

Mathematical Curves in the Real World:

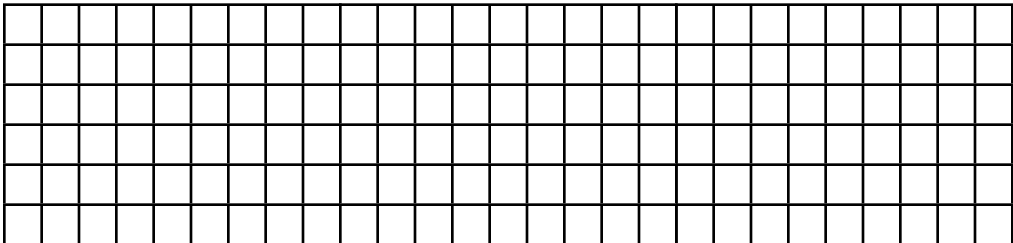
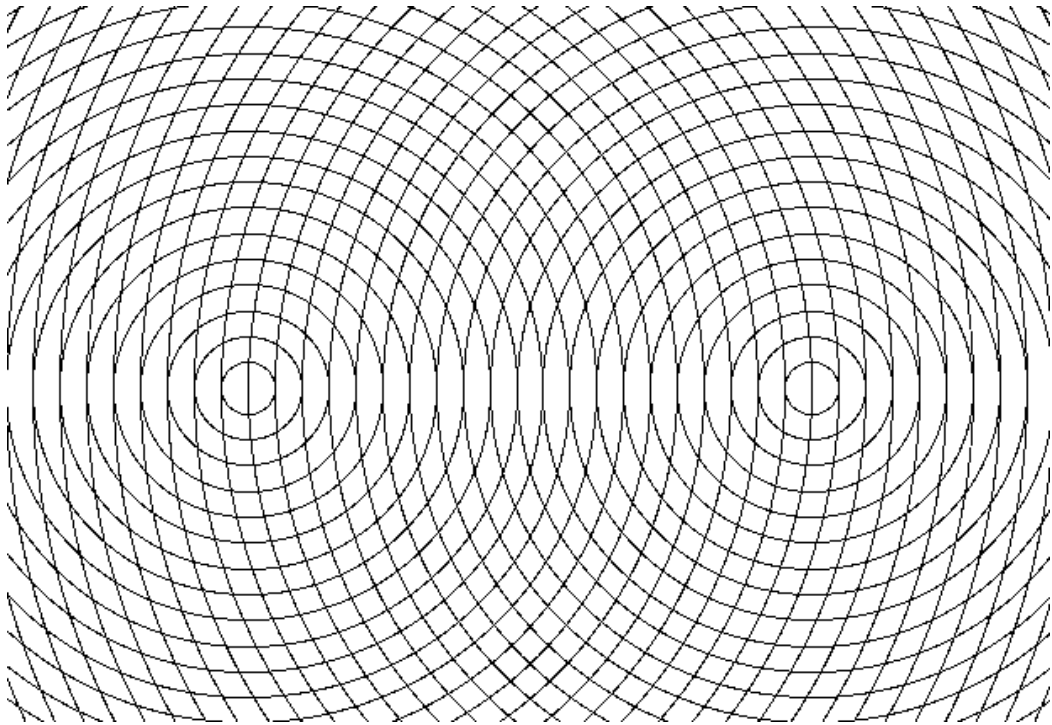
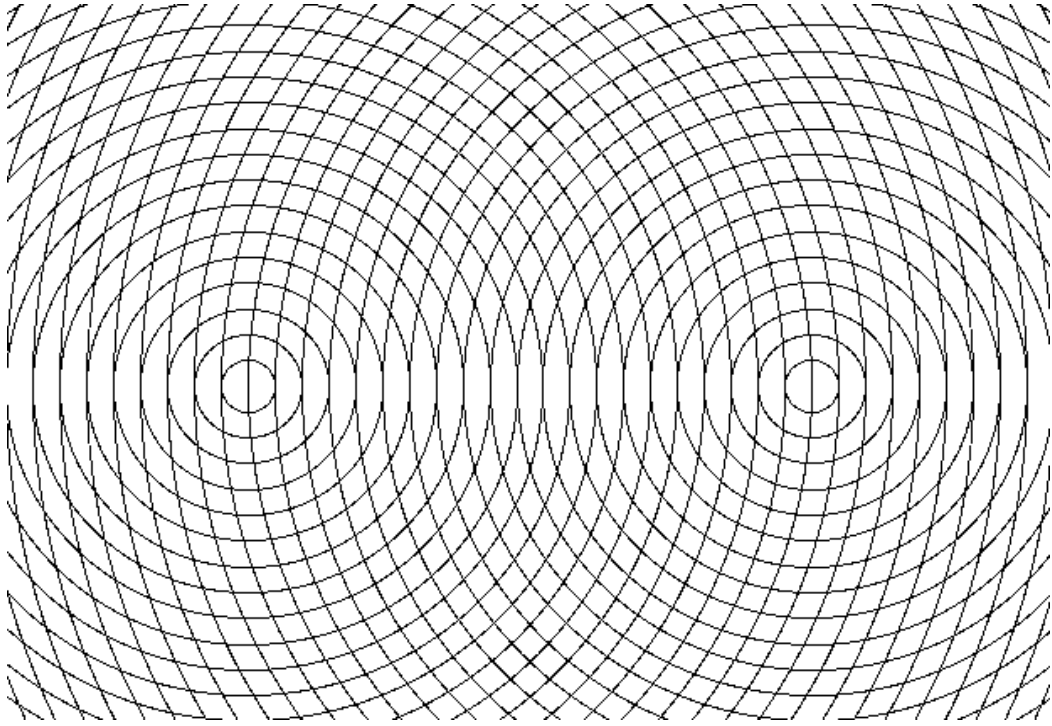
Fun(ctional) Learning

