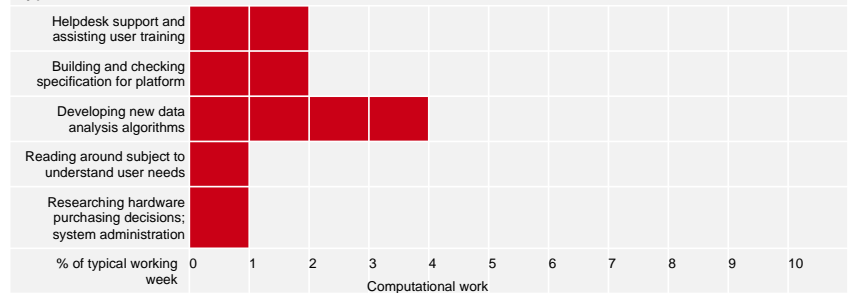


Ivan has just started a new support role in a bioinformatics core facility after working for an electronic health records company for four years. His main project is to develop a major new data integration platform for metagenomics data from coral reefs, but he also has to take his share of helpdesk queries on other projects. "I come from a computer science background, so talking the same language as the guys analysing the data is a bit of a challenge," he says. "I also didn't really figure that I'd be working on the GUI as well as the code – in my last job we had design folks to take care of that".

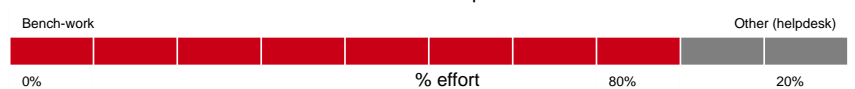
Career timeline



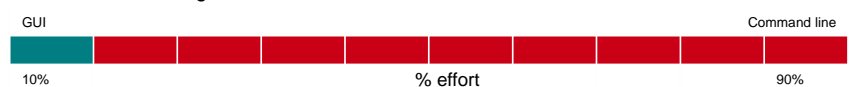
Typical activities



Distribution of time between bench-work and computational work



Preference for using GUI vs command line



Drivers

- Writing algorithms and developing a platform to support novel research
- Supporting other research projects in a busy academic department

Goals

- Define a spec that meets the needs of his users
- Prototype and build part of the platform
- Make sure his part of the project complements others

Pain points

- Has to work with another software engineer who isn't a team player
- Sometimes struggles to interpret what his users want

How can **you** use the competency profiles?

- Think about which persona best matches the people you want to train; if none of them ring true, consider developing your own personas
- Think about which competencies your trainees need to develop
- Find courses or materials that have similar aims: you might be able to make use of these

Acknowledgements



ISCB curriculum taskforce

Lonnie Welch, Russell Schwartz, Sarah Morgan, Bruno Gaeta, Alastair Kilpatrick, Daniel Mietchen, Benjamin Moore, Nicola Mulder, Mark Pauley, William Pearson, Predrag Radivojac, Naomi Rosenberg, Anne Rosenwald, Gabriella Rustici, Tandy Warnow, many others



LifeTrain

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HEE Clinical bioinformatics task & finish group

Tim Aitman, Chris Boustred, Mark Caulfield, Tom Clayton, Jonathan Colbourne, Ann Dalton, Val Davison, Andrew Devereau, Sian Ellard, Helen Firth, Jonathan Green, Georgina Hall, Patricia Oakley, Colin Pavelin, Chris Ponting, Imran Rafi, Anna Schuh, Anneke Seller, Stuart Sutherland, Janet Thornton, Ann-Marie Wright, Caroline Wright, many others

Breakouts

Group 1: User

Leads

- Celia
- Michelle

Group 2: Scientist

Lead

- Nicky

Group 3: Engineer

Leads

- Pedro
- Patricia

Group 4: Scientist

Lead

- Fran

Scenarios for breakouts

- Each breakout group will choose one scenario; we should ensure that we cover all three types of professional, but depending on the preferences of the audience we've got a bit of wiggle room.
- We have preselected leads for each group, and each group will need to select a scribe and a rapporteur.

Questions to address during breakouts

- Which competencies are needed for the scenario considered?
- What are the **three** most important competencies?
- Are you aware of/can you find appropriate training materials or courses from www.mygoblet.org/training-portal (or any other sources of bioinformatics training that you are aware of) that would meet these competency requirements?
- Is there anything that could be done to make the competency profiles more useful?

Reporting back

- The rapporteur has five minutes in which to report back to the group
- Tell us which scenario you chose and why
- Use slides, any other electronic means or flipcharts as audiovisual cues to address each of the questions.
- The lead for each breakout has been given a copy of these slides
- You will all be given a briefing document, including a blank competency profile

Feedback from competency breakouts



H3ABioNet

Pan African Bioinformatics Network for H3Africa



Current draft



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Examples of professionals in this role	Biocurator, physician, lab technician, ethicist	Computational biologist; molecular life scientist	Software developer, software engineer
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Design and implement a computer-based system, process, component, or program to meet desired needs in scientific environments.	N/A	N/A	Working knowledge
Evaluate the ability of a computer-based system, process, component, or	N/A	Working knowledge	Awareness

Bioinformatics user

- Didn't use either of the scenarios provided; used Leon's persona. Focused on someone who wants to know what tools are available and how to use them appropriately, especially to integrate different types of omics data.
- Were surprised to find that the most high priority competencies were the 'working knowledge' ones, not the 'specialist knowledge' ones
- A2/N: redundancy in description of competency
- C1/D: Overlap (use vs abilities)
- Clarification needed for...
- C1: Process/Component - define
- D: 'Techniques' - what is meant?
- J: 'Analyse' - wrong verb? Understand?
- K: Unclear - stating the obvious?
- Should these competencies be able to be used to form/contribute to a job description?

Bioinformatics research scientist

- Used the scenario provided
- Identified required competencies and provided input on how to reword more clearly
- Provided info on what was missing:
 - Basic biostats knowledge
 - Study design
 - Adaptability: changing fields
 - Critical analysis

Bioinformatics core facility scientist

- Felt that the scenario provided needed to be amended to be more realistic
- Identified which competencies a core facility scientist would require
- Identified that personal qualities of the individual would have a major impact on who they would choose to undertake the project in the scenario

Bioinformatics engineer

http://pvanheus.github.io/goblet_competencies/index.html/#/2

- Differentiated team leader competencies vs team member competencies
- Team leader needs to be a bioinformatics scientist; team members need to be bioinformatics engineers
- Identified missing competencies:
 - Project management
 - Interpersonal skills
- Identified possibly appropriate training materials for engineers from the GOBLET training portal

Requests to the ISCB curriculum TF

- Tighter definition of some competencies
- Addition of new competencies (see suggestions in V5)
- Eliminate redundant competencies
- For each role, distinguish between entry-level, established (e.g. 5 y into role) and senior (e.g. 15 years into role)
- Provide a minimal standard at lower levels, e.g. what's the minimum that should be in an undergrad or a master's course for each role?
- Organise into blocks, esp. personal qualities vs scientific and technical competencies
- Provide clearer guidance on how the competency profiles can be used to develop/rework training
- https://docs.google.com/spreadsheets/d/1hEvnrM4FGY2sx2EEynPRMehllw4_B-mGzYqTL8Vt7hk/edit?usp=sharing - V5 SA worksheet

What happens next

Cath to circulate the link to the TtT workshop delegates to sanity check accuracy



Combine with feedback from other workshops



Provide links to the latest version from the ISCB connect portal and the GOBLET website



Draft guidelines and circulate for input from the GOBLET and H3ABioNet communities

Thank you!

