# REACH OUT AND TOUCH SPACE

Bjoern Muetzel (Dartmouth College) - Family Night - MoMath
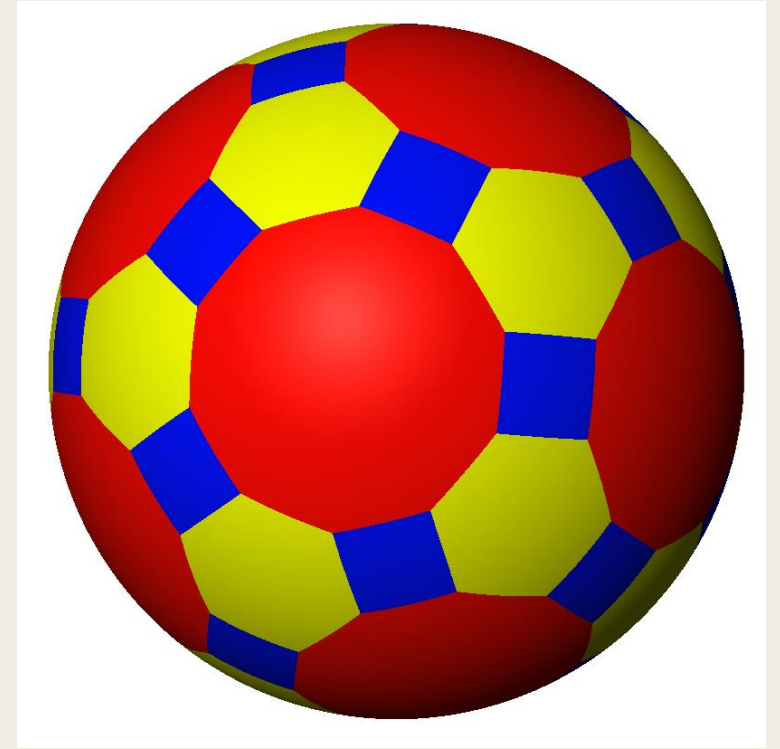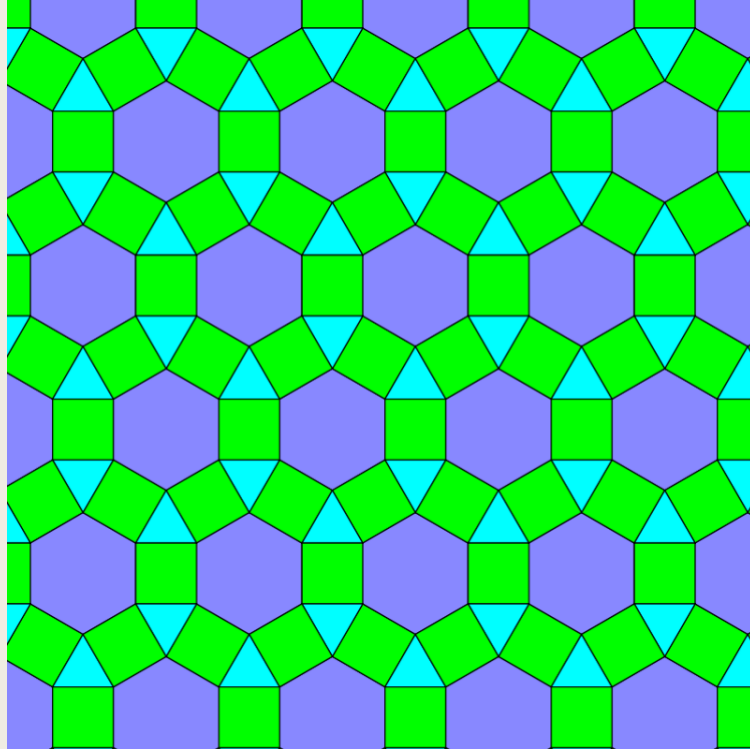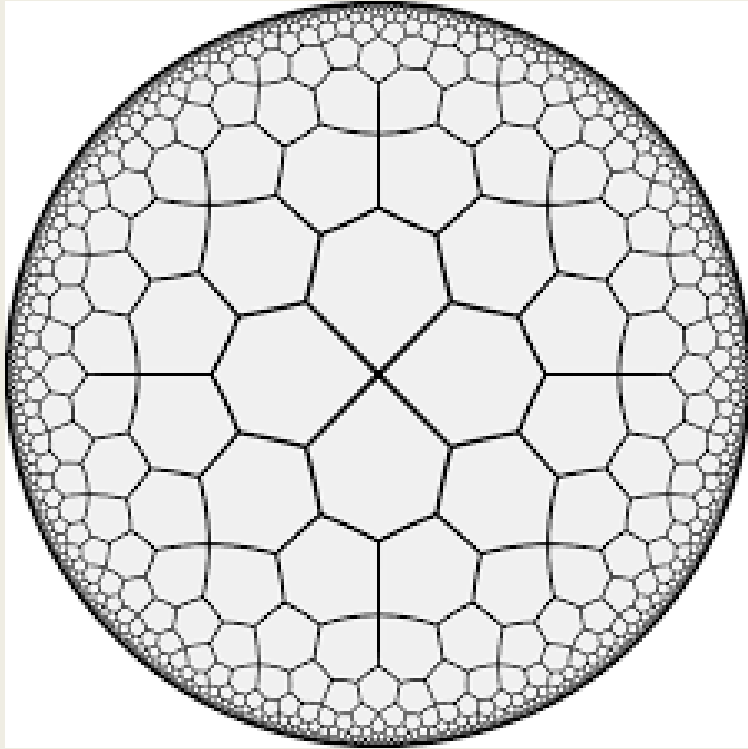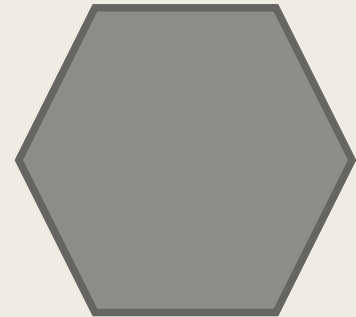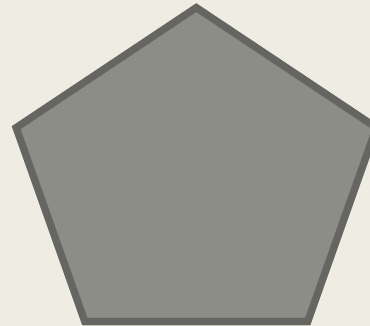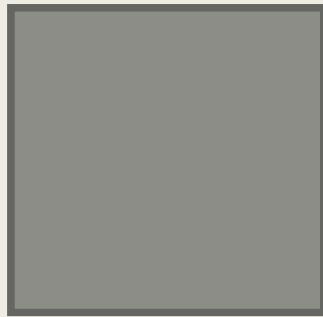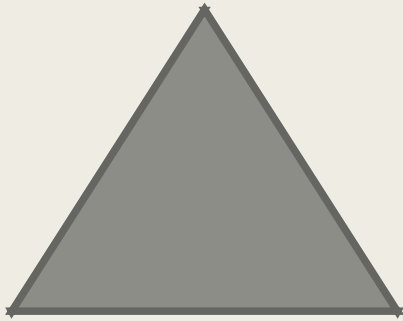
# SPECIAL THANKS TO



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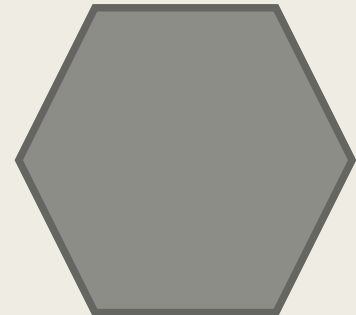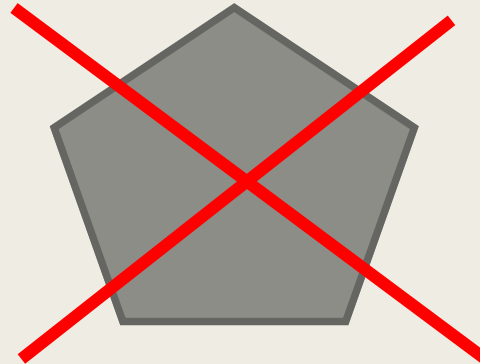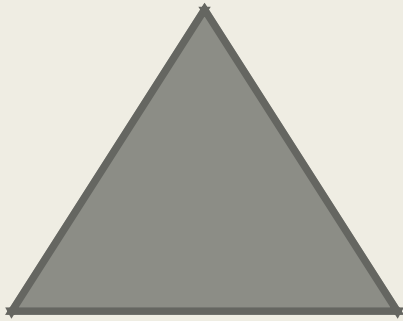
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# REACH OUT AND TOUCH SPACE

SUPPOSE YOU WANT TO TILE YOUR BATHROOM. WHICH REGULAR SHAPES OR POLYGONS COULD YOU USE?

# Suppose you want to tile your bathroom. Which regular shapes or polygons could you use?

# Suppose you want to tile your bathroom. Which regular shapes could you use?

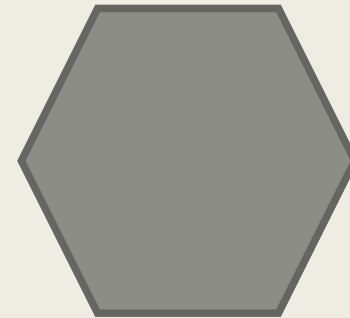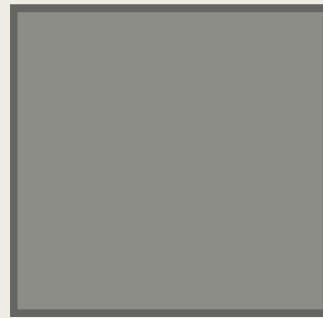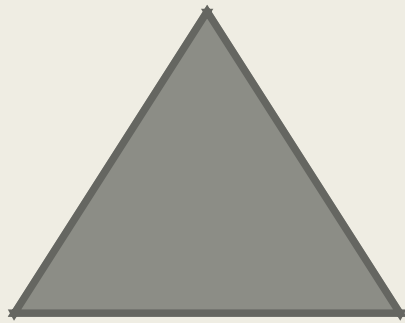# Suppose you want to tile your bathroom. Which regular shapes could you use?

