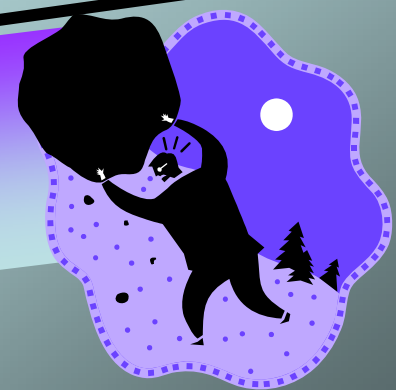


Learning GIS Inspires a Special Ed Student to Overcome Obstacles

by Sara Masters, MEd, MSIS
Computing Workshop



Abstract

In a month-long annual Computing Workshop, **an autistic HS student was inspired by GIS to teach others and to pursue GIS studies, which will lead him to more advanced math courses than was previously expected.** The first year, he began GIS and quickly understood its spatial dimensions and how it integrates many facts into visual images. As an autistic person, visual imagery is inherently important, sometimes eclipsing verbal communication. That summer and the next, he spent about 4 hours a week for several weeks learning GIS and was inspired to design a PowerPoint that neatly taught another special education student. Besides inspiring socialization and purpose in life, it specifically led him to consider taking an upward path in math, continuing with the second Algebra course in a series instead of dropping into the lowest math—only because he learned it was necessary if he wanted to continue with GIS studies.

Using GIS to lead visual learners toward math and science careers

Contents

- Visual / Spatial Learners**
- GIS and Spatial Skills**
- Implementing GIS**

Visual Learning Modality

Cynthia Tobias, in *The Way They Learn* (1994, 99-92)) defined these.

How do we Remember?

- **Auditory**
- **Visual –**
 - needs an illustration to understand
 - drawn to flashy, colorful objects
 - books with graphics
 - daydreaming while listening? – mental picture
- **Kinesthetic**



Multiple Intelligences: Spatial

Cynthia Tobias also described these, from Howard Gardner.

How many ways can we be Smart?

Linguistic, Logical-Mathematical, Musical, Bodily-Kinesthetic, Interpersonal, Intrapersonal, and **Spatial:**

- think in vivid mental pictures
- easily recreate or restructure a given image
- professions include: architecture, drafting, and mechanical drawing.



Learning modality or disability?

- Giving these learners an explanation using **words** often fails

Tobias (152) says: **“Many students who are struggling in school simply have learning styles that are incompatible with the structure of the traditional classroom and academic demands.”**

- + On the other hand, a **Visual/Spatial** overview of the whole picture may trigger spontaneous understanding



Example

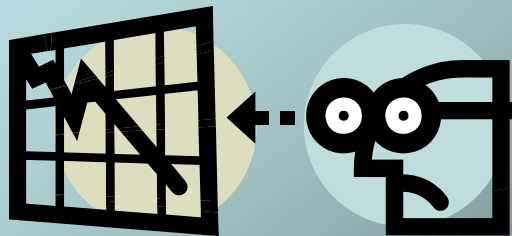
from *Computers, Education and Special Needs* (Goldenberg et al)

In the book, a 9th grade student has a
“...sophisticated sense of perspective and
proportion...”



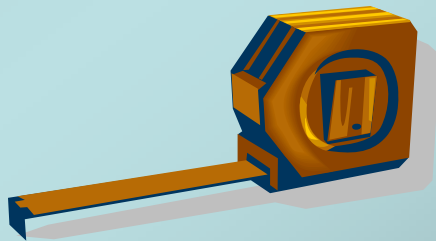
But

“...has difficulties in school...” and is
“...performing well below her potential.”

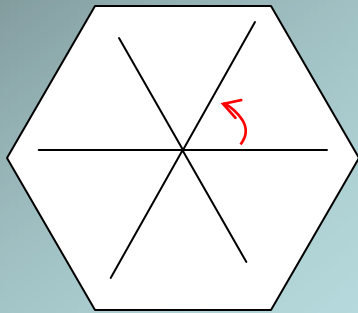


Case Study – 9th grade student

While work in mathematics is considered ‘borderline,’ “She almost always answered questions about length and angle correctly.”



Visual /Spatial Learner



Question:

How many degrees in one interior angle of this equilateral figure ?

