Poetry-with-Mathematics Workshop (7-29-2012) HANDOUT

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A self-portrait / bio of JoAnne Growney using seven of her favorite lines of poetry:

I lift mine eyes unto the hills
How does your garden grow?
I make my magic / of forgotten things
I learn by going where I have to go
Will go on prancing, proud and unafraid
As truth can live with right and wrong
Rage, rage against the dying of the light

(This poem formed of lines from various sources is called a **cento**. These lines are from the *Book of Psalms*, *Mother Goose*, Muriel Rukeyser, Theodore Roethke, Adrienne Rich, E E Cummings, Dylan Thomas.)

Contents of Handout

List of Workshop Activities

1. Consider the samples -- together we will read them aloud.

2. Time to write:
Use the raw materials herein to experiment with several of these types of poems – a poem that uses numbers, a limerick, square, snowball, Fib, or a cento (perhaps built with theorems).

3. Read sample poems aloud to each other.

4. More time to write, ending with composition and reading of a group poem -- an Exquisite Corpse.

2 Limericks and poems shaped by numbers

Limerick:
5 line poem: lines 1, 2, and 5 rhyme
and lines 3 and 4 rhyme.
Usually 3 accented syllables in lines 1, 2, and 5
and 2 accented syllables in lines 3 and 4

Sample limericks:

When I multiply 5 times 3
the answer always will be—
while we are alive --
same as 3 times 5.
We have commutativity.

When it becomes the right time
to factor one hundred and nine
I find no divisor
but 1, and grow wiser--
conclude – one-oh-nine is prime

Alice Silverberg

To Harvard, then Princeton, then seen
on the west coast at UC-Irvine.
She'll take secrets and dress
them in codes one can't guess,
helped NUMB3RS get to TV screen.

Annalisa Crannell

Of math-art connections she'll tell—
and she helps students learn to write well.
Dynamic systems
are among her passions;
in doing-more-with-less she excels!

Poems shaped by syllable count:
Squares, Snowballs, Fibs

A **syllable- square poem** has the same number of lines
as it has syllables per line.

Verify a statement
S (about n) is true
when n is 1, then prove
its truth for n implies
its truth for n+1--
prove S by induction.

A **growing/melting syllable-snowball poem** increases
or decreases the syllable count by 1 as we move
to the next line.

Numbers

One
added
forever,
joined by zero,
paired to opposites—
these build the integers,
base for construction of more
new numbers from old: ratios,
radical roots and transcendentals,
transfinite cardinals—conceptions bold!

The Math-Poet

Her
research
is in rings--
coherent rings,
flat ideals, and on.
But Sarah Glaz goes far
past mathematics, into
poetry -- writes of calculus
and e and lots of other things. She's
organizing a poetry
reading at Bridges Math-Art
Conference at Towson
University
on Saturday,
on July
twenty-
eight.

A **Fib** is a poem whose lines have syllable-counts that
follow the pattern of the Fibonacci numbers:
1, 1, 2, 3, 5, 8, . . .

If
two
angles
both are right
angles then they are
supplements and are congruent.

Math
and
also
poetry—
my favorite things.
Both extend me beyond myself.

3 NUMBER POEMS by Etheridge Knight and Wislawa Szymborska (on back)

Etheridge Knight began writing poetry while an inmate at the Indiana State Prison and published his first collection, *Poems from Prison,* in 1968. His poem "The Idea of Ancestry" shows us what a man in prison finds time to count:

The Idea of Ancestry by Etheridge Knight

1

Taped to the wall of my cell are 47 pictures: 47 black
faces: my father, mother, grandmothers (1 dead), grand-
fathers (both dead), brothers, sisters, uncles, aunts,
cousins (1st and 2nd), nieces, and nephews. They stare
across the space at me sprawling on my bunk. I know
their dark eyes, they know mine. I know their style,
they know mine. I am all of them, they are all of me;
they are farmers, I am a thief, I am me, they are thee.