by

Scott Oliver

soliver@d125.org

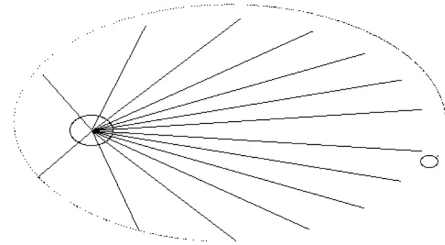
soliver@d125.org



```

REM True BASIC program to illustrate planetary movement
REM Modified from JAVA program written by Kelly Brown
SET WINDOW -100,100,-100,100 ! puts graphics origin in center of screen
BOX CIRCLE -3,3,-5,5 ! Draw Sun
OPTION ANGLE degrees ! uses degrees - not radians
LET e=.6 ! eccentricity of ellipse
LET dt=.1 ! delta time
LET ctr =0
DO
LET radius= (1-e^2)/(1-e*cos(ang)) ! polar form of ellipse
LET deltaang= 2*pi*sqr(1-e^2)/radius^2*dt ! delta ang to match gravitational effects
LET tim=tim+dt
LET ctr=ctr+1
! IF ang <360 and mod(ctr,40)=0 then PLOT LINES: 0,0;px,py ! plots equal areas
LET ang=ang+deltaang
BOX CLEAR px-2,px+2,py-2,py+2 ! erase old planet
LET px= 60*radius*cos(ang)
LET py= 60*radius*sin(ang)
BOX CIRCLE px-1,px+1,py-1,py+1 ! draw new planet
PAUSE .001
LOOP until key input ! loops until a key is pushed
END

```



! Wallpaper for the Mind variations
! Original idea from John Connett as described by A.
K. Dewdney
! in "The Armchair Universe", W.H. Freeman and
Company, 1988
! True BASIC program by Scott Oliver

```

INPUT prompt "what size (horizontal) for screen?":xsize ! inputs screen dimension
LET ysize = xsize*(460/640) ! screen resolution is 640x460
SET WINDOW -xsize,xsize,-ysize,ysize ! puts graphics origin in center of screen
CLEAR
FOR x = -xsize to 0 step 2*xsize/640 ! 640 is horizontal resolution of screen
FOR y= -ysize to ysize step 2*ysize/460 ! 460 is vertical resolution of screen
LET fnval= x^2/4 + y^2/1 ! change this line for different functions
SET COLOR 30*mod(int(fnval),6) ! # colors set to 256
PLOT x,y
PLOT -x,y
NEXT y
NEXT x
END

```

! Draws Hyperboloid by rotating strings

! Written in True BASIC by Scott Oliver

SET WINDOW -20,20,-15,15

OPTION BASE 0

OPTION ANGLE degrees

DIM px(2,60),py(2,60)

LET np =50

SUB init (p)

