SPRINGFIELD MUSEUM OF ART
A Smithsonian Affiliate

Artful Exoplanets: Creating Imaginary Worlds
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Goal: To guide students in exploring known exoplanets, their habitable zones and the likelihood of life on those planets along with creating imaginary life and worlds beyond our own.

Timeline: Program to be used in a 5 day, 3 hour a day camp setting. Easily adapted to integrate into a classroom setting.

- Approximately 4 hours of computer interactives designed by NASA
- Approximately 1 hour of Skype conversation with an astronomical visualization artist
- Approximately 10 hours of creating artwork and hanging the art exhibit.

Outcomes:

- Use code data of exoplanets gathered by NASA to understand facts about specific exoplanets.
- Use code to gather information about weather, light, and time on specific exoplanets
- Use information gathered through code as inspiration for creating imaginary life on a chosen exoplanet.
- Gain mastery of watercolor and paper clay mediums.
- Gain knowledge of the use of color and how it helps the artist tell the “story” of their artwork.
- Gain understanding of the connection between visual arts and other disciplines.

Resources

- Exoplanet Travel Bureau - https://science.nasa.gov/exoplanets/immersive/exoplanet-travel-bureau/
- NASA Eyes on Exoplanets - https://eyes.nasa.gov/apps/exo/
- Harvard Smithsonian Center for Astrophysics Science Education Portal http://waps.cfa.harvard.edu/eduportal/login/index.php
- Recoloring the Universe http://chandra.harvard.edu/edu/pencilcode/
- Astrobiology graphic novels https://astrobiology.nasa.gov/resources/graphic-histories/

Overview

Day 1.

Activity 1: 20 minutes

Students gather to introduce themselves and tell what they like about art or astronomy and talk about some terms that will be important for the week. Students are assigned a computer and login.

Activity 2 & 3: 60 minutes

Students will be introduced to the YouthAstroNet Educator Portal. Students will explore the site together. Students will request images from the robotic telescopes and try image processing for themselves with archived images.

Harvard Smithsonian Center for Astrophysics Science Education Portal
http://waps.cfa.harvard.edu/eduportal/login/index.php

Break: 10 minutes

Activity 4: 25 minutes
Students will launch Alien Safari and Extreme Planet Makeover on NASA's Exoplanet Interactives to explore strange life on earth. https://exoplanets.nasa.gov/interactives/

Activity 5: 35 minutes (with clean-up)

Students will be shown different watercolor techniques that can be utilized when creating their painting of an exoplanet with life. The posters will be talked through to get students thinking about what type of creature could live on different planets.

Activity 6: 30 minutes

Students will be introduced to Exoplanet Exploration and launch NASA's Eyes to explore the discoveries of exoplanets. https://eyes.jpl.nasa.gov/eyes-on-exoplanets.html

Day 2

Activity 1: 30 minutes

Students will be introduced to Computer coding by using Recoloring the Universe interactive. Recoloring the Universe http://chandra.harvard.edu/edu/pencilcode/

Activity 2: 60 minutes

Students will check their image requests from the Youth AstroNet Educator Portal and use the coding to colorize their images.
http://waps.cfa.harvard.edu/eduportal/login/index.php

Activity 3: 20 minutes

Students begin to plan their imaginary life by brainstorming ideas and sketching a plan.

Activity 4: 40 minutes

Students create their foil armatures for their alien clay sculptures.

Day 3

Activity 1: 90 minutes (with clean-up)

Students will work on finishing their armatures if not already completed and then start putting clay on and sculpting it

Activity 2: 90 minutes

Students will explore watercolor techniques and begin watercolor paintings of life on the exoplanet of their choice using the information gathered from NASA's Eyes along with brain storming ideas and sketches created on Day 2.

Day 4

Activity 1: 3 hours

Students will complete watercolor painting from Day 3 and imaginary life using air dry clay.

Day 5

Student will meet at the Springfield Museum of Art to learn how to hang and display their artwork for their exhibition. If time allows students will participate in a gallery activity.

Lesson Plans

Day 1:

Activity 1: 20 minutes Led by Science Teacher/Leader

Students gather to introduce themselves and tell what they like about art or astronomy or both and talk about some vocabulary terms that will be important for the week. Students are assigned a computer and login.