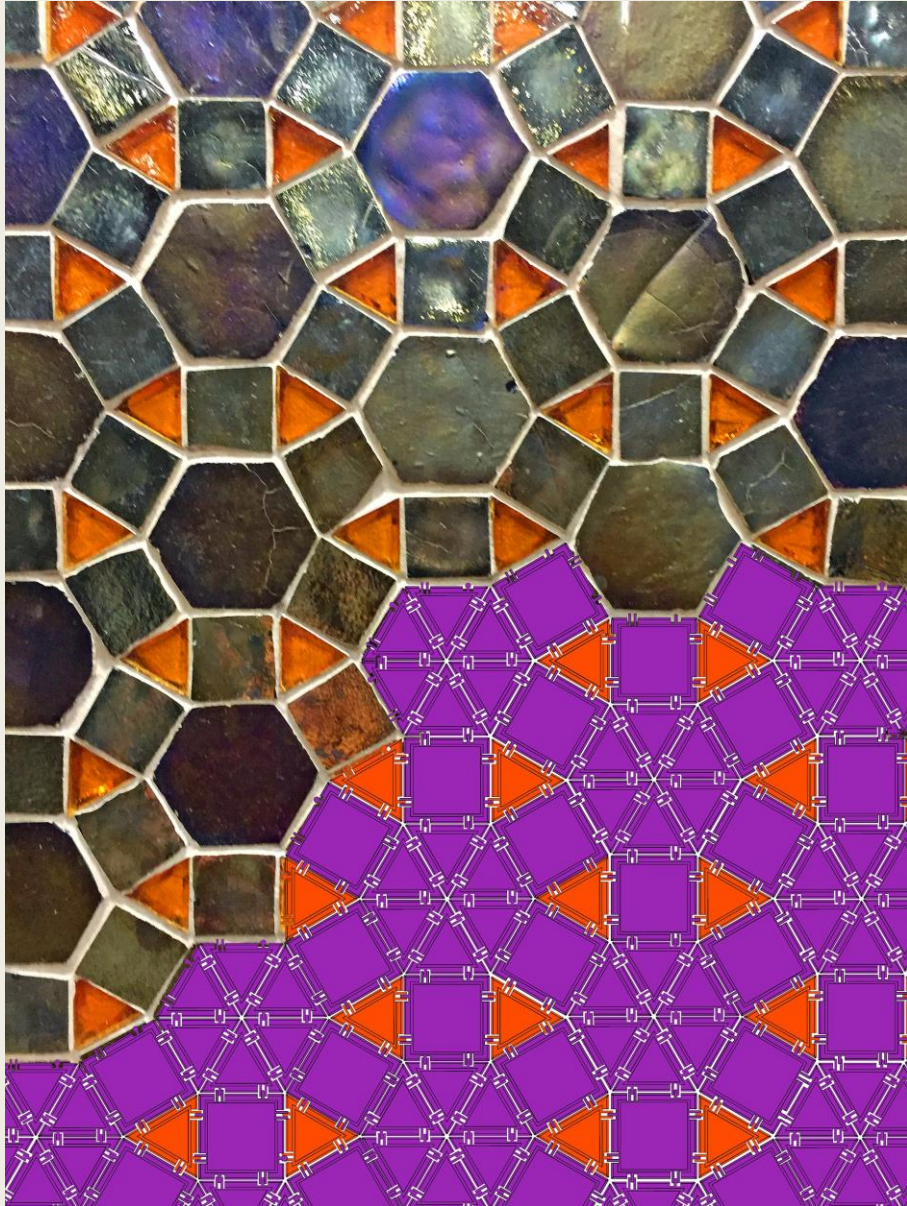Suppose you want to tile your bathroom. Which regular shapes could you use?
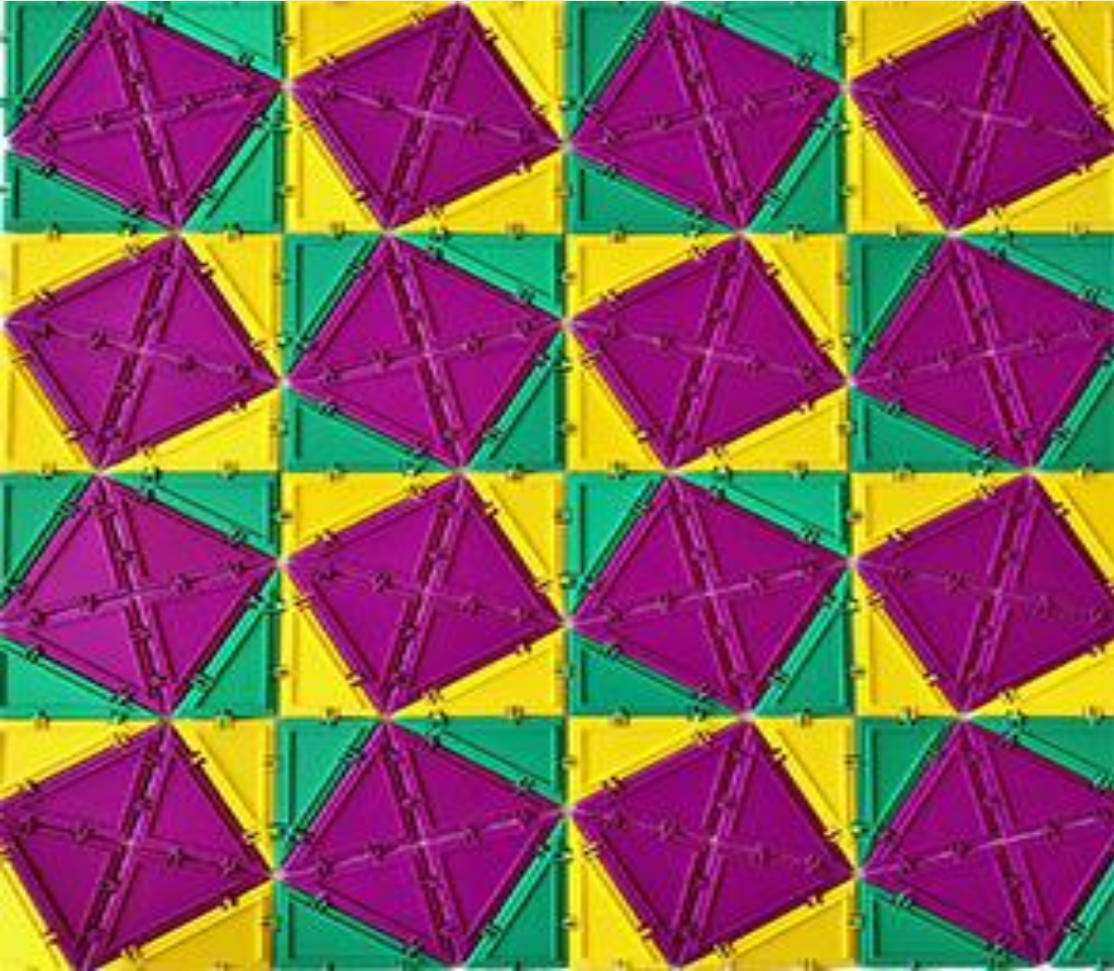
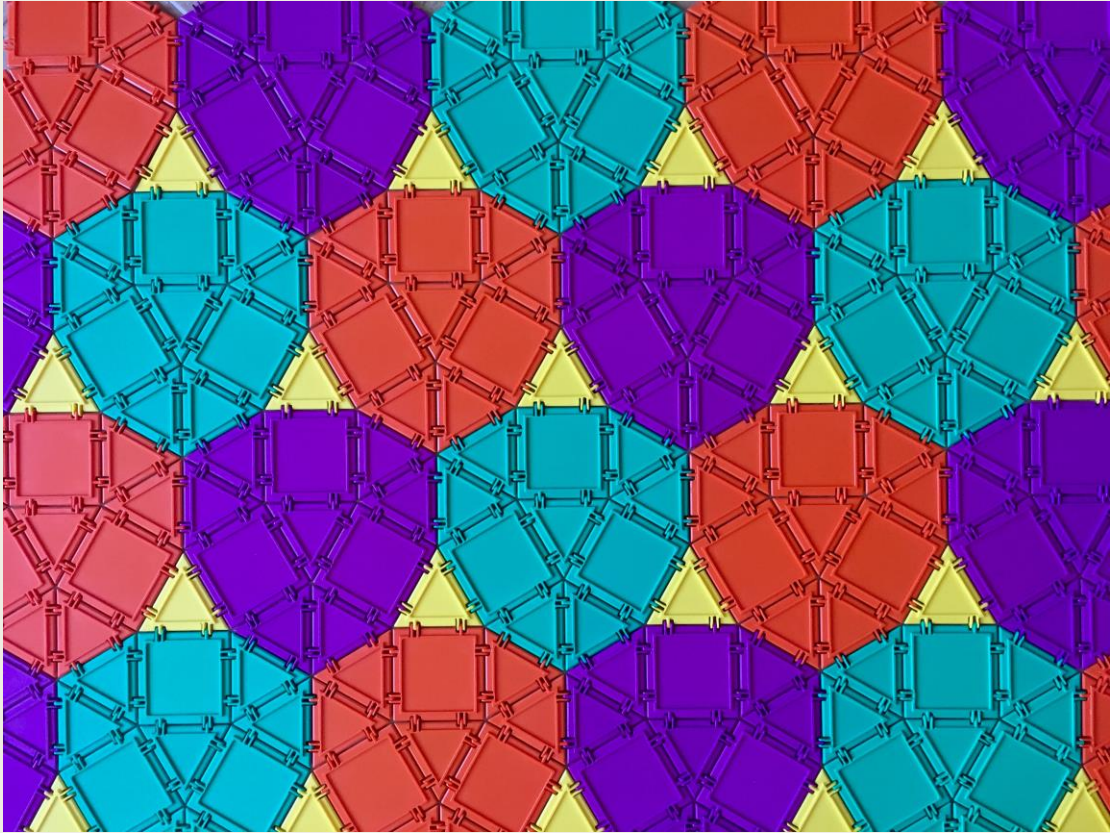CAN WE BE A BIT MORE CREATIVE? IDEA 1: USE SEVERAL DIFFERENT SHAPES.