I have at one time or another been in love with my mother,
1 grandmother, 2 sisters, 2 aunts (1 went to the asylum),
and 5 cousins. I am now in love with a 7-yr-old niece
(she sends me letters in large block print, and
her picture is the only one that smiles at me).

I have the same name as 1 grandfather, 3 cousins, 3 nephews,
and 1 uncle. The uncle disappeared when he was 15, just took
off and caught a freight (they say). He's discussed each year
when the family has a reunion, he causes uneasiness in
the clan, he is an empty space. My father's mother, who is 93
and who keeps the Family Bible with everbody's birth dates
(and death dates) in it, always mentions him. There is no
place in her Bible for "whereabouts unknown."

2

Each fall the graves of my grandfathers call me, the brown
hills and red gullies of mississippi send out their electric
messages, galvanizing my genes. Last yr/like a salmon quitting
the cold ocean-leaping and bucking up his birth stream/I
hitchhiked my way from LA with 16 caps in my pocket and a
monkey on my back. And I almost kicked it with the kinfolks.
I walked barefooted in my grandmother's backyard/I smelled the old
land and the woods/I sipped cornwhiskey from fruit jars with the men/
I flirted with the women/I had a ball till the caps ran out
and my habit came down. That night I looked at my grandmother
and split/my guts were screaming for junk/but I was almost
contented/I had almost caught up with me.
(The next day in Memphis I cracked a croaker's crib for a fix.)

This yr there is a gray stone wall damming my stream, and when
the falling leaves stir my genes, I pace my cell or flop on my bunk
and stare at 47 black faces across the space. I am all of them,
they are all of me, I am me, they are thee, and I have no children
to float in the space between.

"The Idea of Ancestry" is taken from *The Essential Etheridge Knight*, (Univ. PittsburghPress, 1986.

4 NUMBER POEMS

Polish poet Wislawa Szymborska (1923-2012) won the Nobel Prize in Literature in 1996. She has written several poems that involve numbers or other mathematical imagery. For more samples, visit the February 2, 2012 entry at http://poetrywithmathematics.blogspot.com

The Terrorist, He's Watching by Wislawa Szymborska (1923-2012)

The bomb in the bar will explode at thirteen twenty.
Now it's just thirteen sixteen.
There's still time for some to go in,
and some to come out.

The terrorist has already crossed the street.
The distance keeps him out of danger,
and what a view—just like the movies:

A woman in a yellow jacket, she's going in.
A man in dark glasses, he's coming out.
Teenagers in jeans, they're talking.
Thirteen seventeen and four seconds.
The short one, he's lucky, he's getting on a scooter,
but the tall one, he's going in.

Thirteen seventeen and forty seconds.
That girl, she's walking along with a green ribbon in her hair.
But then a bus suddenly pulls in front of her.
Thirteen eighteen.
The girl's gone.
Was she that dumb, did she go in or not,
we'll see when they carry them out.

Thirteen nineteen.
Somehow no one's going in.
Another guy, fat, bald, is leaving, though.
Wait a second, looks like he's looking for something in his pockets and
at thirteen twenty minus ten seconds
he goes back in for his crummy gloves.

Thirteen twenty exactly.
This waiting, it's taking forever.
Any second now.
No, not yet.
Yes, now.
The bomb, it explodes.
Wislawa Szymborska

from *View with a Grain of Sand: Selected Poems* (Harcourt Brace, 1993);
translated by Stanislaw Baranczak and Clare Cavanagh.

Information about Incarceration (esp. black men).