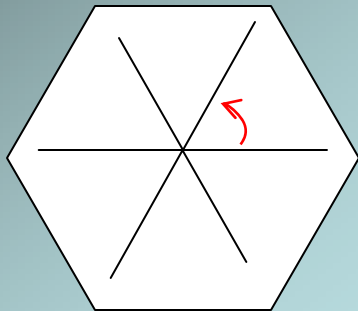
Answer:

60 degrees

Formula

$$\frac{360}{\textit{number_of_sides}} = \frac{360}{6} = 60$$

Visual /Spatial Learner



Question:

How many degrees in one interior angle of this equilateral figure ?

Answer:

60 degrees

Formula

$$\frac{360}{\text{number_of_sides}} = \frac{360}{6} = 60$$

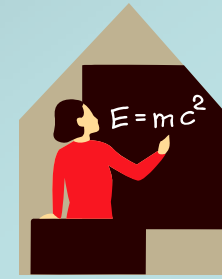
or

Visual

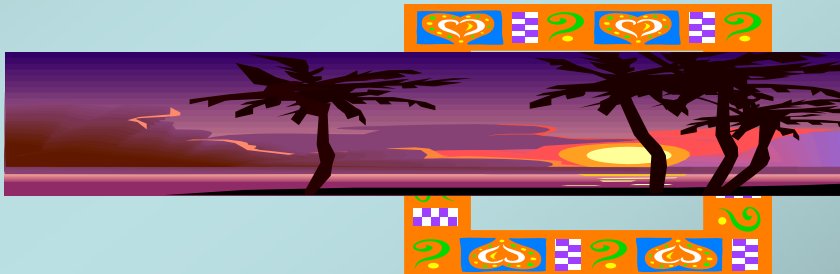


I could just tell it was 60.

Math or Not?



- ❖ Some students are visual/spatial:
 - ❖ Learning disabilities, Autistic spectrum. Artistic abilities
 - ❖ Belittle themselves for not being smart
 - ❖ Avoid math classes: No wonder. They're placed in the most boring math classes, with no elegant shortcuts.

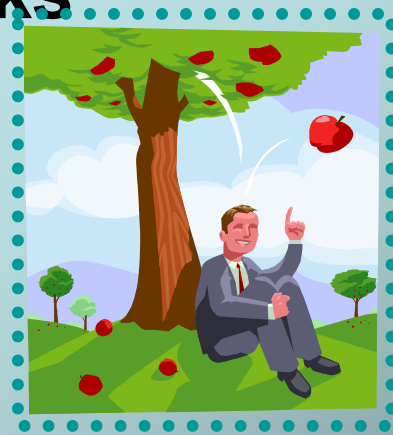


Predicament: Unknown Math Potential Hidden by Their Appearance!

1. **Not allowed to use computer labs, and**
2. **Placed in lowest math tracks**

Perhaps Due to:

- Slurred words
- Lack of self-confidence
- Unusual way of speaking
- Won't look people in the eye (autistic)
- Distaste for words and equations, preferring visual

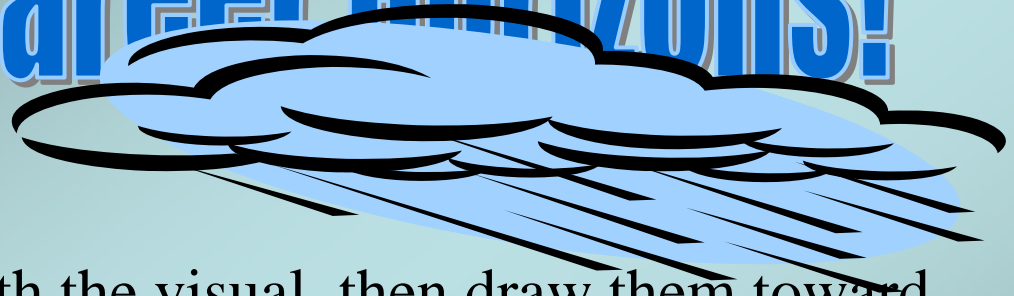


Predicament: Unknown Math Potential Hidden by Their Appearance!

Problems Specific to Autistic Spectrum, in different degrees:

- No ability to take others' perspective (a Theory of Mind deficit)
- Turn taking
- Issues with the abstract
- Visual learning instead of verbal lectures
- Memory retention
- Echolalia (repeating words)
- Difficulty planning ahead

Open Up Career Horizons!