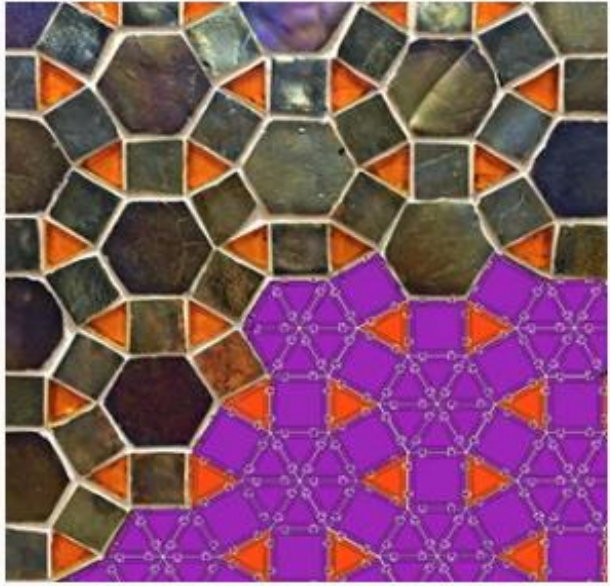CAN WE BE A BIT MORE CREATIVE? IDEA 1: USE SEVERAL DIFFERENT SHAPES.

CAN WE BE A BIT MORE CREATIVE?
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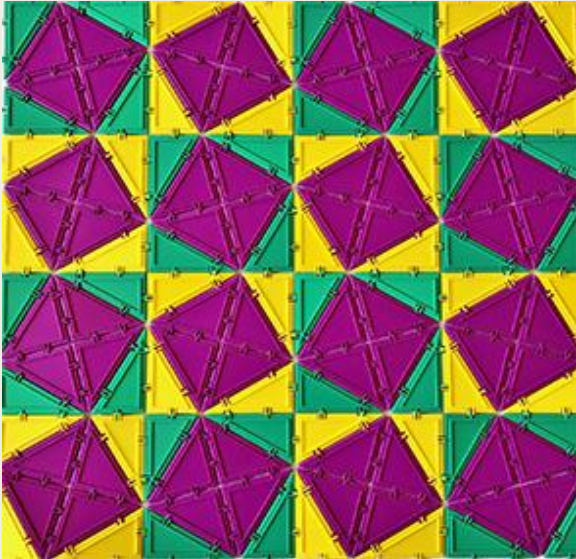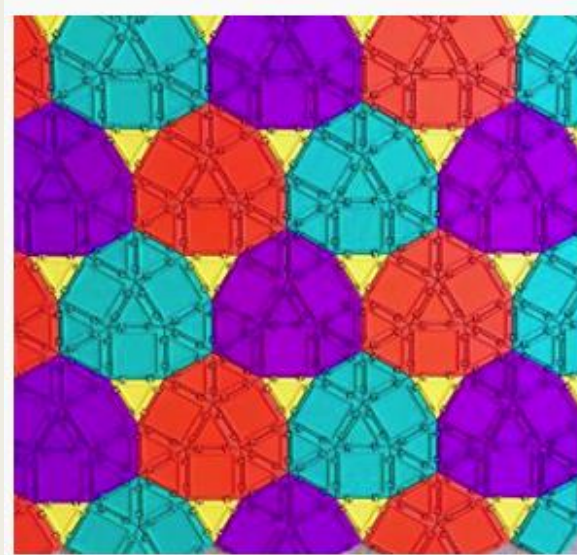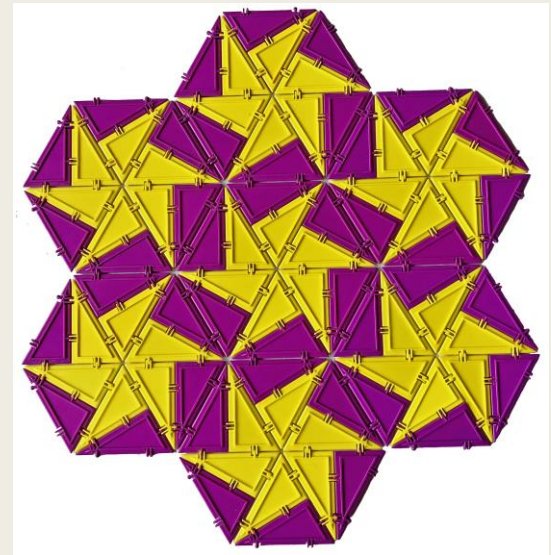CAN WE BE A BIT MORE CREATIVE?
IDEA 1: USE SEVERAL DIFFERENT SHAPES.

**1**

**2**

**3**

**4**

**5**

CAN WE BE A BIT
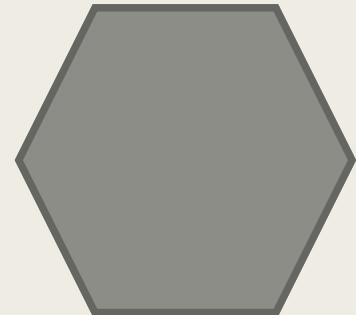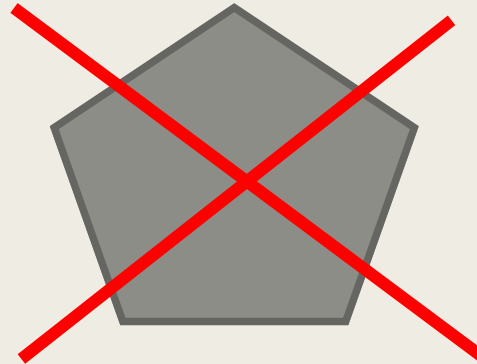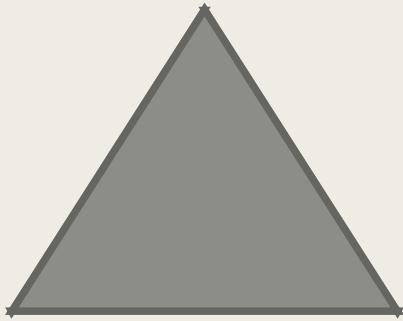MORE CREATIVE?
IDEA 1: USE SEVERAL
DIFFERENT SHAPES.

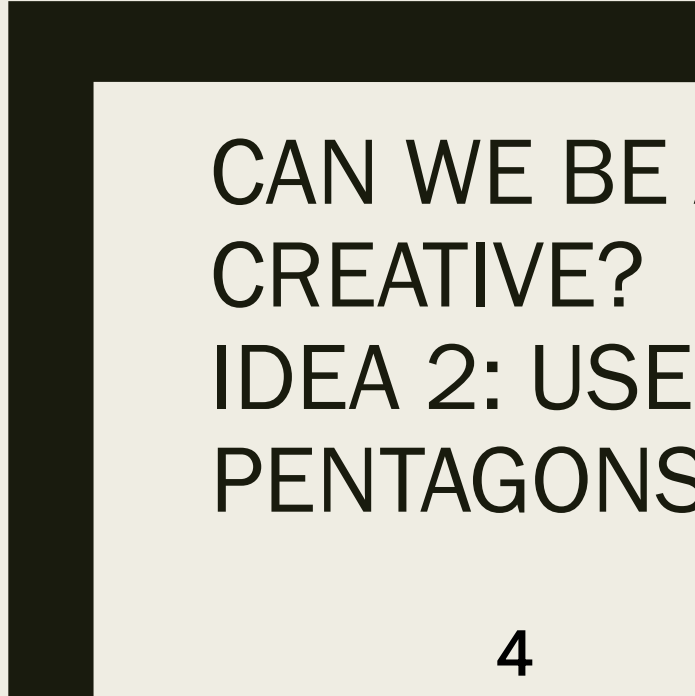# Suppose you want to tile your bathroom. Which regular shapes could you use?
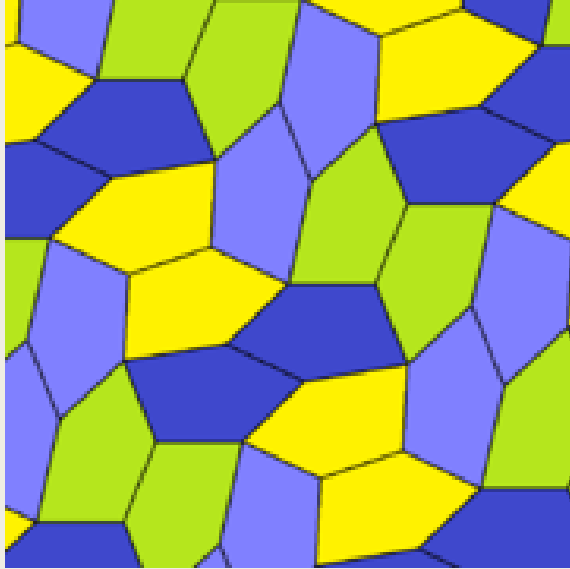


Regular pentagons do not work, but what about irregular ones?