One source: "The Caging of America" by Adam Gopnik. THE NEW YORKER January 30 2012 PP 72-77. For most privileged, professional people, the experience of confinement is a mere brush, encountered after a kid's arrest, say. For a great many poor people in America, particularly poor black men, prison is a destination that braids through an ordinary life, much as high school and college do for rich white ones. More than half of all black men without a high-school diploma go to prison at some time in their lives. Mass incarceration on a scale almost unexampled in human history is a fundamental fact of our country today—perhaps *the* fundamental fact, as slavery was the fundamental fact of 1850. In truth, there are more black men in the grip of the criminal-justice system—in prison, on probation, or on parole—than were in slavery then. Over all, there are now more people under "correctional supervision" in America—more than six million—than were in the Gulag Archipelago under Stalin at its height. That city of the confined and the controlled, Lockuptown, is now the second largest in the United States.

from Wikipedia: Only approximately 12%-13% of the American population is African American, but they make up 40.1% of the almost 2.1 million male inmates in jail or prison (U.S. Department of Justice, 2009).

From http://www.prisonsucks.com/ Incarceration is not an equal opportunity punishment. On December 31, 2005, there were 2,193,798 people in U.S. prisons and jails. The United States incarcerates a greater share of its population, 737 per 100,000 residents, than any other country on the planet. But when you break down the statistics you see that incarceration is not an equal opportunity punishment.

U.S. incarceration rates by race, June 30, 2006:

- **Whites:** 409 per 100,000 **Latinos:** 1,038 per 100,000 **Blacks:** 2,468 per 100,000

Gender is an important "filter" on the who goes to prison or jail, June 30, 2006:

- **Females:** 134 per 100,000 **Males:** 1,384 per 100,000

Look at just the males by race, and the incarceration rates become even more frightening, June 30, 2006:

- **White males:** 736 per 100,000 **Latino males:** 1,862 per 100,000 **Black males:** 4,789 per 100,000

If you look at males aged 25-29 and by race, you can see what is going on even clearer, June 30, 2006:

- **For White males ages 25-29:** 1,685 per 100,000. **For Latino males ages 25-29:** 3,912 per 100,000.
- **For Black males ages 25-29:** 11,695 per 100,000. (That's 11.7% of Black men in their late 20s.)

Or you can make some international comparisons:

South Africa under Apartheid was internationally condemned as a racist society.

- **South Africa under apartheid (1993), Black males:** 851 per 100,000
- **U.S. under George Bush (2006), Black males:** 4,789 per 100,000

From *The Washington Post* (front page article by Joel Achenbach, 7-25-2012) **with reference to the recent Colorado rampage:** The United States is a less violent country than it was two decades ago. The homicide rate, which hit a peak in the early 1990s at about 10 per 100,000 has been cut in half, to a level not seen since the 1960s. . . . . The United States experienced 645 mass murder events – killings with at least 4 victims – between 1976 and 2010. . . The US homicide rate of roughly 5 per 100,000 people is about 3 times that of Canada, about 4 times that of Australia, nearly 5 times Britain's rate and about 12 times the rate in Japan. The US rate is also roughly 5 times that of China.

Math definitions (From MATH GLOSSARY for Cut the Knot: http://www.cut-the-knot.org/glossary/atop.shtml)

A *circle* is a geometric shape - a set of points - consisting of points equidistant from a given point, the center of the circle. The common distance of the points on the circle to its distance is called the *radius* of the circle.
Closed interval is a piece of a straight line that includes its endpoints. On the number line, *closed intervals* [a, b] are defined as $\{x: a \le x \le b\}$. Closed intervals are closed sets.
Completeness. There are at least three distinct notions of *completeness*. **Axiomatic completeness**.
An axiomatic theory is *complete* if every syntactically correct statement in the theory can be proven either right or wrong.
Graph's completeness. A graph is *complete* if any two of its vertices are connected by exactly one edge. A complete graph with N vertices is often denoted as K_N. **Metric completeness.** A metric space is *complete* if all Cauchy sequences of its elements converge. The ***absolute value*** is defined for real and complex numbers. For real numbers, the absolute value coincides with the number itself if the latter is either positive or zero. The absolute value of a negative number is obtained by multiplying the number by -1, i.e. by changing its sign. The absolute value of a number r is denoted $|r|$. Therefore, $|r| = r$ for $r \ge 0$ and $|r| = -r$ for negative r. In other words, $|r|$ is the distance from number r to the origin. In this form, the definition applies to complex numbers that are identified with points in the plane. **Perfect numbers** Every number n is divisible by at least 1 and n. The sum of all divisors of n is called $\sigma(n)$. n is perfect if $\sigma(n) = 2n$. The numbers for which $\sigma(n) < 2n$ are known as *deficient*. The numbers for which $\sigma(n) > 2n$ are called *abundant*.