“We are going around the room to introduce ourselves and tell one thing about what you like about art and/or astronomy. I will model this for you:

(fill in the blanks) “I am_____. I like_____ because _____”

Week Overview:

This week we are going to explore exoplanets that have been discovered in recent years and use our imaginations to design life that might be found on these planets.

- Today we will begin by exploring the Harvard/Smithsonian Micro-Observatory and learning how to take photos of the cosmos and coloring those photos. We will look at posters that have been created for NASA by an astronomical visualization artist. We will learn to use 2 other websites from NASA to explore exoplanets and what is known about them. Also, we will learn some watercolor techniques we might use for our exoplanet life.
- Tomorrow we will check out the images we requested from the Micro-Observatory, learn some computer coding skills necessary to discover what elemental gases are on the exoplanets and begin designing our imaginary life on an exoplanet.
- On Wednesday we will learn to use the interactive Planet Maker to design your planet. We will also begin the armatures for your sculptures of life on your planet.
- Thursday will be dedicated to finishing our artwork for it to be ready for the exhibition on Friday.
- Friday we will concentrate on hanging the exhibit and hosting a reception for parents and the community.

Let's look at these vocabulary terms and see how much we already know about astronomy. Have students make their best guesses ot the definitions then give the actual definition.

Suggested Vocabulary Terms

astronomy	astronomer
atmosphere	axis
big bang theory	cosmos
debris	exoplanet
extraterrestrial	gravitational force
gravity	mass
orbit	planet
revolution	visible light

Activity 2: 30 minutes Led by Science Teacher/Leader

Students need to sign into their computers and navigate to:

> Harvard Smithsonian Center for Astrophysics Science Education Portal
> http://waps.cfa.harvard.edu/eduportal/login/index.php

Each student will have an assigned username and password and should go ahead and login. After students login, give a brief overview of the site. Remind them that this site can be accessed from home and all image requests take overnight to process.

The Science teacher/leader will show the group the Requesting an Image Tutorial found at the bottom of the YouthAstroNet Activity Portal under Tutorials and Other Useful Videos.

Following the tutorial students will navigate to the YouthAstroNet Activity Portal and scroll down and click on MicroOservatory Robotic Tools and choose Telescope image request. Students will request multiple image targets from the telescopes. Students need to request images that have three color filters as well as images that have no filters. Remind students that the more requests they make will result in more opportunities to receive images. Not all images are usable due to cloud cover or other atmospheric conditions.

Activity 3: 30 minutes Led by Science Teacher/Leader

The science leader/teacher will show the students the Image Processing Tutorial. Students will return to main menu and scroll down and click on MicroOservatory Robotic Tools and choose **Use Images in JS9** . Students will be directed to choose the same image from the archived images and be led in the image processing process together.

Students will then choose an archived image to process on their own. Depending on time of these activities students may be able to process more than one image.

10 minute break

Activity 4: 25 minutes led by Science Teacher/Leader

Students will launch Alien Safari on NASA's Exoplanet Interactives to explore strange life on earth. Students will open https://exoplanets.nasa.gov/interactives/ launch Alien Safari to explore extreme life on earth. The Science leader will lead a discussion of life on earth in extreme environments.

How might extreme life exist on exoplanets in habitable zones of their stars?

Activity 5: 35 minutes (with clean-up) led by Art Teacher/Leader

Watercolor techniques

Art teacher/leader demonstrate each technique allowing the students 5 minutes to complete before moving on to the next technique.

Supplies:

- Watercolor paper cut in small rectangles approximately 4.5"x6"
- Watercolor paint
- Wax resist crayons
- Table salt and rock salt
- Rubbing Alcohol
- Paint brushes
- Water cups
- Pipettes

Step 1. Give the students 4 4.5"x6" rectangles of watercolor paper so they can practice these watercolor techniques:

a) Wax resist
b) Alcohol
c) Coarse salt
d) Fine salt

Step 2. Drip water onto each color in your watercolor palette to prepare it to be used.

Step 3. Technique 1: wax resist (see Appendix a)

- Using the wax resist crayons draw a simple shape or a series of patterns or lines on a small piece of paper making sure to press hard.

- Color in some part of the shape or pattern with the wax resist crayon, again making sure to press hard.
- Paint over the entire drawing with one color.
- Does the paint cover the lines? What happens to the paint?

Step 4. Technique 2: alcohol (see Appendix b)

- Select several colors of paint and paint the second rectangle making sure it is very wet.
- Use the pipette to drip several drops of alcohol onto the wet surface.
- What happens to the paint?