LET rad =10

LET angx=15

LET ang = 360/np

FOR i = 0 to np

LET x = cos(i*ang)*rad

LET y = sin(i*ang)*rad

LET px(1,i)= -cos(angx)*x+y

LET py(1,i)=-sin(angx)*x-10

LET px(2,i)=-cos(angx)*x+y

LET py(2,i)=-sin(angx)*x+10

NEXT i

END SUB

SUB drawc(inc)

PLOT LINES: -20,0;20,0

PLOT LINES: 0,-20;0,20

PLOT LINES: -20*cos(angx),-20*sin(angx);20*cos(angx),20*sin(angx)

REM draw top and bottom

set color "black"

FOR i = 0 to np-1

PLOT LINES: px(1,i),py(1,i);px(1,i+1),py(1,i+1)

PLOT LINES: px(2,i),py(2,i);px(2,i+1),py(2,i+1)

NEXT i

FOR i = 0 to np-1

set color 20* mod (i,14)+10

PLOT LINES: px(1,i),py(1,i);px(2,mod(i+inc,np)),py(2,mod(i+inc,np))

NEXT i

END SUB

CALL init(p)

FOR inc = 0 to np

CLEAR

CALL drawc(inc)

PAUSE 1

NEXT inc

END

!Draws concentric circles

!Written in True BASIC

SET WINDOW -20,20,-15,15

FOR r = 1 to 40

BOX CIRCLE -10-r,-10+r,-r,r

BOX CIRCLE 11-r,11+r,-r,r

NEXT r

END

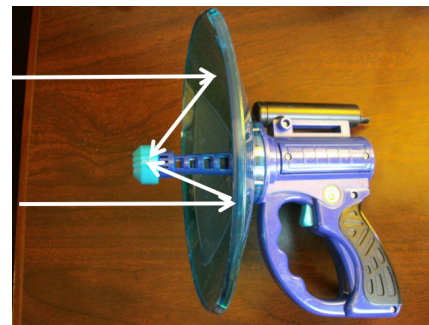
ParabFold

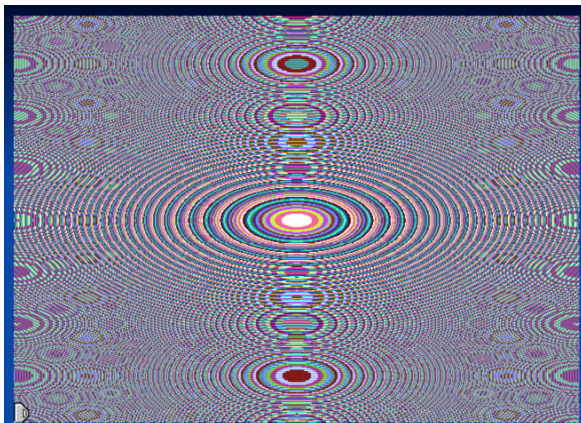
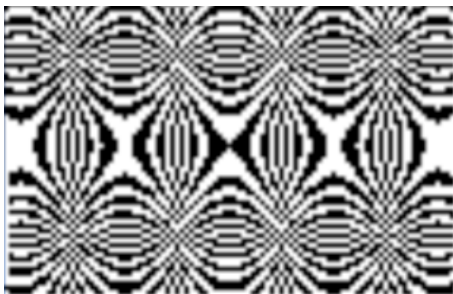
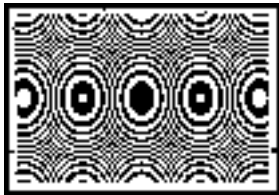
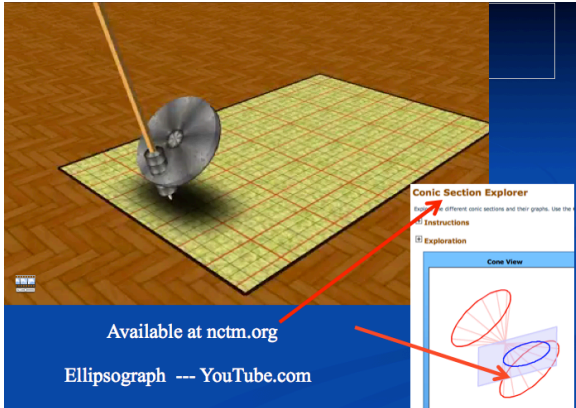
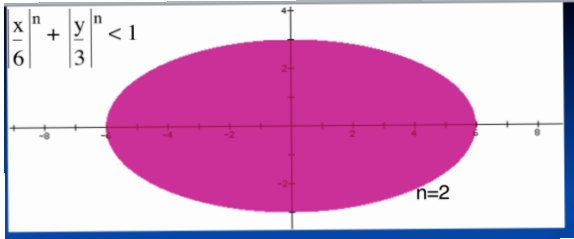
```
AxesOff
FnOff
PlotsOff
-10 -> Xmin
10 -> Xmax
FnOff
ClrDraw
Prompt F
-F-1 -> Ymin
F+7 -> Ymax
Circle(0,F,.2)
Line(-20,-F,20,-F)
Pause
For(X,-6,6,1.0)
-F -> Y
If X=0
Then
500 -> M
Else
-F/X -> M
End
-1/M -> N
X/2 -> P
0 -> Q
-150 -> R
N(R-P)+Q -> S
150 -> T
N(T-P)+Q -> U
Line(R,S,T,U)
End
```



