Implications of Core Brain Function for the High School Remedial Algebra or College Developmental Algebra Curriculum & Pedagogy

Description:
Learning is about creating new neural associations in the brain. But what you learn is meaningless if you do not understand it or it is not stored to long-term memory. Fortunately, science is clear about the neural processes the brain uses to create long-term memory and how it understands something new. The question is: Does our classroom practice and curriculum implement what neuroscientists know will create understanding and long-term memory? This workshop will offer ideas and examples from high school remedial algebra or college developmental algebra on how to implement the brain science and provide reasons why it will cause learning with understanding and long-term memory with recall.

Typical Schedule:
8:30 am – 8:45 am
Welcome

Session 1: 8:45 am – 10:20 am
A. What we should know about the core brain function of neural associations
B. Reactions to neural associations
C. The neuroscience of visualizations and pattern generalizing

Session 2: 10:30 am – 12:00 noon
A Reactions to visualizations and pattern generalizing
B. Developmental Algebra at your college/Remedial Algebra at your high school

LUNCH: Noon – 1:00 PM

Session 3: 1:00 PM – 2:20 PM
Application of neuroscience in the remedial/developmental algebra classroom – Part 1

Session 4: 2:30 PM – 3:30 PM
Application of neuroscience in the remedial/developmental algebra classroom – Part 2

Speaker:
Ed Laughbaum is an emeritus professor of mathematics from Columbus State Community College, and recently retired as the director of the Ohio Early College Mathematics Placement Testing Program and the College Short Course Program in the mathematics department at The Ohio State University. He is presently interested in the implications of basic brain processes on understanding and long-term memory/recall as related to the teaching of remedial algebra with handheld technology. Ed has authored over 65 publications and he has given over 270 presentations at state, national, and international conferences in 12 countries. Ed has taught mathematics for 43 years, and has won numerous teaching awards including the Presidential Award and the Mathematics Excellence Award from the American Mathematical Association of Two-Year Colleges.

Ed's professional work included numerous committees and task forces at the Ohio Board of Regents. He represented the Ohio DOE on the Achieve Algebra II End-of-Course Exam as a member of the Item Review, Data Review and Assessment Committees. He has been the editor of the *Ohio Journal of School Mathematics* for the last 13 years. He was the director and instructor of the AMATYC Outer Banks Summer Institute from 1999 to 2008.

Typical Table of Contents

Additional days include other functions, concepts, and procedures.

Connections – An Extended Example (pp. 1 – 13)

Function representation connected to contextual situations

For each set below, describe the shape of the relationship, when graphed, and identify when it is increasing or decreasing.

Below is the data showing the amount of water left in a 40 quart (1280 ounces) tree watering bag as time passes. The landscape guy set the drip rate for 16 ounces per hour. Time is in hours. Create interactive data by running the program WDRIP40A.

t	0	1	2	3	4	5	6	12	18	24	30	36	42	48	54	60	66
A	1280	1264	1248	1232	1216	1200	1184	1088	992	896	800	704	608	512	416	320	224

Below are the possible wages for a server working at the Blue Point Café in Duck, NC. He is paid a salary plus he earns an average of $3.50 in tips per person served. His wages depend on how many people he serves during the week. (Run the program BLUEPT58 for the data to create interactive data.)

Persons	10	15	20	25	30	35	40	45	50	55
Wages	75.00	92.50	110.00	127.50	145.00	162.50	180.00	197.50	215.00	232.50

Below is data showing how charges from the electric company depend on the number of kilowatt-hours of electricity used. (Run the program ELECT59 to create interactive data.)

kWh	200	400	600	800	1000	1200	1400	1600	1800	2000
Charge	23.82	38.14	52.47	66.79	81.11	95.43	109.75	124.08	138.4	152.72

The table below is data for the relationship between public education expenditures (in billions) in the United States with time in years. (Run the program EDUEXP59 to create interactive data.)

Time	1940	1950	1960	1970	1980	1990	2006
Expenses	3.3	8.9	23.9	68.5	165.6	377.5	900

Source: U.S Department of Education, National Center for Educational Statistics

Below is the data showing the amount of saline solution left in a 1000 *ml* I. V. drip bag as time passes. The nurse set the drip rate for 4 *ml* per minute. Time is in minutes. Create interactive data by running the program WDRIP39.

t	0	5	10	15	20	25	30	40	50	60	70	80	90	100	110	120	140	160	180	200	220
A	1000	980	960	940	920	900	880	840	800	760	720	680	640	600	560	520	440	360	280	200	120

Below is the data showing the amount of saline solution left in a 500 *ml* I. V drip bag as time passes. The nurse set the drip rate for 4 *ml* per minute. Time is in minutes. Create interactive data by running the program WDRIP39A.