Step 5. Technique 3 salt (see Appendix c)

- On the third rectangle dip a paint brush in water and paint the entire rectangle.
- Paint the entire rectangle again using color.
- Sprinkle the wet paint with fine salt.
- What happens as the paint dries?

Step 6. Technique 4 coarse salt (see Appendix d)

- On the last rectangle dip a paint brush in water and paint the entire rectangle.
- Paint the entire rectangle again using color.
- Sprinkle coarse ground salt over the wet paint.
- What is the difference between the coarse salt and the fine salt after it dries?

How can these techniques be used in your paintings of life on an exoplanet?

Activity 6: 30 minutes led by Science Teacher/Leader

Science teacher/leader will introduce students to Exoplanet Exploration and launch NASA's Eyes to explore discoveries of exoplanets. Students will either a) use the web version (https://eyes.nasa.gov/apps/exo/) or download the desktop version (http://eyes.jpl.nasa.gov/exoplanets)

Once downloaded the student will open the app and start Eyes on Exoplanets. Students will explore the interactive with the help of the Science teacher/leader. Students will learn of exoplanet discoveries and the habitable zones in these solar systems. This will promote them thinking about the living conditions for their imaginary life and conditions their life will need to survive.

Discussion starter questions:

1. What different environments is life found on earth?
2. What might this mean for life on other planets?
3. What might life look like on some of the exoplanets you have looked at today?

Day 2:

Activity 1: 55 minutes led by Science Teacher/Leader

Science teacher/leader will introduce students to Computer coding by using Recoloring the Universe interactive.

Recoloring the Universe http://chandra.harvard.edu/edu/pencilcode/

Use Recoloring the Universe Virtual Lab to introduce computer coding. Students will navigate to http://chandra.harvard.edu/edu/pencilcode/index.html#activities and begin the video coding activities.

Handouts for this interactive can be found here
http://chandra.harvard.edu/graphics/resources/handouts/lithos/hourofcode_webB.pdf

Pencil and Paper activities can be found here
http://chandra.harvard.edu/edu/pencilcode/pencil_paper.html

Activity 2: 55 minutes led by Science Teacher/Leader

Students will check their image requests from the Youth AstroNet Educator Portal and use JS9 to colorize their images. http://waps.cfa.harvard.edu/eduportal/login/index.php

Students need to sign into their computers and navigate to Harvard Smithsonian Center for Astrophysics Science Education Portal
http://waps.cfa.harvard.edu/eduportal/login/index.php. Students will log in and scroll down to MicroObservatory Robotic Tools and choose **Use Images in JS9** , click on the my list tab. Choose an image from my list and color it using the steps learned in day 1. They should color multiple images and save them to the desktop of their computer. Later one image of their choosing should be added to a portable drive to be printed for the art exhibit.

Led by the Science teacher/leader students will view the tutorial “Creating a True Color Image” and process one image together using an archived image with three filter colors.

Students will then use their own images collected in red, green, and blue to create a true color image.

10 minute break

Activity 3: 20 minutes led by Art Teacher/Leader

Students begin to plan their imaginary life by brainstorming ideas and sketching a plan.

Activity 4: 40 minutes led by Art Teacher/Leader

Foil armature for paper clay figures (see appendix e)

Supplies

- Foil
- Masking tape
- Toothpicks
- Bamboo skewers
- Popsicle sticks

Steps:

1. Compress pieces of foil in shapes that represent the imaginary creature.
2. Any appendages can be represented by toothpicks, bamboo skewers or popsicle sticks stuck into the foil shape and securely taped into place.
3. Make sure the armature can stand or sit un-aided.

Students can take a look at the graphic novel Astrobiology Living beyond the solar system for further inspiration https://astrobiology.nasa.gov/resources/graphic-histories/

Day 3:

Activity 1: 40 minutes led by Art Teacher/Leader

Leader will demonstrate adding the paper clay to the armatures and smoothing it out or adding texture. (see Appendix f)

Students finish their armatures if they are not already completed and begin sculpting using the paper clay.

Activity 2: 40 minutes led by Science Teacher/Leader

Science teacher/leader will guide students to use the Planet maker interactive.

Planet Maker - http://planetmaker.apoapsys.com/

Students will use this site to design a planet including the atmosphere, moons, star and surface of the planet. This will be used as inspiration for the watercolor paintings of the planet and its life form.