6 Material for poems

Properties and Theorems:

Reflexive Property	A quantity is congruent (equal) to itself. a = a
Symmetric Property	If a = b, then b = a.
Transitive Property	If a = b and b = c, then a = c.
Addition Postulate	If equal quantities are added to equal quantities, the sums are equal.
Subtraction Postulate	If equal quantities are subtracted from equal quantities, the differences are equal.
Multiplication Postulate	If equal quantities are multiplied by equal quantities, the products are equal. (also Doubles of equal quantities are equal.)
Division Postulate	If equal quantities are divided by equal nonzero quantities, the quotients are equal. (also Halves of equal quantities are equal.)
Construction	Two points determine a straight line.
Construction	From a given point on (or not on) a line, one and only one perpendicular can be drawn to the line.

Right Angles	All right angles are congruent.
Straight Angles	All straight angles are congruent.
Congruent Supplements	Supplements of the same angle, or congruent angles, are congruent.
Congruent Complements	Complements of the same angle, or congruent angles, are congruent.
Linear Pair	If two angles form a linear pair, they are supplementary.
Vertical Angles	Vertical angles are congruent.
Triangle Sum	The sum of the interior angles of a triangle is 180º.
Exterior Angle	The measure of an exterior angle of a triangle is equal to the sum of the measures of the two non-adjacent interior angles. The measure of an exterior angle of a triangle is greater than either non-adjacent interior angle.

Base Angle Theorem (Isosceles Triangle)	If two sides of a triangle are congruent, the angles opposite these sides are congruent.
Base Angle Converse (Isosceles Triangle)	If two angles of a triangle are congruent, the sides opposite these angles are congruent.

Side-Side-Side (SSS) Congruence	If three sides of one triangle are congruent to three sides of another triangle, then the triangles are congruent.
Side-Angle-Side (SAS) Congruence	If two sides and the included angle of one triangle are congruent to the corresponding parts of another triangle, the triangles are congruent.
Angle-Side-Angle (ASA) Congruence	If two angles and the included side of one triangle are congruent to the corresponding parts of another triangle, the triangles are congruent.
Angle-Angle-Side (AAS) Congruence	If two angles and the non-included side of one triangle are congruent to the corresponding parts of another triangle, the triangles are congruent.
Hypotenuse-Leg (HL) Congruence (right triangle)	If the hypotenuse and leg of one right triangle are congruent to the corresponding parts of another right triangle, the two right triangles are congruent.
CPCTC	Corresponding parts of congruent triangles are congruent.
Angle-Angle (AA) Similarity	If two angles of one triangle are congruent to two angles of another triangle, the triangles are **similar.**
SSS for Similarity	If the three sets of corresponding sides of two triangles are in proportion, the triangles are similar.
SAS for Similarity	If an angle of one triangle is congruent to the corresponding angle of another triangle and the lengths of the sides including these angles are in proportion, the triangles are similar.
Side Proportionality	If two triangles are **similar**, the corresponding sides are in proportion.
Mid-segment Theorem	The segment connecting the midpoints of two sides of a triangle is **parallel** to the third side and is half as long.
Sum of Two Sides	The sum of the lengths of any two sides of a triangle must be greater than the third side
Longest Side	In a triangle, the longest side is across from the largest angle. In a triangle, the largest angle is across from the longest side.
Altitude Rule	The **altitude** to the hypotenuse of a right triangle is the mean proportional between the segments into which it divides the hypotenuse.