CircleFold

```
AxesOff
FnOff
PlotsOff
ZStandard
ZSquare
ClrDraw
Circle(0,0,8)
Degree
Prompt F
Circle(F,0,.2)
Circle(0,0,.2)
For(D,0,360,10)
cos(D)*8 -> X
sin(D)*8 -> Y
If X=F
Then
500 -> M
Else
Y/(X-F) -> M
End
If M=0
Then
500 -> N
Else
-1/M -> N
End
(X+F)/2 -> P
(Y+0)/2 -> Q
-150 -> R
N(R-P)+Q -> S
150 -> T
N(T-P)+Q -> U
Line(R,S,T,U)
End
```





Planets

Degree

.4 -> E

.5 -> D

-1 -> Xmin

1.5 -> Xmax

-1.5 -> Ymin

1.5 -> Ymax

AxesOff

ClrDraw

0 -> A

0 -> T

0 -> C

Pt-On(0,0)

While (A<720)

(1-E²)/(1-Ecos((A) -> R

2π√((1-E²)/R²*D -> G

C+1 -> C

A+G -> A

R*cos((A) -> X

R*sin((A) -> Y

Pt-On(X,Y)

If (fPart((C/10)=0)*(A<360)

Line(0,0,X,Y)

End

Wallpaper

ClrDraw

AxesOff

FnOff

For(X,Xmin,Xmax,ΔX)

For(Y,Ymin,Ymax,ΔY)

int(X²+Y²/4) -> Z

If int(Z/2)=Z/2

Pt-On(X,Y)

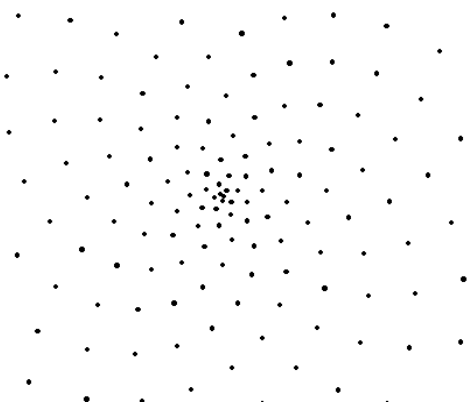
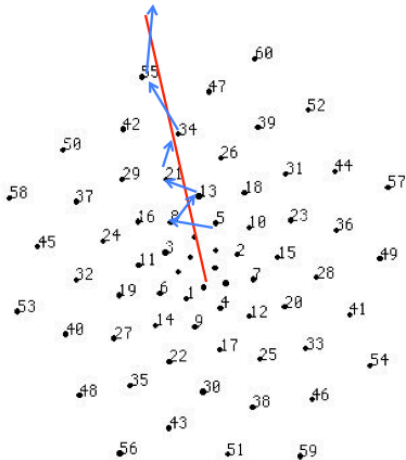
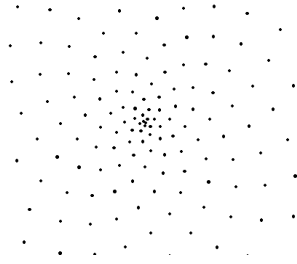
End