Break: 10 minutes

Activity 3: 90 minutes led by Art Teacher/Leader

Students will sketch their life form onto watercolor paper and begin paintings incorporating techniques learned on Day 1.

Day 4:

Activity 1: 3 hours

Complete Watercolor painting and clay sculpture

Students should finish the watercolor painting started on Day 3 and/or take this time to finish the clay sculpture started in activity 1.

Alternate activities for students that finish early

1. Mini-zine: Follow folding instructions attached to last page (See Appendix g) to make a mini comic book about their alien life and planet. Encourage them to draw out pictures and color, as well as captions describing the action
2. Shadow box of planet: Use jewelry box halves to decorate with tissue paper and modge podge and a mini colored sculpture of life using Crayola air dry clay. Decorate with trinkets such as sequence, beads, etc.

Day 5:

Students meet at the Springfield Museum of Art to learn to curate an exhibit.

Activity 1: 20 minutes led by Art Teacher/Leader

Matt artwork

Using precut matt board students will frame watercolor paintings.

Activity 2: 30 minutes led by Art Teacher/Leader

Curating the Exhibit

Discussion Questions:

1. What pieces in the body of work are similar?
2. What to the pieces have in common?
3. What pieces have similar colors?
4. What pieces are most different from the others?
5. What pieces should be next to each other?

Begin laying the work around the gallery in categories as the questions are being answered. Have students work together to organize work.

Activity 3: 60 minutes led by Art Teacher/Leader

Hang Exhibit

Students will measure and hang each piece, choose pedestals for displaying paper clay sculptures and place labels for exhibition.

Activity 4: 30 minutes led by Art Teacher/Leader

Gallery Tour

Students will be broken up into groups or taken as a whole depending on the behavior and size of the group through the galleries to discuss artwork on view. Use the Looking Closer handout found on the last page of this curriculum.

Activity 5: 30 minutes led by Art Teacher/Leader

Chalk drawing Mural Collaborative

Using an image from the permanent collection prepared in advance by cutting into one-inch squares, students will each receive a square to draw on the sidewalk to complete the image chalk mural.