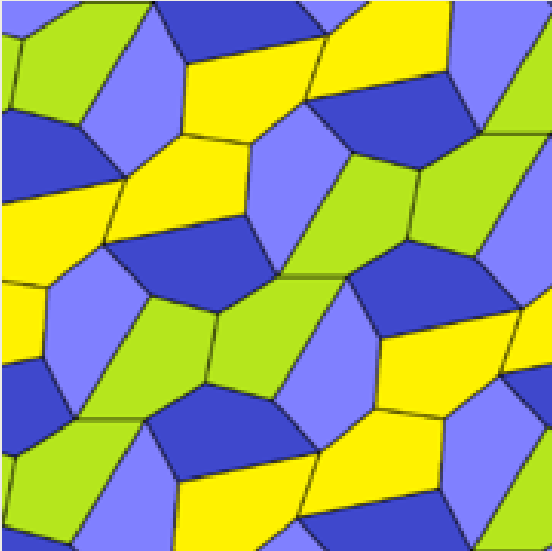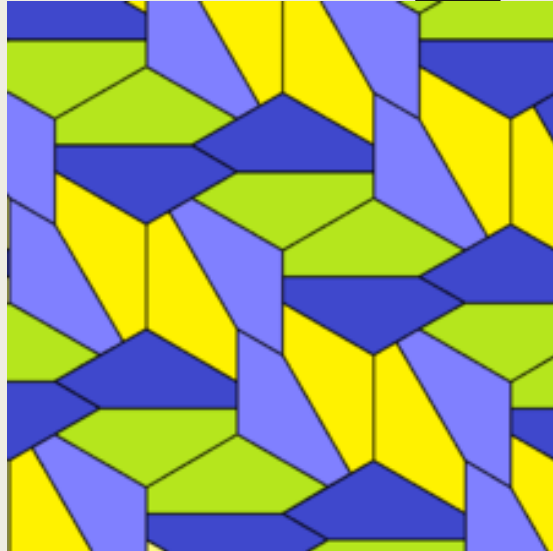CAN WE BE A BIT MORE CREATIVE? IDEA 2: USE IRREGULAR PENTAGONS.

**1**



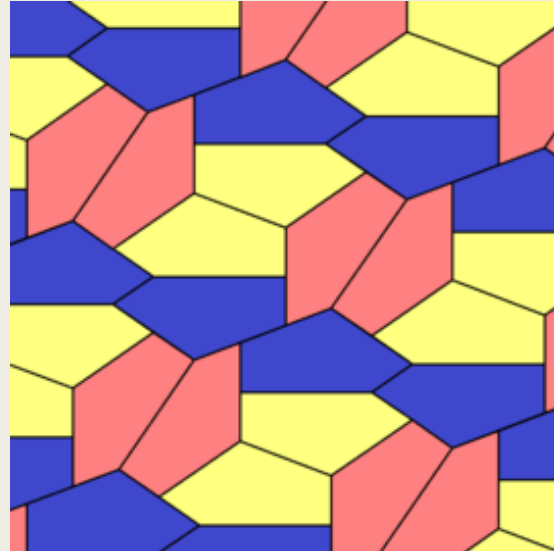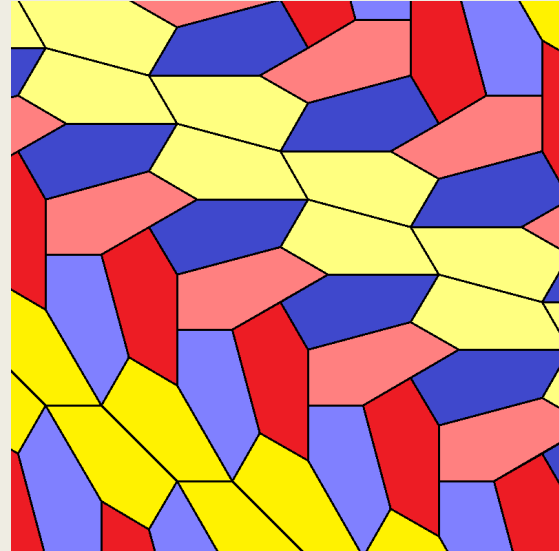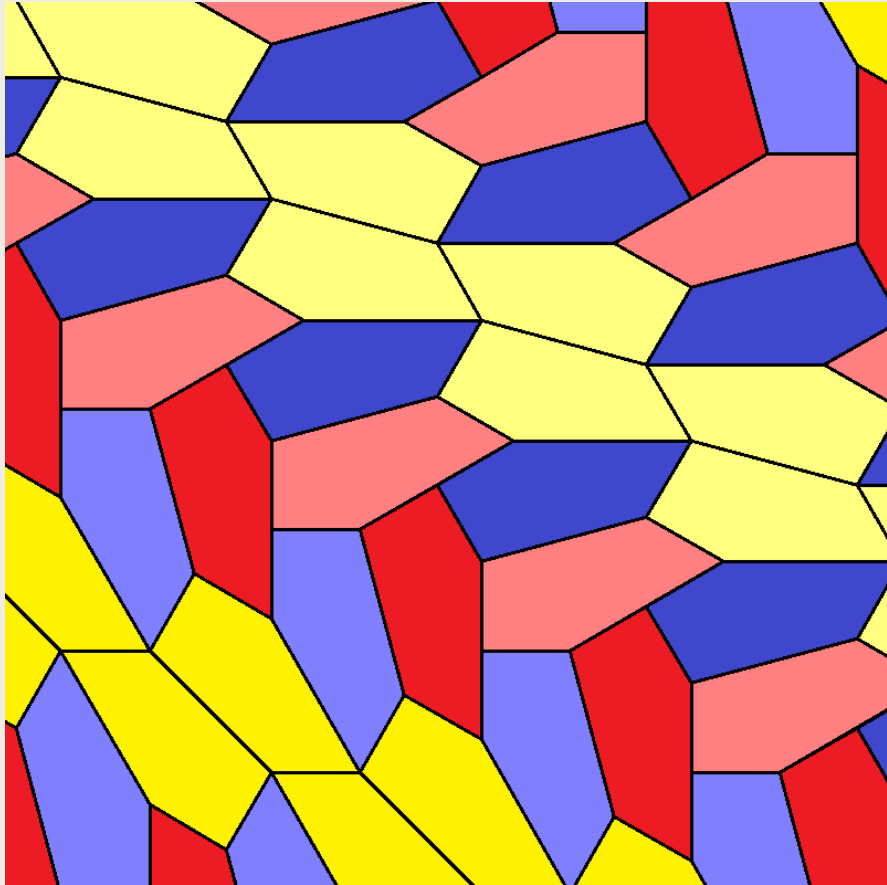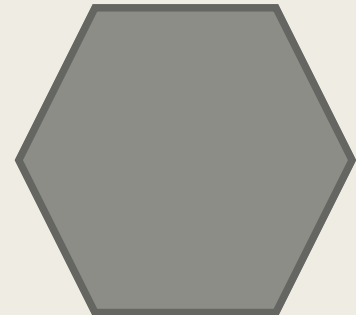CAN WE BE A BIT MORE CREATIVE?
IDEA 2: USE IRREGULAR PENTAGONS

**2**

**3**

**4**

**5**

THERE ARE 15 FAMILIES OF PENTAGON TILINGS, THE LAST ONE WAS DISCOVERED IN 2015.
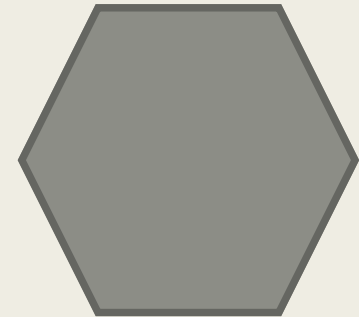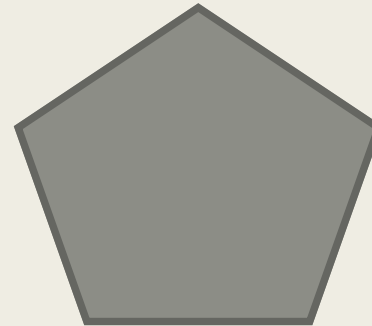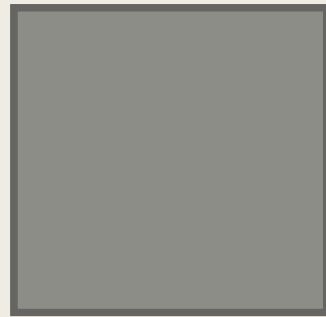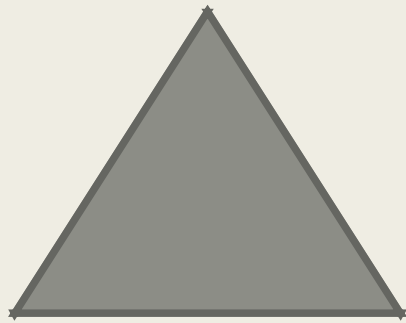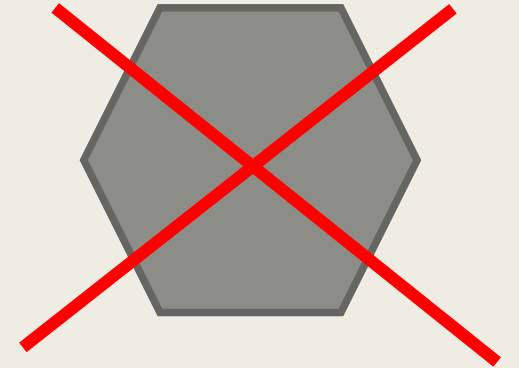
Pentagonal tilings