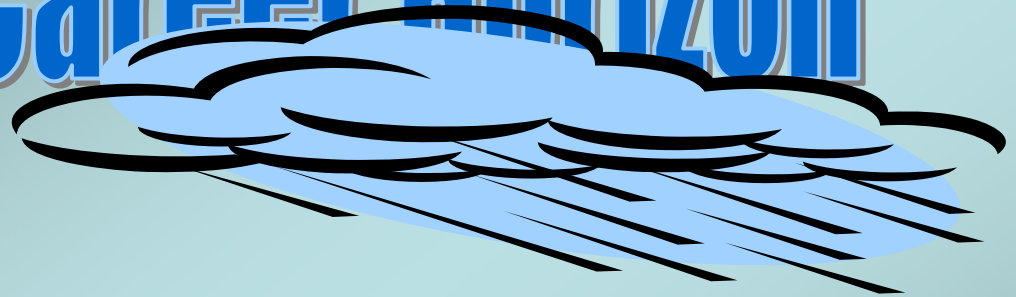
- ❖ Engage these students with the visual then draw them toward standard, textual notation
 - ❖ Convey value of using text and numbers

GIS is a great medium for this!

Change the Curriculum:

- **Adjust learning modalities; speed up learning**
- **Various needs, struggles**
- **Goal – get them to successful careers.**

Open Up Career Horizon



- **Many students with learning disabilities are visual learners.**
- **Autistic – visual + high math scores**
- **I also notice that my online Art school students – can do math, but have low self-esteem**

Open Up Career Horizon



Curriculum:

- Use a Visual mode, such as a game which designs Bridges, but demand measurement (or the Bridge will fall down!)
- Trick them into using their hidden Math abilities



GIS and Spatial Skills

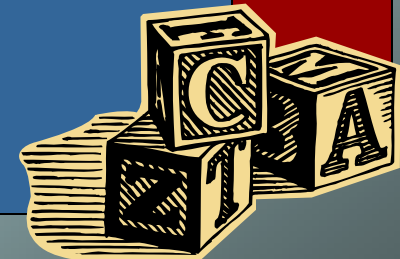
From an **official** U.S. NRC Report (2005)

Learning to Think Spatially:

GIS as a Support System in the K-12 Curriculum

(314 pages!)

**Recommends integrating
spatial thinking into the
existing K-12 curriculum.**



Spatial Thinking

“Spatial thinking is a skill used in everyday life, the workplace and science to solve problems using concepts of space, visualization, and reasoning...”



Their examples

Spatial Thinking

...visualizing relationships of spatial structures in terms of locations, distances, directions, shapes, and patterns...”

(Committee 2005)

...sounds like GIS!

GIS and Spatial Skills

Spatial skills have long been linked to math and science abilities.

For instance, Elizabeth Fennema, (GEMS speech, 2002) said,

“We found that ... spatial visualization is positively correlated with mathematics achievement “

GIS and Spatial Skills

GIS is:

- visually compelling
- linked to **accurate factual data**

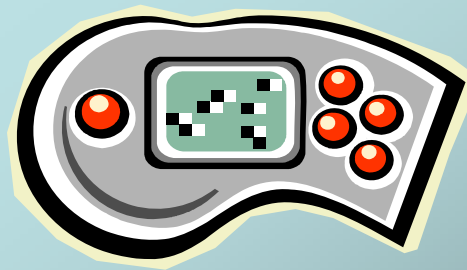
“GIS is a teaching tool that faculty can use to help students visualize complex spatial relationships in many disciplines.”

--July 2006 *ArcUser*, Ann Johnson

Capture their imagination

How can we capture the student's imagination, while developing spatial abilities, navigation, and accurate measurement? Maybe VR, video games, CAD...?

GIS!



Through GIS, visual /spatial learners can be influenced to learn more about math and science.

Implementing GIS

My opinion:

- **Allow students to work through the GIS tutorials provided with the software, with minimal support in an open lab. [An example follows.](#)**
- **Create more lesson plans and curriculum integrated with other subjects.**

GIS is inspirational

**Autistic HS student
learned math
through GIS and
now pursues GIS
studies**



*Photo by Mary Hart

Conclusion

**GIS opens up new possibilities,
expanding mathematical horizons for
Special Needs and others.**

Conclusion

Give them one-on-one experiences, where they can pursue their particular bent. If they are attracted to the visual layers of GIS and have hidden math abilities, finding success in an occupation would save the country millions of dollars (vs. welfare) and bring purpose and happiness to their lives.