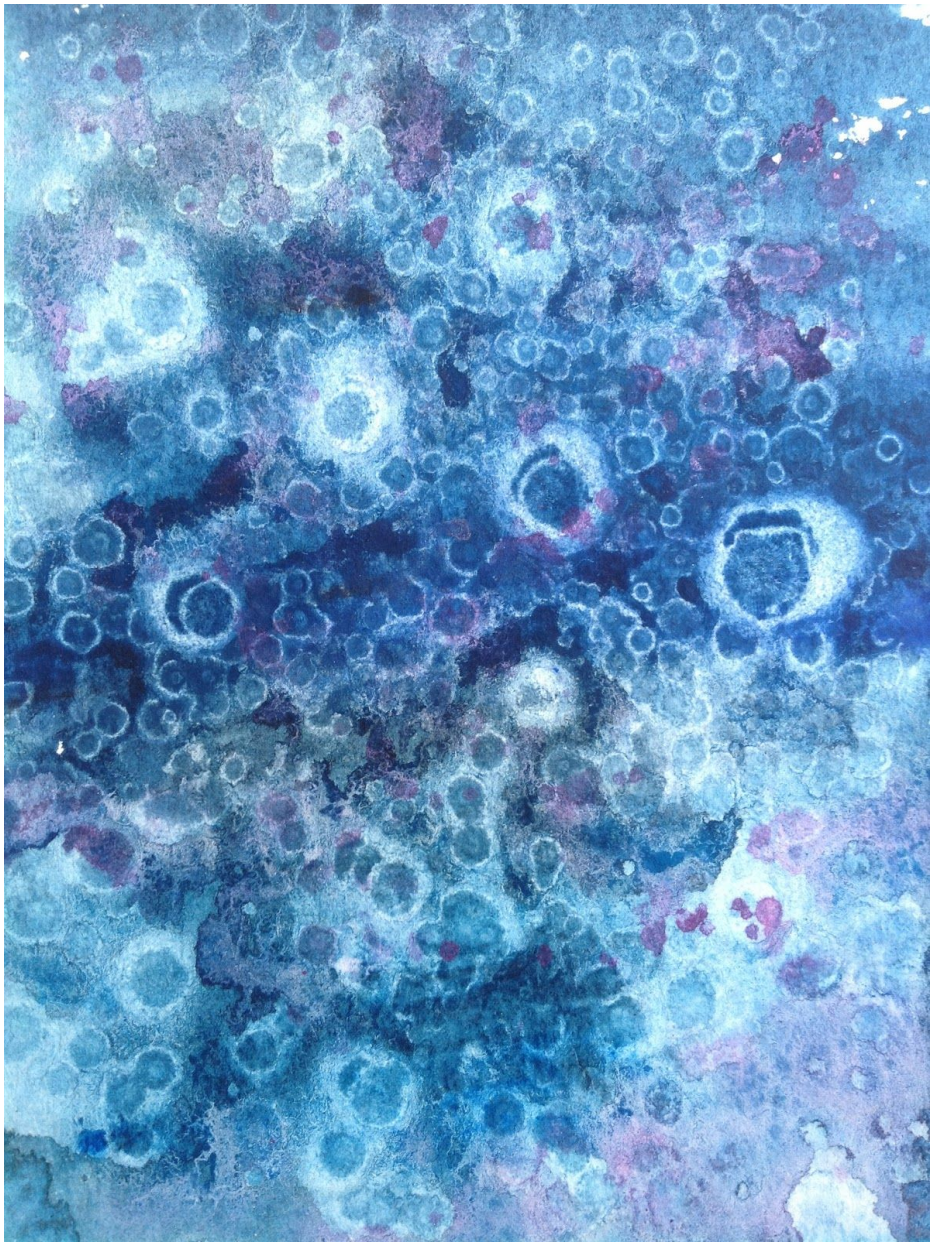
Activity 6: Open ended

Parents and Reception

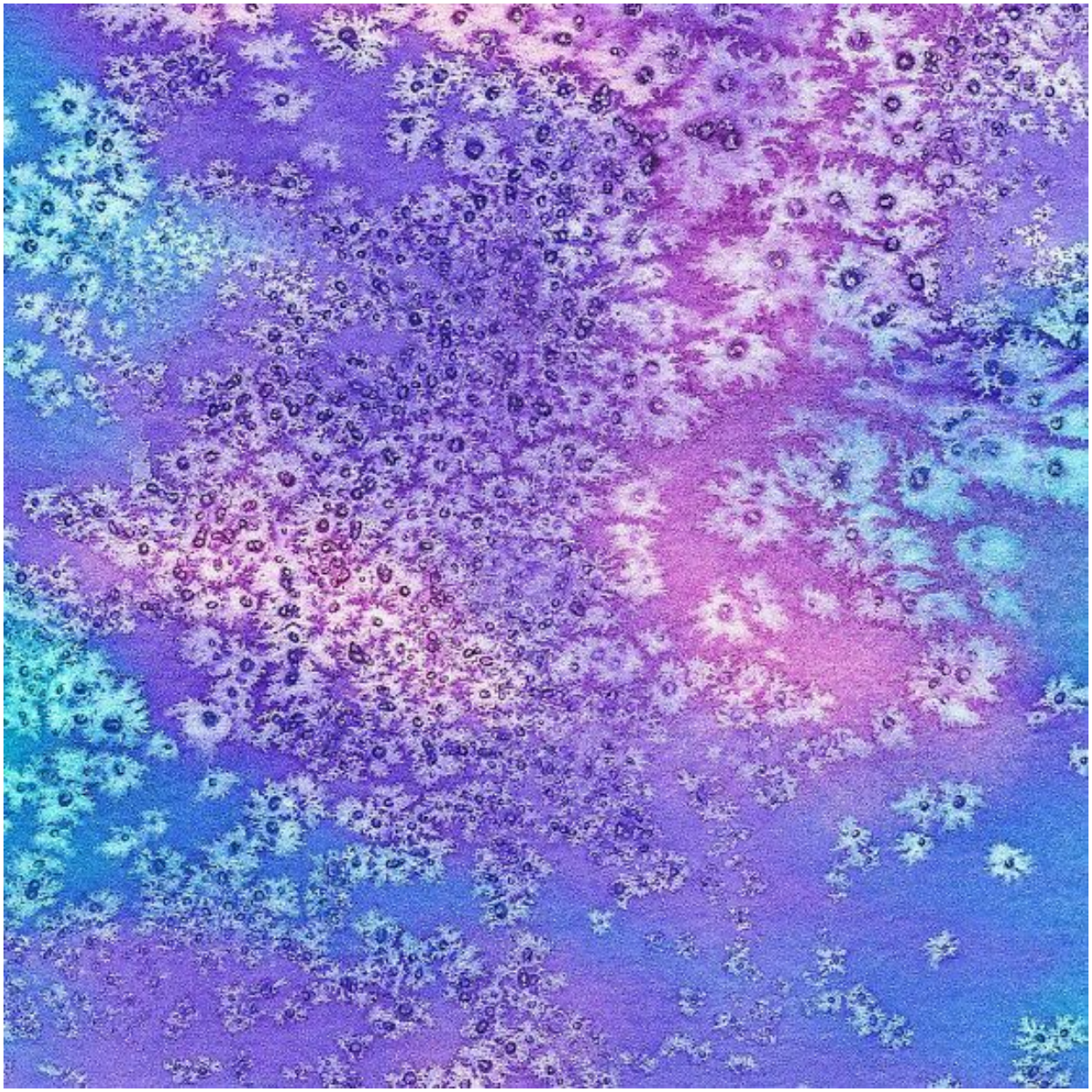
Parents arrive and walk through the gallery viewing the artwork created by the students and visit the outside chalk mural.