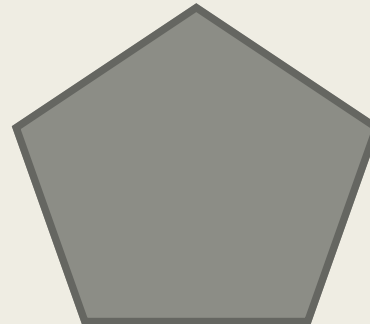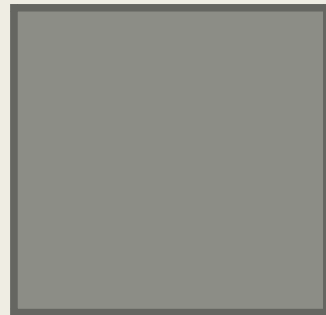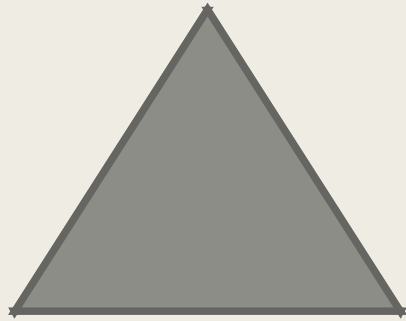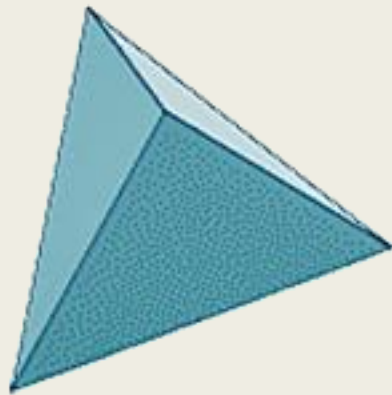# Now we want to make symmetric polyhedra using these regular polygons.
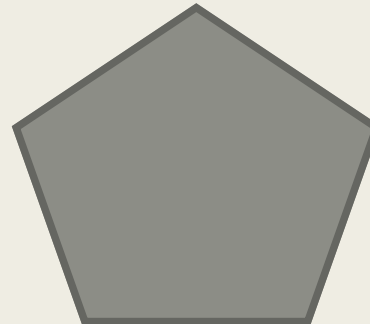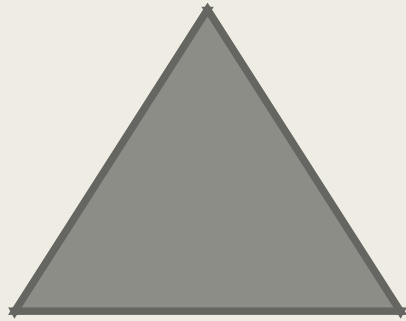
# Which one does not work?

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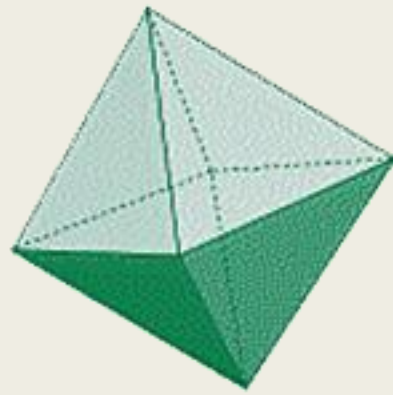# This time it is the hexagon!

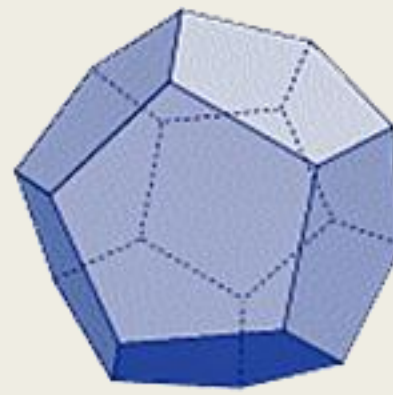Tetrahedron    Hexahedron    Octahedron    Dodecahedron Icosahedron
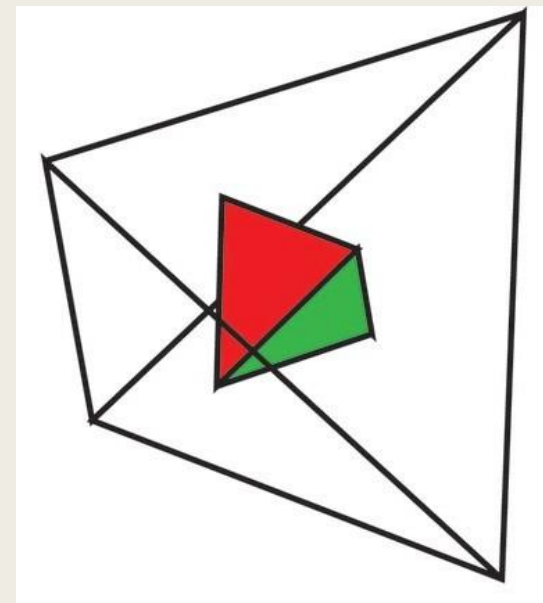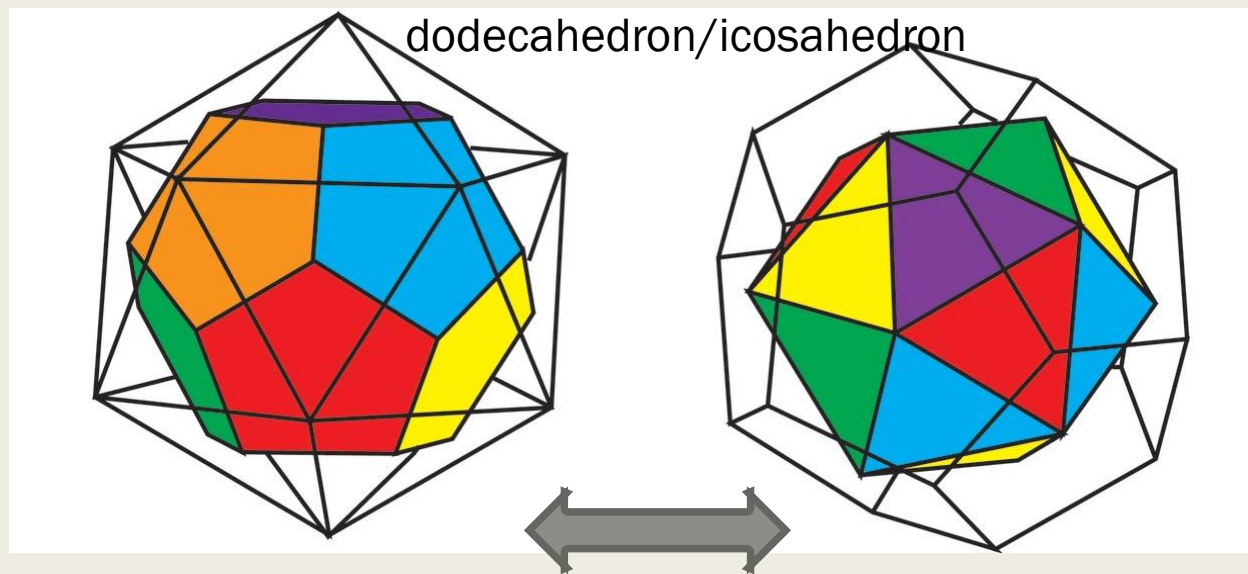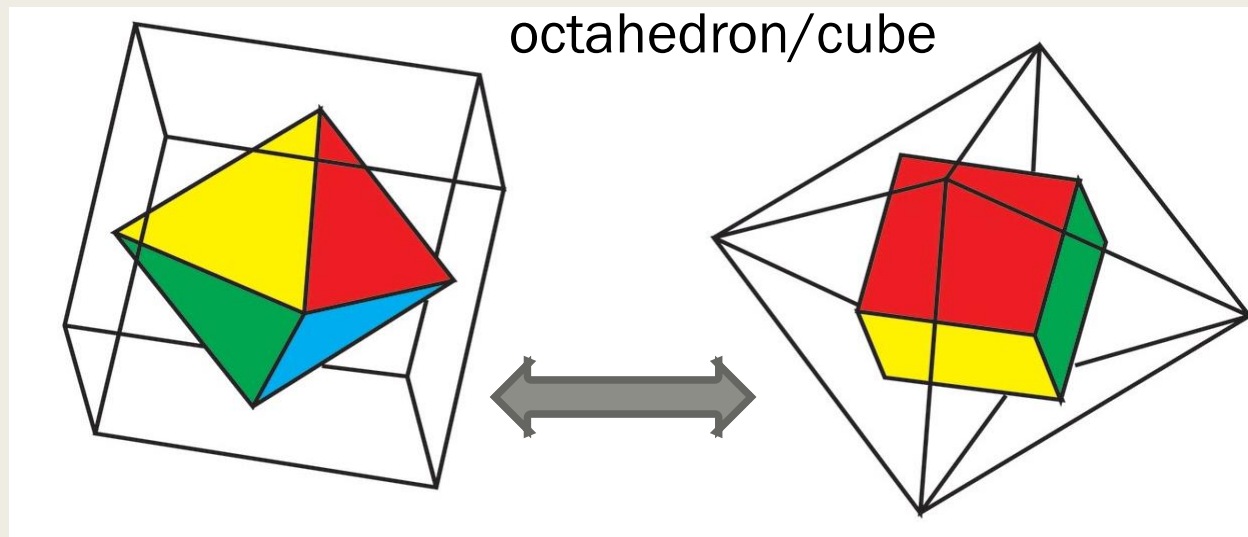
# THE 5 PLATONIC SOLIDS

# DUALITY

octahedron/cube

dodecahedron/icosahedron

WHAT ABOUT THE SPHERE?
THE SPHERE DOES NOT COUNT AS A PLATONIC SOLID.