Conclusion

As the student learns GIS, he/she will most likely gain confidence and TAKE MORE MATH and SCIENCE, which this country needs!

A student's history

In 2005, the author tutored a 9th grade Special Needs student, using *Cognitive Tutor: Algebra I* (software and book) in order to make his **return to public school** easier for him. He had been in a special needs school for years.

He also studied GIS with the author, using tutorials from the book *Getting to Know ArcGIS Desktop, 2nd edition*, an ESRI book by Ormsby, Napoleon, Burke, Groessl, and Feaster. **Because of his autism, he caught on quickly to the visual style of GIS and was very enthusiastic about it.** For both combined, we spent about 4 to 8 hours/week together for 4 weeks.

As he wanted to become a teacher, he began to create a PowerPoint that would teach GIS to others. He designed everything himself. I showed him how to create screen shots, but he completed them himself and decided exactly what to put on each slide.

A student's history - 2

The second year, 2006, the author tutored him again for several weeks of the month-long workshop. This included GIS and designing simple virtual reality environments and characters.

We were pleased to hear that **he had completed the Algebra I course successfully with a B**, during the intervening school year.

Unfortunately, his family viewed his future as dim, so they were pushing him into the Business Math track, dropping Algebra II.

A student's history - 3

Wonderfully, the now 10th grade student began to ask about how he could achieve a career in GIS. I showed him GIS career advice:

Careers in GIS --

<http://www.gis.com/jumppages/homepage/career1.html>

Then we began to look at GIS majors at the college he is hoping to attend. When he discovered that a high level of math was required, he began to get excited about following **a higher track of math**, including Algebra II, which was reasonable, since he had passed Algebra I with a B. **Suddenly, the possibilities for his life were set on a different course!**

Description of Workshop

The *Computing Workshop for Special Needs Students* is a month-long, annual event that opens up career and educational opportunities for secondary level special needs students who have cognitive differences such as autistic spectrum disorder, mental retardation, and learning differences that otherwise block them from pursuing their computer interests (such as digital image editing, photography, animation, web design, programming, and virtual reality). Students are tutored one-on-one and in small groups. Social interaction and innovation are encouraged.

An autistic student quickly designed and produced the following slide show -- Learning GIS.



Although he was given some help while **learning** the *ArcGIS Desktop* tutorial and how to take screen shots, **he decided on his own how to teach this to another student.** He had no help while he quickly organized the most important features, took screen shots, and added colors. One computer showed his PowerPoint while the other student followed his directions on a second computer. He did this completely on his own.

Intro to Slide Show - 2

After learning GIS, he wrote:

“I was on this career site and I was searching and **I saw this career that looked interesting. It was called GIS specialist.** It looked interesting because I like maps and computers, so I figure this career is perfect for me.

I am taking courses at my High School to help me get ready for this career. The courses I am taking are CAD (Computer Aided Drafting), and some other computer classes that I forget at the moment...

My second career choice if I can't be in GIS is a sports writer.”

Acknowledgments

- I would like to thank Mary Hart for co-founding the Computing Workshop for Special Needs Students, and allowing creative freedom and encouraging hope, for faculty and students in her annual workshop, and
- Friends and family, including Dan Ritchie, Chip McCormick, Noboru Matsuda, and Peter Brusilovsky for good advice on this Presentation, and
- ESRI for inviting me here.

Appendix A:

**Student slide show
“Teaching GIS”**

Learning GIS 9.1

By *name omitted*

2006

GIS Links

[GIS video](#)

