

# A Conceptual Framework for the Core Concept of Cell-Cell Communications



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## Overview

Cell-cell communications was selected by faculty one of the three most important core concepts in physiology (Michael & McFarland, 2011). We have unpacked this concept to create a conceptual framework, the CC-CF. We established the validity of the CC-CF through a survey sent to physiology faculty. The CC-CF can be used to guide teaching and learning. The next step will be to continue validating the CF with input from additional physiology instructors at professional meetings.

## Cell-Cell Conceptual Framework Development

A core concept of "information" was defined in Michael et al. (2009). This core concept was initially outlined by J Michael and then unpacked by sub-set of our project team (H Model, MP Wenderoth & J McFarland). The entire project team (Cliff, McFarland, Michael, Modell, Wenderoth & Wright) then edited the initial unpacking and developed the first draft of the CC-CF in October 2011. J Michael adapted this CC-CF in November 2011 as a "Core Concepts of Endocrine Signaling" which was used with a class of first year medical students. The CC-CF underwent several rounds of editing and finally, in Fall 2015, was vetted with by other physiology faculty via SurveyMonkey. This survey established content and construct validity. We define content validity as "accurate and appropriate for undergraduate physiology" and construct validity as "important and relevant for undergraduate physiology" (McFarland et al., in press).

## Surveying Physiology Faculty

Invitations to participate in the survey were sent to physiology faculty who had participated in past surveys (Michael & McFarland 2011). 37 completed surveys were collected.

Respondents were presented with the 51 items making up the CF and asked to rate each item on a scale from 1 (Not Important) to 5 (Essential). They were also asked to comment on any errors that they uncovered and to suggest additional items that were needed. The responses submitted were tabulated. Three questions about this CF were asked:

- (1) Do faculty responses confirm content validity?
- (2) Is the importance of an item in the CF determined, in part, by its position in the hierarchy?
- (3) Are all of the main ideas making up the CF equally important?

This QR code will take you to our website where you will find our abstract and a link to the entire Cell-Cell Conceptual Framework (CC-CF).

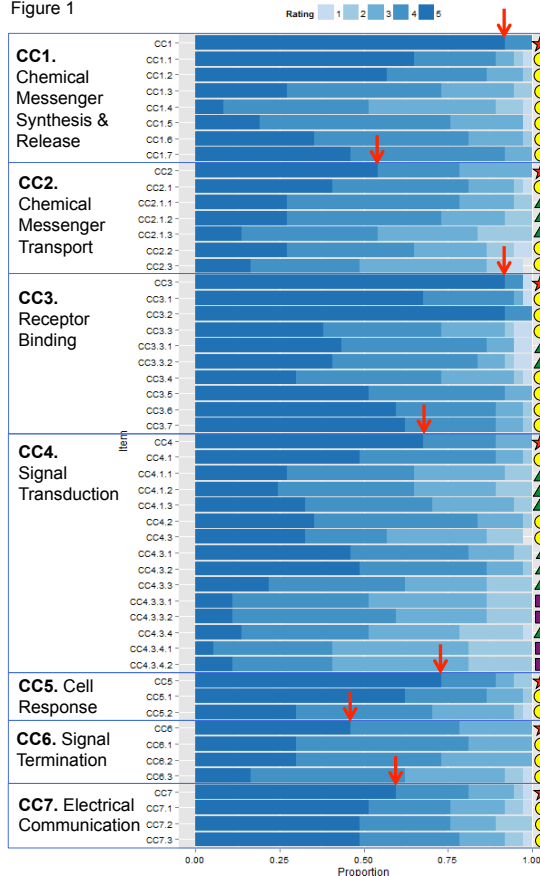
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## The Cell-Cell Communications Conceptual Framework

The CC-CF is made up of 7 main ideas (critical components, Level 0: CC1-CC7 ★) and hierarchically arranged constituent ideas (Level 1, e.g. CC1.1 ●). In all, there are 51 items in the CC-CF, at 4 levels (Level 2, e.g. CC4.3.3 ▲; Level 3, e.g. CC4.3.3.2 ■). *The handouts that are available (& the website [physiologyconcepts.org](http://physiologyconcepts.org)) present the entire CC-CF and the responses to the survey.*

Figure 1



## Results of the Survey

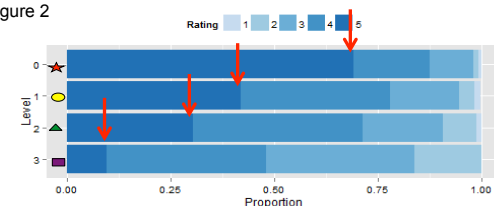
(1) Content validity

The mean and SD were calculated for each item in the CC-CF. The means ranged from 3.46 (between *Important* and *Moderately Important*) to 4.92 (slightly less than *Essential*). No more than 2 respondents rated any item as *Not Important* and all items were rated as *Essential* by at least two respondents.

(2) Position in the hierarchy

The ratings for all of the items at each of the four levels of the CC-CF were counted and a bar graph drawn (Figure 2). It is clear on visual inspection that those items lower in the hierarchy were deemed less important than those higher up.

Figure 2



(3) Importance of the main ideas

The ratings for all of the 7 main ideas are displayed in Figure 1, red arrows point to proportion of ratings as *Essential*. The 7 main ideas of the CC-CF are NOT equally important.

## Implications for Teaching/Learning Physiology

We have produced a conceptual framework for the important core concept of Cell-Cell Communications judged by faculty to be valid. However, it is also clear that not every item in this CF will be deemed to be equally important. The student population being addressed, the particular course involved, the learning objectives of the instructor, and the career goals of the students are all factors that must be taken into account when using the conceptual framework to help student develop and appropriate understanding of physiology.

## References

- Michael, Modell, McFarland & Cliff. The "core principles" of physiology: What should students understand? *Adv Physiol Educ* 33:10-15, 2009.
- Michael & McFarland. The core principles ("big ideas") of physiology: Results of faculty surveys. *Adv Physiol Educ* 35:336-341, 2011.
- McFarland, Wenderoth, Michael, Cliff, Wright & Modell. A Conceptual Framework for Homeostasis: Development and Validation, (In press), *Adv Physiol Educ*