# HOWEVER, WE CAN USE THE PLATONIC SOLIDS TO TILE THE SPHERE!

**NOTE:** ON A SPHERE THERE ARE NO STRAIGHT LINES.

INSTEAD WE USE THE LINES THAT MINIMIZE THE DISTANCE BETWEEN TWO POINTS.

THESE ARE THE GREAT CIRCLES AND ARE ALSO CALLED GEODESICS.

# Spherical tilings coming from the platonic solids



Tetrahedron    Hexahedron    Octahedron    Dodecahedron    Icosahedron
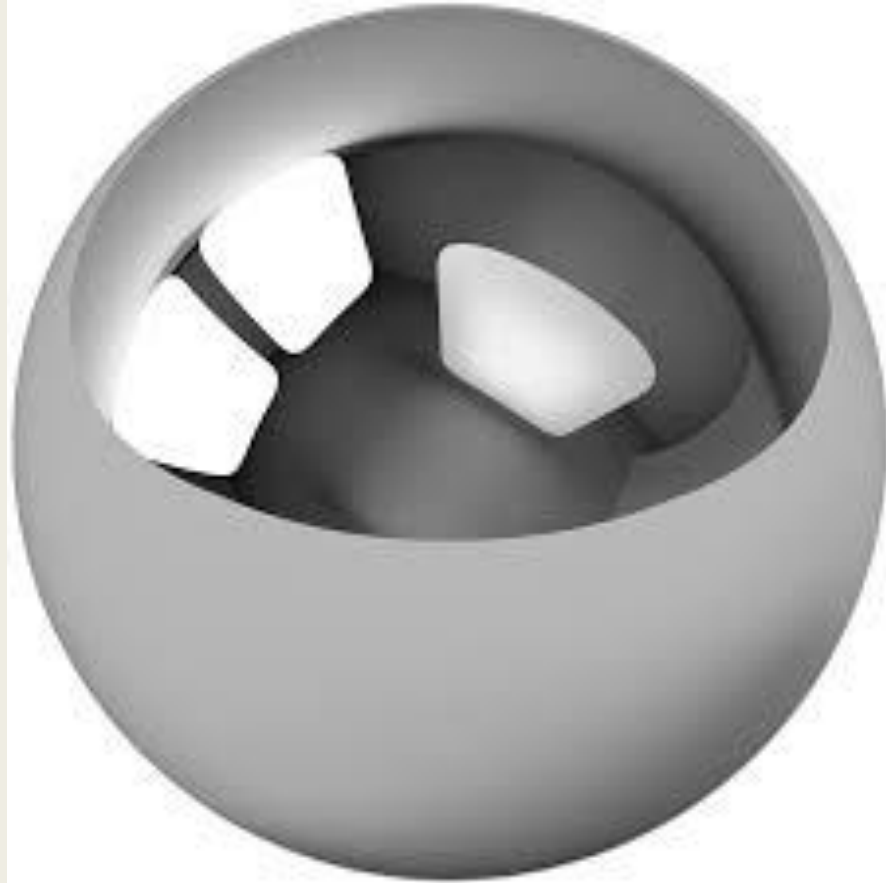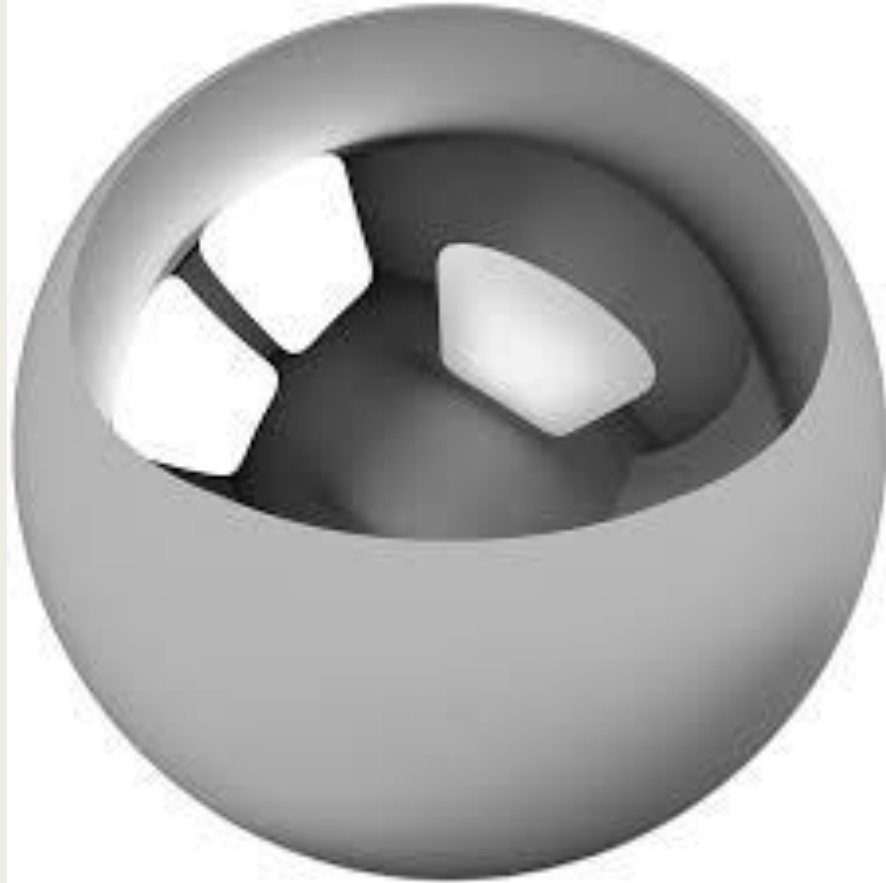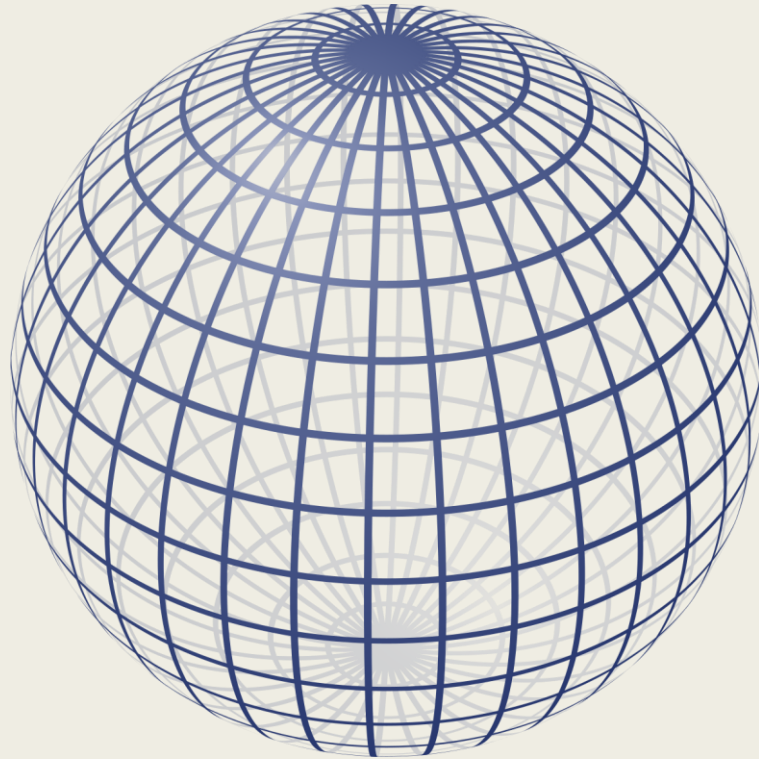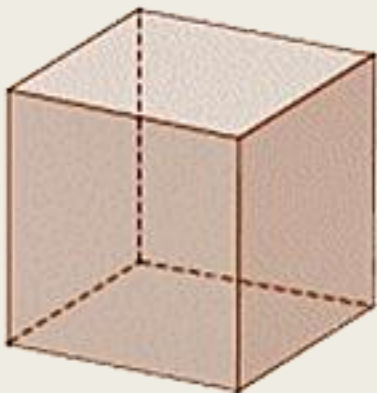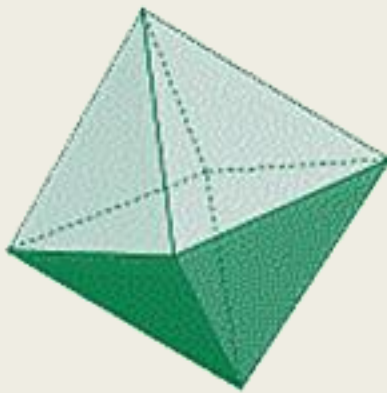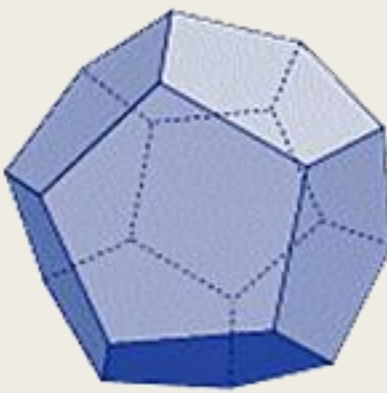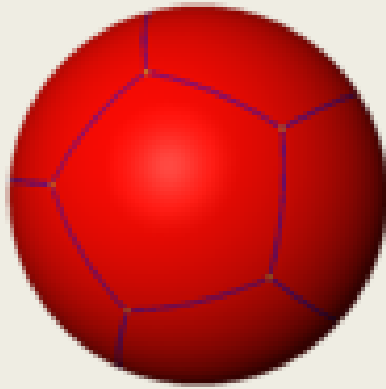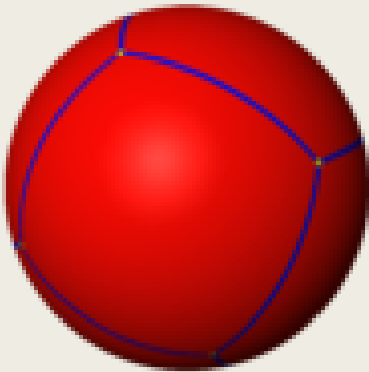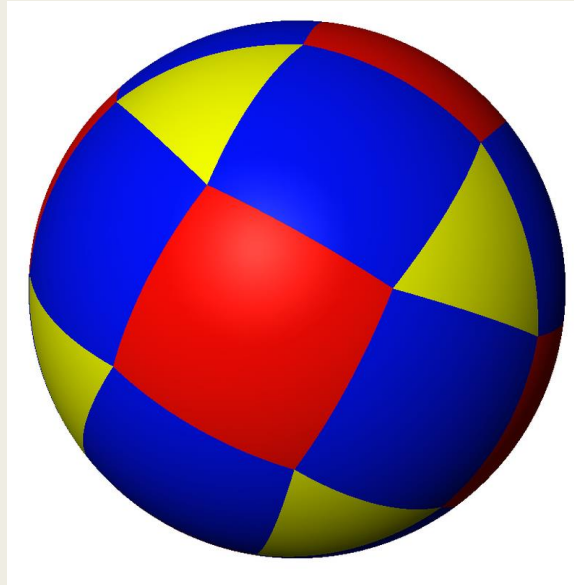
THERE ARE MANY SPHERICAL TILINGS, ALSO WITH SEVERAL POLYGONS.

