(Bio)chemistry as Liberal Education

or

Why More Science with Less Arts and Humanities is a Really Bad Idea

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Imagination is more important than knowledge.
Albert Einstein

Only if we understand, will we care.
Only if we care, will we help.
Only if we help, shall we be saved.
Jane Goodall

What are the meaning and purpose of education?
What is Liberal Education?

What are the Liberal Arts?

What are the meaning and purpose of education?
The University of Salford, UK, Announces Plans to Close its School of the Humanities, Languages, and Social Sciences in Order “to secure the future of the university”

“...as we would no longer recruit, after 2013, to modern languages, linguistics and areas of politics and contemporary history (except postgraduate security studies programmes), the School of Humanities, Languages and Social Sciences would eventually be disestablished”.

Vice-Chancellor Martin Hall, as quoted in Salford culls courses ‘to secure future’ Times Higher Education 5 June 2013 | By John Morgan
President Philip issued a directive today to suspend all new admissions to five program areas – Classics, French, Italian, Russian, and Theatre.

From the University’s News Release,
“University at Albany Announces Measures to Rethink, Balance and Reallocate Resources in Face of Reduced State Fiscal Support,” October 1, 2010
Sources told THE that, internally, management said the decision was part of a drive to increase teaching income from the Higher Education Funding Council for England by switching to science, technology, engineering and mathematics (STEM) subjects.

A banding system operated by Hefce puts humanities subjects such as philosophy in band D, which receives the lowest funding.

Loss of philosophy at Middlesex raises fears for humanities
Times Higher Education
6 May 2010 | By John Morgan
On the Expectations Students Bring to Higher Education:
It’s the $$$, Copain.

Le second constat est l'importance qu'ils accordent à l'autonomie économique. Ils travaillent, ils consomment et le cégep ne sert plus qu’à acquérir un emploi bien rémunéré.

(The second thing is the importance they place on economic independance. They work, and they buy things, and CEGEP is just a means of finding a well-paying job. (My translation.))

Libre opinion - À la recherche de l'intelligence perdue
Xavier Brouilette
Le Devoir
June 7, 2011
The study of the humanities evolved during the 20th century “to focus almost entirely on personal intellectual development,” said Richard M. Freeland, the Massachusetts commissioner of higher education. “But what we haven’t paid a lot of attention to is how students can put those abilities effectively to use in the world.”

*For example?*

Patricia Cohen

*In Tough Times, The Humanities Must Justify Their Worth*

February 25, 2009

The New York Times
The study of the humanities evolved during the 20th century “to focus almost entirely on personal intellectual development,” said Richard M. Freeland, the Massachusetts commissioner of higher education. “But what we haven’t paid a lot of attention to is how students can put those abilities effectively to use in the world.”

Mr. Freeland is part of what he calls a revolutionary movement to close the “chasm in higher education between the liberal arts and sciences and professional programs.” The Association of American Colleges and Universities recently issued a report arguing the humanities should abandon the “old Ivory Tower view of liberal education” and instead emphasize its practical and economic value.

Patricia Cohen
In Tough Times, The Humanities Must Justify Their Worth
February 25, 2009
The New York Times
Sky-high tuition fees are charged by American colleges and universities to feed bloated administrations and ... faculty — some teaching in fields where there are far too few jobs relative to the number of students. The cost of tuition has fuelled growing discontent among unemployed and underemployed graduates saddled with enormous student debts and no way to pay them.
And for companies unable to find people to do skilled work, it means stymied growth that reduces Canadian productivity and prosperity. Such is the sad toll when publicly financed universities put “academic freedom” to teach whatever they choose ahead of the interests of their students, and the national economy.