End

SUNFLOWR

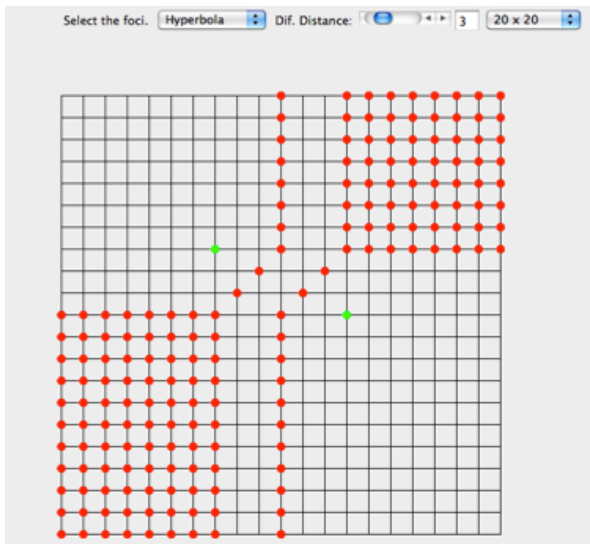
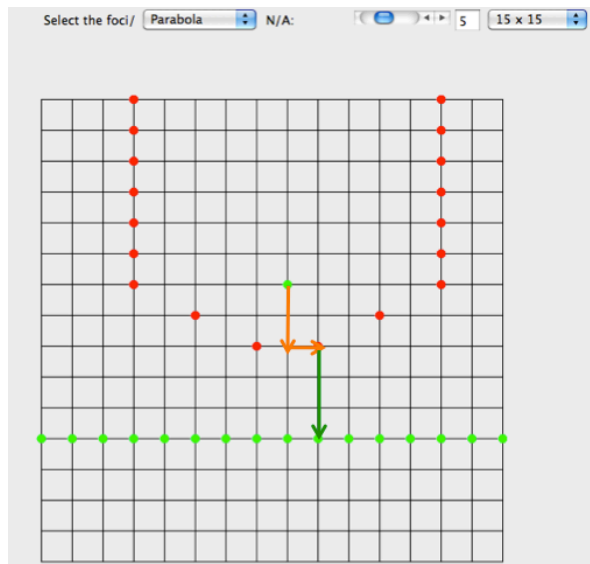
```

ClrDraw
FnOff
PlotsOff
AxesOff
Degree
ZStandard
ZSquare
ClrHome
Input "ANG INC?",I
Input "RAD INC?",J
0->A
.1->R
For(B,1,450)
Pt-On(Rcos(A),Rsin(A))
A+I->A
R+J->R
End
    
```



```

ClrDraw
FnOff
ZStandard
ZSquare
{-9,9,9,-9,-9}->L1
{9,9,-9,-9,9}->L2
.19->D
For(I,1,99,1)
For(L,1,4,1)
Pt-On(L1(I),L2(I))
L1(I+1)-L1(I)->A
L2(I+1)-L2(I)->B
sqrt(A^2+B^2)->C
L1(I)+D/C*A->L1(I)
L2(I)+D/C*B->L2(I)
End
L1(1)->L1(5)
L2(1)->L2(5)
End
    
```



Bibliography

- Adam, John A. , Mathematics in Nature, Modeling Patterns in the Natural World, Princeton University Press, 2003
- Akopyan, A. V., Geometry of Conics, American Mathematical Society, 2007
- Amato, Ivan: Super Vision - a New View of Nature, Harry N. Abrams, Inc. ,2003
- Ball, Phillip, Shapes: Nature's Patterns: a Tapestry in Three Parts, Oxford University Press, 2009
- Brown, Kelly Jo (programmer): "Kepler's Laws of Planetary Motion" in JAVA - SIG's 100 Best Applets, John Wiley & Sons, 1997.
- Brown, Richard G.: Advanced Mathematics - Precalculus with Discrete Mathematics and Data Analysis, McDougal Littell/ Houghton Mifflin, 1997
- Bryant, John & Sangwin: How Round is Your Circle? , Princeton University Press, 2008
- Clawson, Calvin C.: Mathematical Sorcery - Revealing the Secrets of Numbers, Plenum Press, 1999
- Dewdney, A. K.: The Armchair Universe: An Exploration of Computer Worlds, W. H. Freeman and Company, 1988
- Foley, Gregory D. : "The Shape of an Ellipse", NCTM Mathematics Teacher, Nov 2011
- Gardner, Martin: Mathematical Carnival, Vintage Books/Random House, 1977
- Gardner, Martin: The Last Recreations, Springer-Verlag, 1997
- Gardner, Martin: Penrose Tiles to Trapdoor Ciphers, W. H. Freeman & Company, 1989
- Gazalle, Midhat J.: Gnomon - From Pharaohs to Fractals, Princeton University Press, 1999
- Goodstein, David L. & Judith R.: Feynman's Lost Lecture: The Motion of Planets around the Sun, W.W. Norton & Co.,1996
- Gullberg, Jan: Mathematics from the Birth of Numbers, W.W. Norton & Company, 1997
- House, Peggy, et al: Mission Mathematics Grades 9-12, NCTM Inc, 1996
- Huntley, H. E. , The Divine Proportion, A Study in Mathematical Beauty, Dover Publications, Inc. 1970