Material for poems

Theorems (from http://www.quora.com/Which-are-the-most-beautiful-mathematical-theorems-and-why)

The Pythagorean Theorem (Geometry, Pythagoras): In any right-angle triangle, the area of the square whose side is the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares of the other two sides.

Euclid's Theorem of the Infinitude of Primes (Number Theory, Euclid) There are infinitely many primes.

It is hard to imagine any theorem that can be more succinctly expressed than Euclid's. The theorem is obviously of fundamental importance in Number Theory.
The Minimax Theorem (Game Theory, John von Neumann): For every two-person, zero-sum game with finite strategies, there exists a value V and a mixed strategy for each player, such that (a) Given player 2's strategy, the best payoff possible for player 1 is V, and (b) Given player 1's strategy, the best payoff possible for player 2 is −V.

The Brouwer Fixed Point Theorem (Topology, Luitzen Brouwer): Every continuous function *f* from a convex compact subset *K* of a Euclidean space to *K* itself has a fixed point.

Cauchy's Residue Theorem (Complex Analysis, Augustin-Louis Cauchy): Suppose *U* is a simply connected open subset of the complex plane, and $a_1, \ldots, a_n$ are finitely many points of *U* and *f* is a function which is defined and holomorphic on *U* \ $\{a_1, \ldots, a_n\}$. If γ is a rectifiable curve in *U* which bounds the a_k, but does not meet any and whose start point equals its endpoint, then the integral of f along a closed contour enclosing the points $a_1, \ldots, a_n$ is equal to the sum of the residues of f at the points $a_1, \ldots, a_n$ (up to a constant).

Fourier's Theorem (Function Theory, Joseph Fourier): If a function $f(x)$ satisfies the Dirichlet conditions on the interval $-\pi < x < \pi$, then its Fourier series converges to $f(x)$ for all values of x in this interval at which $f(x)$ is continuous, and approaches $1/2[f(x + 0) + f(x - 0)]$ at points at which $f(x)$ is discontinuous (where $f(x - 0)$ is the limit on the left of f at x and $f(x + 0)$ is the limit on the right of f at x).

The Halting Theorem (Computability Theory, Alan Turing): There is no general algorithm to solve the halting problem : for *all* possible program-input pairs (i.e. the halting problem is algorithmically undecidable).

Cantor's Theorem (Set Theory/Transfinite Analysis, Georg Cantor): For *any* set *A*, the set of all subsets of *A* (the power set of *A*, denoted P(*A*)) has a strictly greater cardinality than *A* itself, i.e. $|A| < |P(A)|$

Schubert's Prime Knot Factorization Theorem (Knot Theory, Horst Schubert) Let K be a nontrivial knot. Then K can be factored into prime knots and any two prime factorings of K are the same up to order.

Gödel's Incompleteness Theorems (Mathematical logic/Metamathematics, Kurt Godel): The first incompleteness theorem states that no consistent system of axioms whose theorems can be listed by an "effective procedure" (essentially, a computer program) is capable of proving all facts about the natural numbers. For any such system, there will always be statements about the natural numbers that are true, but that are unprovable within the system. The second incompleteness theorem states that if such a system is also capable of proving certain basic facts about the natural numbers, then one particular arithmetic truth the system cannot prove is the consistency of the system itself.

Fundamental Theorem of Algebra (from Wolfram Alpha) Every polynomial equation having complex coefficients and degree ≥ 1 has at least one complex root. This theorem was first proven by Gauss. It is equivalent to the statement that a polynomial $P(z)$ of degree n has n values z_i (some of them possibly degenerate) for which $P(z_i) = 0$. Such values are called polynomial roots.