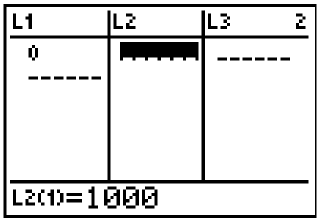
t	0	5	10	15	20	25	30	40	50	60	70	80	90	100	110	120	125
A	500	480	460	440	420	400	380	340	300	260	220	180	140	100	60	20	0

Below is the data showing the amount of water left in a 12 quart (384 ounces) tree watering bag as time passes. The landscape guy set the drip rate for 3 ounces per hour. Time is in hours. Create interactive data by running the program WDRIP40.

t	0	1	2	3	4	5	6	12	18	24	30	36	42	48	54	60	66
A	384	381	378	375	372	369	366	348	330	312	294	276	258	240	222	204	186

Connecting symbolic form to graphic and numeric forms, variable, expression, function, increasing/decreasing behavior, and the zero of a function

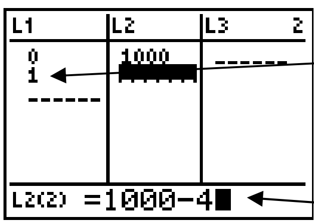
A 1000 *ml* I.V. drip bag is attached to a patient; the nurse set the drip rate at 4 *ml* per minute.



Question: If 0 minutes have passed since hanging the I.V. drip, how much fluid remains in the bag?

Student response: Since the bag has 1000 *ml* to start, at time 0 it must still contain 1000 *ml*.

Why asked: The idea is to build a pattern so that students will generalize it. When students generalize, it forms a memory and establishes understanding. (Hawkins, 128, 89)



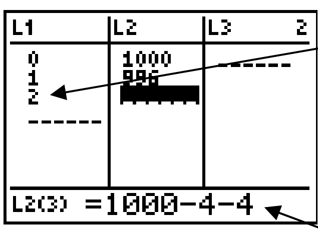
Question: If 1 minute has passed since starting the I.V. drip, how much fluid remains in the bag?

Student response: 996 *ml*.

How did you find that?

Student response: 1000 – 4.

It is crucial that students see the edit line as the pattern is being developed.



Question: If 2 minutes have passed since starting the I.V. drip, how much fluid remains in the bag?

Student response: 992 *ml*.

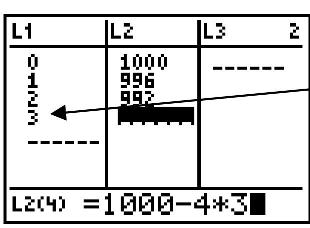
Question: How did you find that?

Student response: (996 – 4).

Question: Ok, and where does the 996 come from?

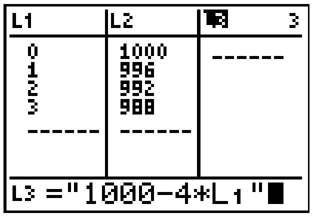
Student response: (1000 – 4) – 4.

Why asked: To build a table like students have seen before and to build the generalized pattern of the data in numeric form.

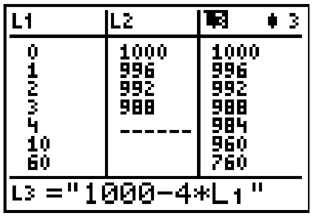


Question: If 3 minutes have passed since starting the I.V. drip, how much fluid remains in the bag?

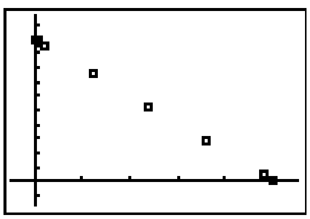
Typically, students answer 1000 – 4 – 4 – 4 because the average brain generalizes on the third iteration, but the teacher directs them to 1000 − 4×3. At this point, we will try another couple time values to confirm that we have the correct numeric generalization.

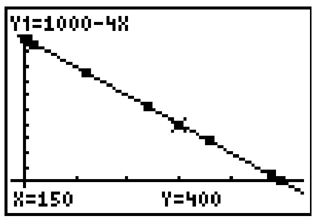


Once the numerical form of the model has been generalized, the next question to ask is how much fluid remains in the bag for *t* (or L1) minutes. Having taught this process in 50-75 classes, the author has never had a class not generalize the symbols at this point. There is no need to draw attention to the values in L1, nor are any other clues needed. **But ask students if 1000 – 4L_1 is the same as 1000 + (-4L_1). Ask if 1000 – 4L_1 is the same as -4L_1 + 1000.**



The power of symbols is demonstrated by asking how much fluid remains after 10 minutes, or 60 minutes, or maybe 120 minutes. We have now connected the mathematical concepts of variable, expression, increasing/decreasing (below), function, and function representation, to an I. V. drip. Ask why the coefficient of L_1 is negative.





To make connections among representations, graph the data and the model. Use trace and scroll along the data and then jump to the model for a variety of data points. Discuss increasing/decreasing. Trace to the zero (when the bag is empty). This will prime the students for a lesson on zeros at a later time.

The action of tracing on this model with a graphing calculator provides the simultaneous stimuli the brain needs to make connections among three representations of a function. In addition, this external stimulus connects the function representations to the real-world context giving the otherwise abstract mathematics a meaning (Pinker, 1997). This improves understanding of the concepts.

Additional days include other functions, concepts, and procedures.