Jung, Inchul and Kim, Yunghwan, "Using Geometry Software to Revisit the Ellipse", Mathematics Teacher Volume 97, nbr 3, March 2004

Kending, Keith, Conics, MAA Publication, 2005

Klarner, David A. (Ed.): The Mathematical Gardner, Wadsworth International, 1981

Larson, Roland E., Hostetler, Robert P., Edwards, Bruce H., and Heyd, David E.: Precalculus with Limits: A Graphing Approach (2nd Edition), Houghton Mifflin Company 1997

Layzer, David: Constructing the Universe, Scientific American Library, 1984

Lee, Kevin and Cohen, Yoseph: Fractal Attraction, SandPiper Software, 1991

Lockhart, Paul: Measurement, Belknap Press of Harvard Univ. Press, 2012

Madden, Sean, "Parabolas Under Pressure", The Mathematics Teacher, Vol 102, no. 9, May 2009

Madden, Sean & Allison, Dean: "Pirates of the Parametric", The Mathematics Teacher, May 2011

Maor, Eli: e: the Story of a Number, Princeton University Press, 1994

Morrill, W. K.: Analytic Geometry (2nd Edition), International Textbook Company, 1964

Peitgen, Jurgens, Saure: Fractals for the Classroom, Springer-Verlag, 1992

Peterson, Ivars: Mathematical Treks, From Surreal Numbers to Magic Circles, Science News Book (MAA), 2002

Pickover, Clifford A.: Computers, Pattern, Chaos and Beauty, St. Martin's Press, 1990

Pickover, Clifford A.: The Loom of God- Mathematical Tapestries at the Edge of Time, Plenum Press, 1997

Pickover, Clifford A. : The Math Book, Sterling Publishing Co. Inc, NY , 2009

Scher, Daniel: Exploring Conic Sections with the Geometer's Sketchpad, Key Curriculum Press, 1995

Savin, Anatoly: "Billiard Math" in Quantum, November/December 1996

Shesso, Renna: Math for Mystics, From the Fibonacci Sequence to Luna's Labrynth to the Golden Section and other Secrets of Sacred Geometry, Weiser Books, 2007

Sinicrope, Rose & Bellittiere: "Ellipses and Orbits: Asteroids and Comets", NCTM Mathematics Teacher, Dec 2011/ Jan 2012

Skinner, Stephen, Sacred Geometry, Deciphering the Code, Sterling Publishing Co, Inc. 2006

Stewart, Ian: Life's Other Secret, John Wiley & Sons, Inc., 1998

Stewart, Ian: What Shape is a Snowflake? - Magical Numbers in Nature, W.H. Freeman and Company, 2001

Strogatz, Steven: The Joy of X, A Guided Tour of Math, From One to Infinity, HMH, 2012

Thompson, D'Arcy Wentworth: On Growth and Form- The Complete Revised Edition, Dover Publications, 1992

Wheeler, John Archibald: A Journey into Gravity and SpaceTime, Sci. American Library, 1990

Wolfram Research, Mathematical Explorer (software), 2001

Wolfram Demonstrations Project (online)

<http://www.2dcurves.com/>

<http://www-history.mcs.st-and.ac.uk/Curves/Curves.html> Famous Curves Index

<http://en.wikipedia.org/wiki/Curve>

<http://www.k12.hi.us/~mathappl/MAch3Curves.html>

<http://mathworld.wolfram.com/Spirograph.html>

http://www.hkame.org.hk/html/modules/tinyd2/content/Edumath/v20/03Schumann_3D-dynamic.pdf

<http://www.pdf-finder.com/Introduction-to-Conics-with-Cabri-3D.html>

<http://www.mathedpage.org/conics/three-d/>

<http://www.ticalc.org/pub/83plus/basic/math/geometry/>

<Http://congreso.us.es/ewcg04/cosmoakiyama.pdf>

Toysmith 3-D Mirascope

Mirage 3-D Instant Hologram Maker

At Youtube.com :

**Ellipsograph Hyperbolagraph Parabolagraph Hyperboloidgraph
two circle roller two half circle roller two ellipse roller**