Fundamental Theorem of Arithmetic . .. The fundamental theorem of arithmetic states that every positive integer (except the number 1) can be represented in exactly one way apart from rearrangement as a product of one or more primes (Hardy and Wright 1979, pp. 2-3).

Euclid's Theorems A theorem sometimes called "Euclid's first theorem" or Euclid's principle states that if p is a prime and $p \mid ab$, then $p \mid a$ or $p \mid b$ (where $\mid$ means divides). A corollary is that $p \mid a^n \Rightarrow p \mid a$ (Conway and Guy 1996). The fundamental theorem of arithmetic is another corollary (Hardy and Wright 1979).

8 Material for poems

Women of Mathematics: FROM http://www.agnesscott.edu/lriddle/women/women.htm

Lisa Sauermann, a resident of Germany, is ranked No. 1 in the International Mathematical Olympiad Hall of Fame, having won four gold medals (2008-2011) and one silver medal (2007) in this international mathematics competition. She received a perfect score of 42 on the 2011 exam, the only participant to do. She is currently a student at the University of Bonn.

Shijie (Joy) Zheng, a member of the class of 2011 at Phillips Exeter Academy, Exeter, NH, is the only girl among the twelve winners of the 40th U.S.A. Mathematical Olympiad. The USAMO is a six-question, two-day, nine-hour essay/proof examination with problems requiring pre-calculus methods to be solved. Joy also won the The Wendy Ravech-Akamai Mathematics Scholar Award, presented for the first time at the Mathematical Olympiad Awards Ceremony that took place on June 6 at the Carnegie Institution for Science in Washington, D.C. She received a gold medal for the U.S. team at the 2010 China Girls Mathematics Olympiad.

Hypatia of Alexandria lived approximately during the years 370-415 AD. She was the daughter of Theon of Alexandria who was a teacher of mathematics at the Museum of Alexandria in Egypt. She studied with her father and taught in the Neoplatonist school of philosophy. Though little historical evidence exists about her, it is believed that she wrote on mathematics, astronomy, and philosophy. She was known to dress as a scholar or teacher instead of in women's clothing. She drove her own chariot which was not considered a norm for women's behavior. As a woman who did not know her place and one who espoused heretical teachings in astronomy regarding the motion of planets and the heavenly bodies, the Christian Bishop Cyril incited a mob to riot and they attacked her and murdered her.

Alicia Boole Stott was the daughter of George Boole (known for Boolean logic). She had a special intuition that helped her visualize objects in the fourth dimension developing a special interest in four-dimensional hypercubes also known as tesseracts. A woman who lived 1860-1940, she was not afforded a formal education in mathematics. Married with two children, her husband recognized her talent and encouraged her to study with other mathematicians. Eventually she published several papers and built models representing four-dimensional figures with cardboard and wood.

Ada Lovelace, 1815-1852, was known as the first computer programmer. She met Charles Babbage, the so-called *Father of the Computer*, and became interested in a concept he had for a mechanical device to compute values of quadratic functions. She also became interested in some of his ideas of another machine which would use punched cards to read instructions and data to solve mathematical problems. She had a vision that these machines, the future computers, could go beyond mere calculating or number-crunching.

Olive Clio Hazlett October 27, 1890 - March 8, 1974 (written by Larry Riddle, Agnes Scott College)

Olive Clio Hazlett was born in Cincinnati and grew up in Boston where she attended the public schools. She received her bachelor's degree from Radcliffe College in 1912, and a master's degree in 1913 and a Ph.D. in 1915, both from the University of Chicago. Her thesis director for both degrees at Chicago was Leonard Dickson. She was his second female doctoral student after Mildred Sanderson. The title of her Ph.D. degree was "On the Classification and Invariantive Characterization of Nilpotent Algebras." The published version appeared in the American Journal of Mathematics, vol 38 (1916), pp109-138 [Abstract].