spherical tilings

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LET'S MAKE A CUBOCTAHEDRON.

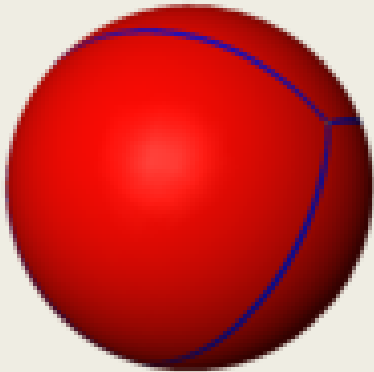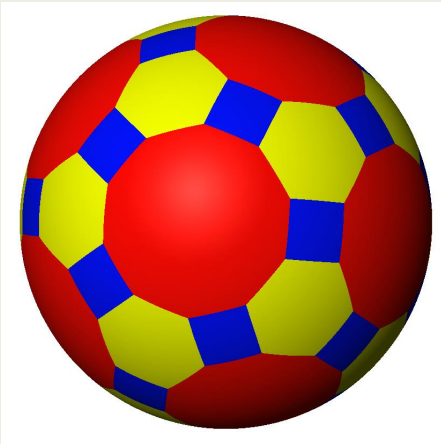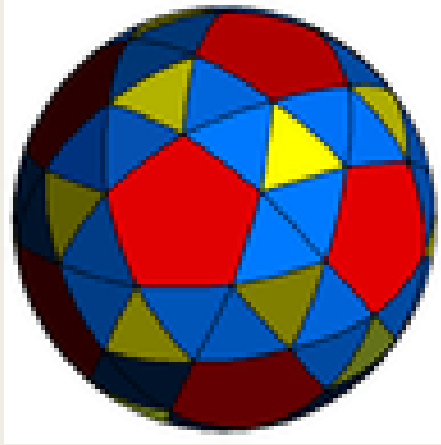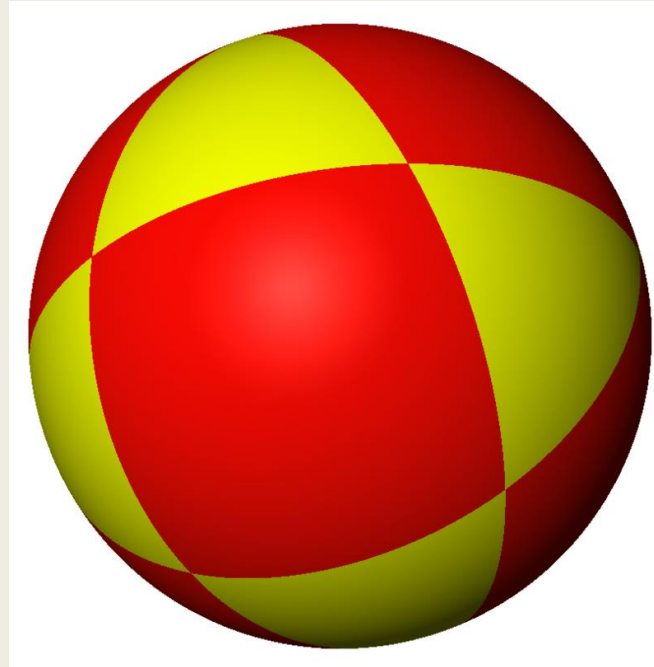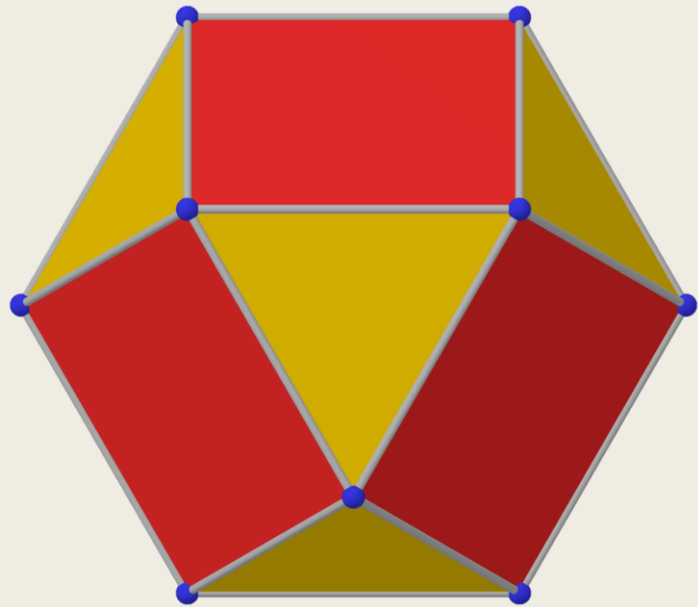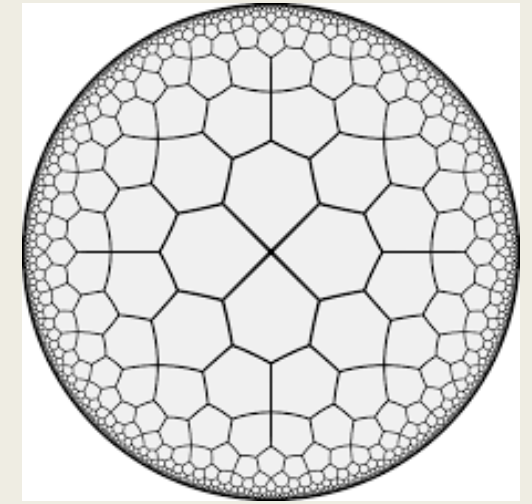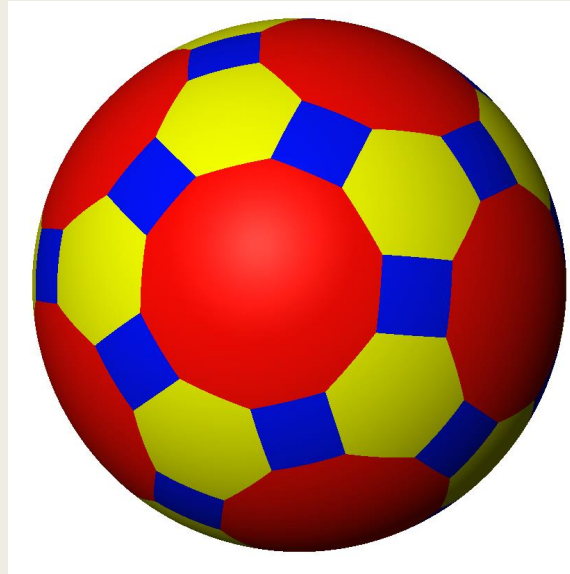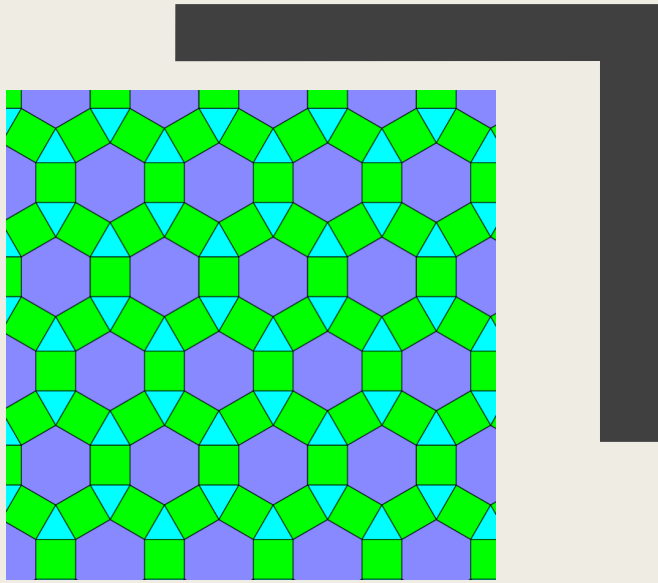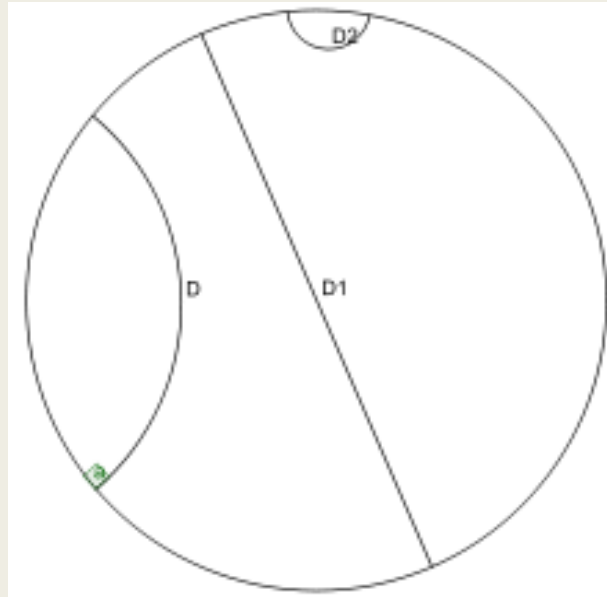spherical tilings