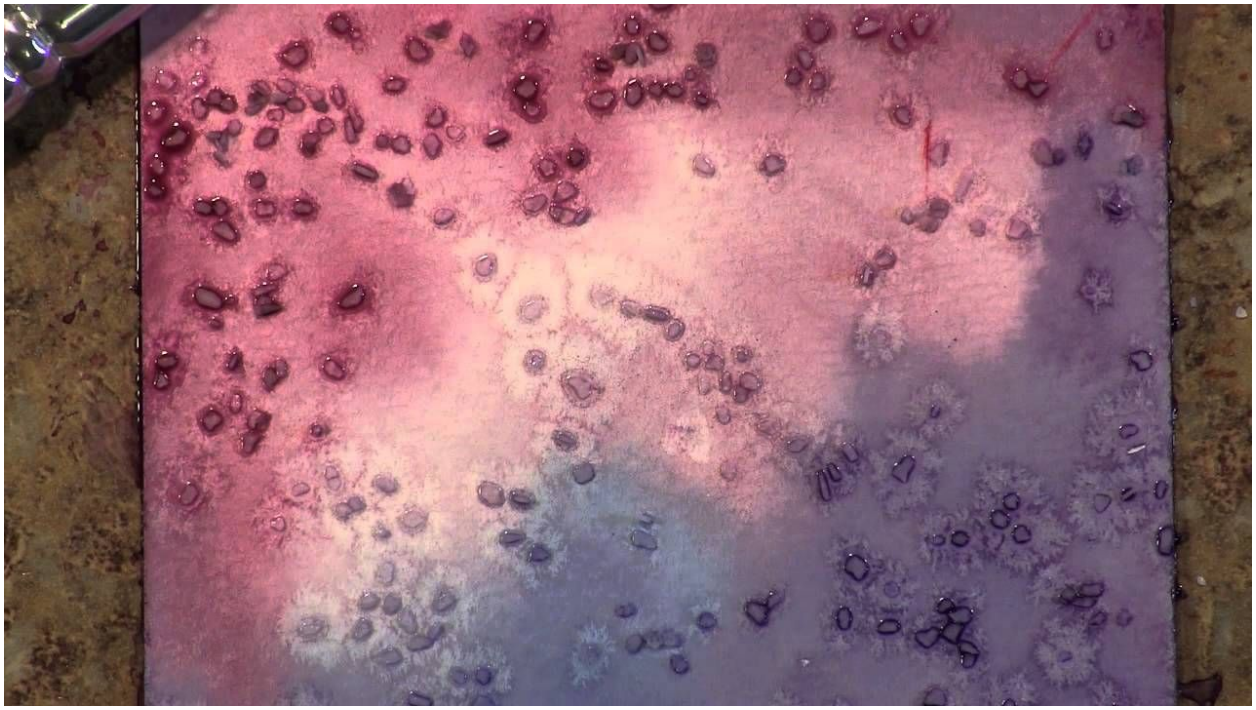
Appendix a



Appendix b



Appendix c



Appendix d



Appendix e (use wooden skewers and toothpicks in place of wire)



Appendix f