During 1915-1916, Hazlett did research on invariants of nilpotent algebras at Harvard as an Alice Freeman Palmer Fellow of Wellesley College. The next two years were spent at Bryn Mawr before she took an assistant professor position at Mount Holyoke. She was promoted to associate professor in 1924 but was dissatisfied by what she perceived as a lack of time and library facilities to pursue her research in algebra. In 1925, therefore, she moved to the University of Illinois as an assistant professor with a salary of $3,000. When she applied for the job at Illinois, Dickson called her "one of the two most noted women in America in the field of mathematics" [Rossiter 174]. She was to remain at Illinois for the rest of her professional career.

During Hazlett's first year at Illinois she taught College Algebra I and II, Differential and Integral Calculus I and II, and the year long graduate sequence in Modern Algebra. In 1928 she received a Guggenheim Fellowship in 1928 to spend a year in Italy, Switzerland, and Germany. During this year she presented a paper on "Integers as Matrices" at the International Congress of Mathematicians. She then requested and received an extension of her Guggenheim Fellowship to spend another year in Europe. When she returned to Illinois in 1930, she was promoted to associate professor with a salary of $4,000.

During the 1931-32 academic year, her teaching load had not changed much from her first year at Illinois. That year she taught calculus, plane trigonometry and analytic geometry, and again taught the graduate sequence in Modern Algebra. During the academic year 1935-1936, Paul Halmos was a student in her graduate algebra class. In his "automathography", Halmos writes

Algebra was taught by Olive Hazlett who was, by our lights, a famous and important mathematician: she published papers and she taught advanced courses...Hazlett's course was based mainly on the first volume of van der Waerden, with, of course, some deletions and additions. She enjoyed telling us about one of her papers whose title she gave as "Embedding a ring in a field," and she enjoyed telling us how her colleague Shaw teased her about it--it evoked a picture of nefarious agricultural activities, he said.

In 1935 Hazlett wrote a letter to the chair of the mathematics department complaining about having to teach the large service courses to nonmajors. Indeed, she was so unhappy at Illinois that she had a series of mental breakdowns in the 1930s and 1940s from which she never recovered [Rossiter 365]. She took a paid sick leave from December, 1936 to August, 1937. By that time her salary had been reduced to $3,500 because of the Depression. Most, if not all, of her work was to be taken care of by the department without additional expense, but the leave was granted with the provision that any additional expenses to the university due to the leave would be deducted from her salary. She was not able to return to teaching at the end of the leave, however, and was forced to take another leave of absence for one year on account of ill health. She apparently returned to teaching after this, however, for an article in the 1995 mathematics department newsletter reports

When she was a senior during 1940-1941, alumna Eleanor Ewing Erlich...remembers, Henry Brahana taught the first semester of introduction to higher algebra and the second was taught by Professor Olive Hazlett, "who was tall, thin, her long grey hair done up in a bun, wisps of hair always hanging down in her face. She seemed so different that we in her class were rather frightened of her."

Hazlett was again on leave during 1944-45 for war work, and in 1946 was placed on disability leave until further notice. She remained on disability leave until her official retirement in 1959 as Associate Professor Emerita. She lived the rest of her life at her home in Peterborough, New Hampshire.

Hazlett wrote seventeen research papers, the last appearing in 1930, on nilpotent algebras, division algebras, modular invariants, and the arithmetic of algebras. According to Green and LaDuke, she wrote more papers than any other pre-1940 American woman mathematician. Some of her work was in an area that was denoted by "formal modular invariants," known now as the theory of invariants in characteristic *p*. In this work she translated the differential operator methods of the characteristic zero case to characteristic *p*, inventing the theory of differential equations in positive characteristic. She also wrote the article on quaternions for the 14th edition of the Encyclopedia Britannica. She served as an editor of the Transactions of the American Mathematical Society from 1923 to 1935 and served on the Council of the AMS from 1926 to 1928.