Besides flat and spherical there is a third standard geometry. This is the hyperbolic geometry.

We do not see this one very often, as it does not fit well in our space.
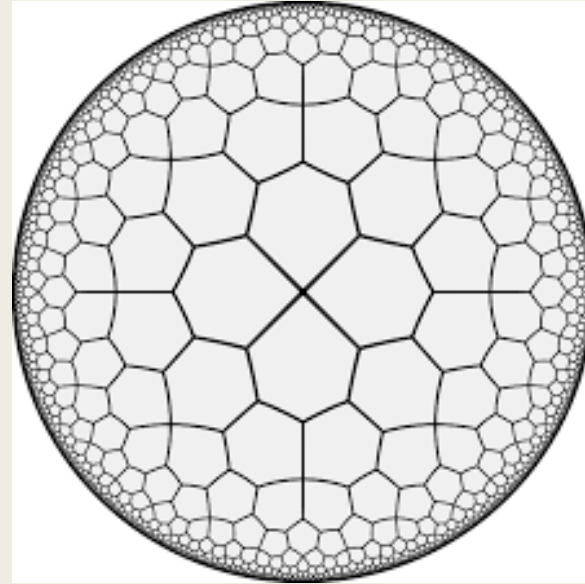
THIS HYPERBOLIC GEOMETRY CAN BE DESCRIBED AS A DISK, WHERE GEODESICS, OR SHORTEST PATHS ARE CIRCLES MEETING THE BOUNDARY AT AN ANGLE OF 90 DEGREES OR STRAIGHT LINES PASSING THROUGH THE CENTER.
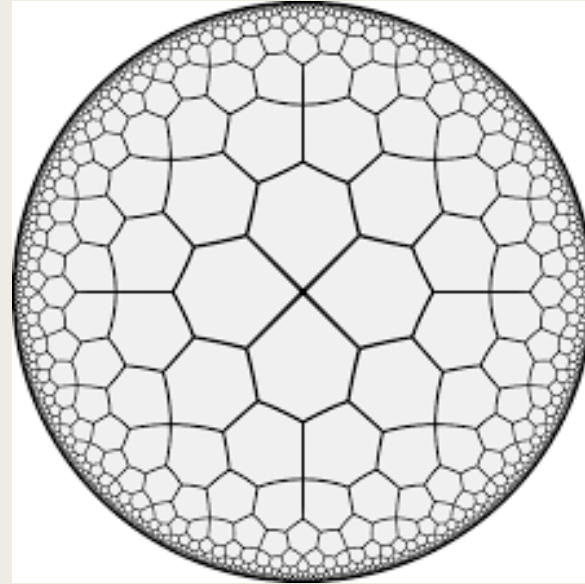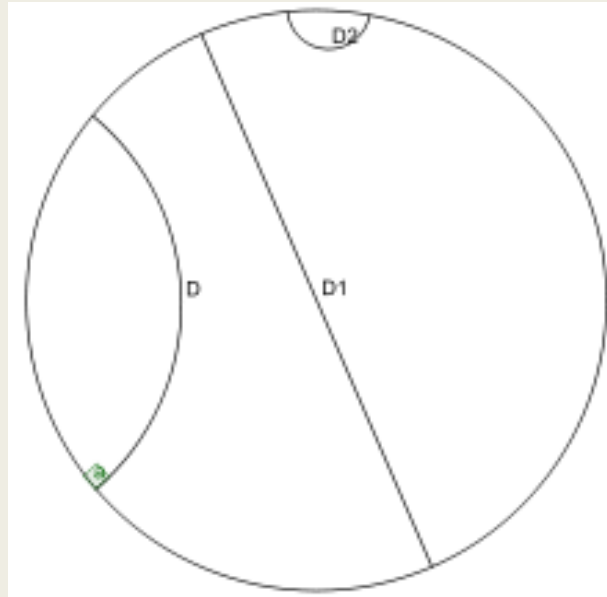
ADDITIONALLY DISTANCES ARE MEASURED DIFFERENTLY, SUCH THAT ALL HEXAGONS ON THE LEFT HAND SIDE HAVE THE SAME SIZE.

(courtesy of Malin Christersson)
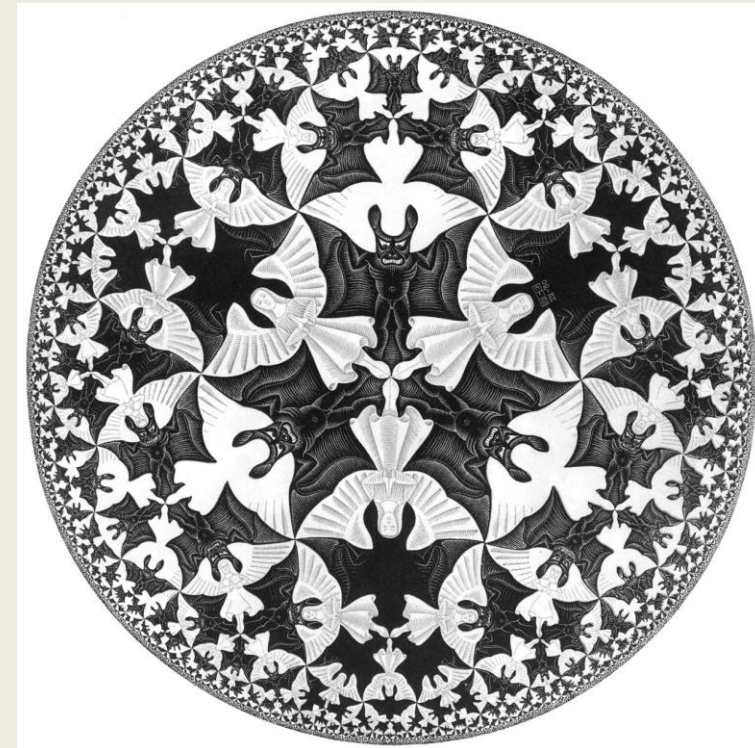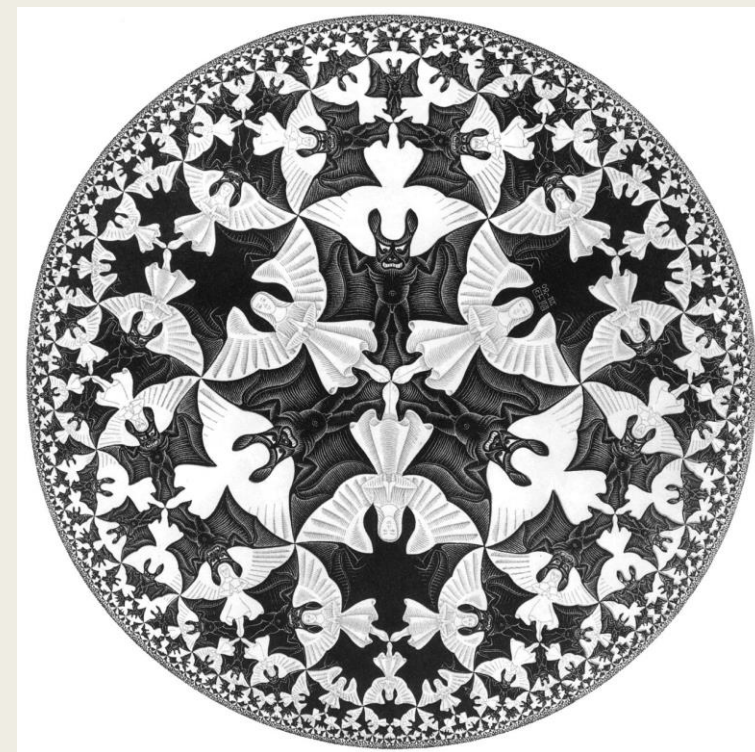
THIS SPACE ALLOWS FOR THE MOST VARIETY OF TESSELLATIONS.

hyperbolic_tilings

IT INSPIRED M.C. ESCHER FOR HIS FAMOUS PICTURES.

THESE CAN NOT BE USED TO TILE THE BATHROOM, BUT MAKE GREAT PLATES FOR THE KITCHEN!

GEOMETILES®

THANK YOU FOR YOUR ATTENTION