Divisions between haves and have-nots begin with having skills – or not
Gwyn Morgan
...but the call for reallocation of resources to programs in demand generated real indignation. In response to statistics showing the majority of arts graduates either end up in low skill-level jobs, I was told that “there’s more to getting an education than turning out workers for corporations” *(as if my advocacy of programs focused on where the jobs are were part of some sort of a capitalist plot).*

Divisions between haves and have-nots begin with having skills – or not

Gwyn Morgan
The Humanities in Crisis? Not at Most Schools
Scott Saul, Associate Professor of English, Berkeley
The New York Times
Op-ed
July 3, 2013

–argues that students are still drawn to the humanities (even if they’re no longer majoring in them) in numbers that have been pretty constant over the past twenty years.
Steven Pinker, Professor of Linguistics, MIT (now Harvard)
The Blank Slate: The Modern Denial of Human Nature

Notes that, in fact, the arts are flourishing in society. Witness the enormous popularity of television drama, comedy, (reality), etc. shows, the availability and variety of music, the availability of film, novels, and so on. Actually, we’re surrounded by art.
OK – So there’s some debate
Maybe I’m overreacting.

Suppose I’m not.

What can STEM faculty do about it?

(Leaving aside, for the moment, whether STEM faculty ought to do something about it)
Hemoglobin: The Principal Oxygen-Carrying Protein in Blood
And the Nature of Scientific Truth-Claims – 1

It is tetrameric: there are 4 subunits – each subunit binds one $O_2$ molecule.
Scientific Truth Claims – 2:
Oxygenated and Deoxygenated Hemoglobin Exhibit Slightly Different Structures

Deoxy-Hb

Oxy-Hb

What are the meaning and purpose of education?
Scientific Truth-Claims – 3:
Hemoglobin Binds Oxygen “Cooperatively”

Oxygen binds poorly when its concentration is small. But, as oxygen concentration increases, its binding becomes increasingly favourable.

This behaviour suggests that early oxygen binding events increase the probability of subsequent oxygen binding events - this is an example of “allostery.”

What are the meaning and purpose of education?
Truth Claim 1:
The Koshland – Némethy – Filmer “Sequential” Model of Allostery

4 subunits
4 oxygen binding events

Each binding event causes deoxy $\rightarrow$ oxy structure shift in one subunit

Subunits change from deoxy $\rightarrow$ oxy state independently of each other, but:

The more oxy subunits there are, the more likely the remaining deoxy subunits are to bind oxygen.

Increasing probability to bind oxygen.

What are the meaning and purpose of education?
Truth Claim 2: The Monod – Wyman – Changeux “Concerted” Model of Allostery

4 subunits

Oxygen may bind to either the deoxy-state tetramer or the oxy-state tetramer.

There are no mixed structural states.

As long as the oxy-state tetramer binds oxygen more avidly than the deoxy-state tetramer, the oxy-state predominates at large pO2; the deoxy-state predominates at small pO2.

Increasing probability to bind oxygen.

What are the meaning and purpose of education?
On Complex Reasoning in Biochemistry:
Protein Folding – 1

Folding is the process by which a polymer of amino acids that is randomly sampling conformational space becomes a specific, compact, functional, 3D object.
On Complex Reasoning in Biochemistry:
Protein Folding – 2

Folding is:

Entropically favoured with respect to the conformational freedom of bulk water.
Entropically opposed with respect to the conformational freedom of the protein chain.
Enthalpically favoured with respect to protein – protein self interactions.
Enthalpically unpredictable with respect to protein – water interactions.

The habits of mind required to grasp protein folding are the same as those required to assess whether or not a cultural decline in the liberal arts is underway.

What are the meaning and purpose of education?
The best evidence for this is the shrinking number of tenured and tenure-track faculty and the corresponding rise of adjuncts, part-timers more akin to itinerant workers than to embedded professionals.

Tenured and tenure-track teachers now make up only 35 percent of the pedagogical workforce and “this number is steadily falling.”

Stanley Fish
The Last Professor
The New York Times
January 18, 2009
On Why STEM Professors Ought to Care – 2

“Bums in seats.”

Declining by Degrees.*

Tri-council funding.

What Have I Suggested?

A long tradition of liberal education is at risk of becoming entirely vocational in nature.

The risk is primarily brought about by the cultural privilege afforded to market imperatives.

The long term intellectual health of Western civilization is at stake.

The long term health of Western democracy is at stake.

STEM faculty are at risk just like everyone else.
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Drs. Richard Arum and Josipa Roska
authors of “Academically Adrift: Limited Learning on College Campuses”
What are the meaning and purpose of education?