<http://www.gis.com/index.html>

Learn GIS

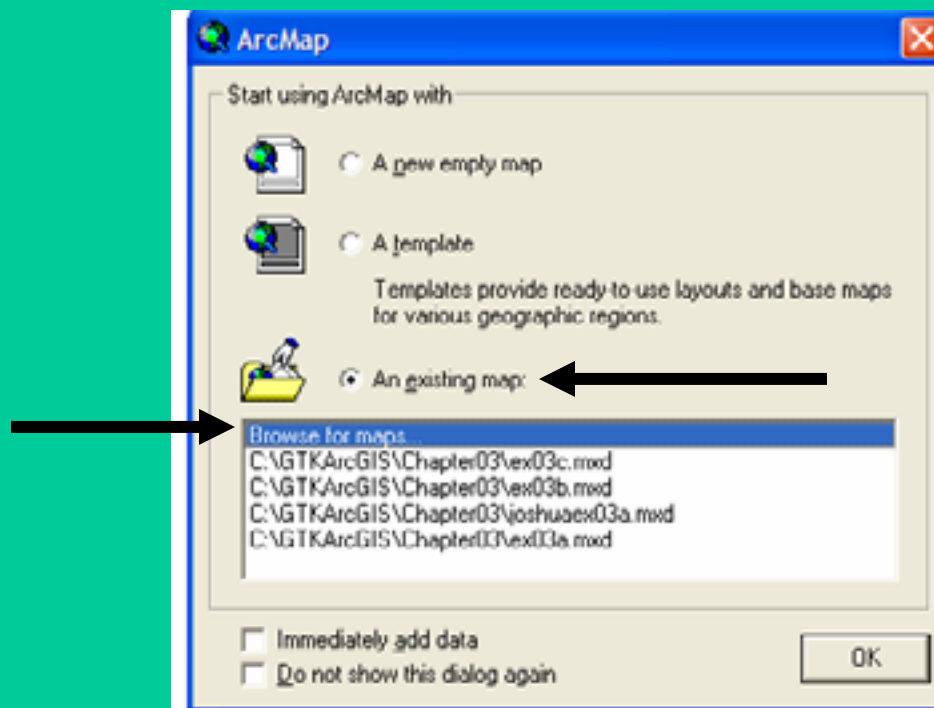
careers IN GIS

http://www.gis.com/careers/geospatial_career.html

Opening a Map

1. Go to Start/Programs
2. Open ArcGIS
3. Go to ArcMap

Choose “Existing Map” and “Browse for maps”



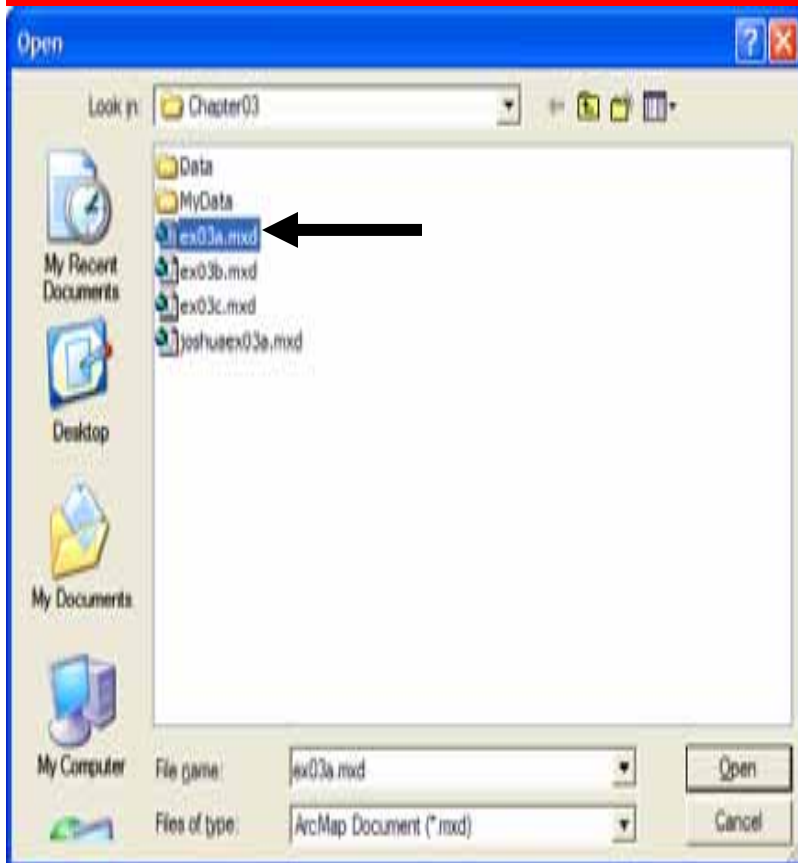
Choose a Chapter

Ch 3

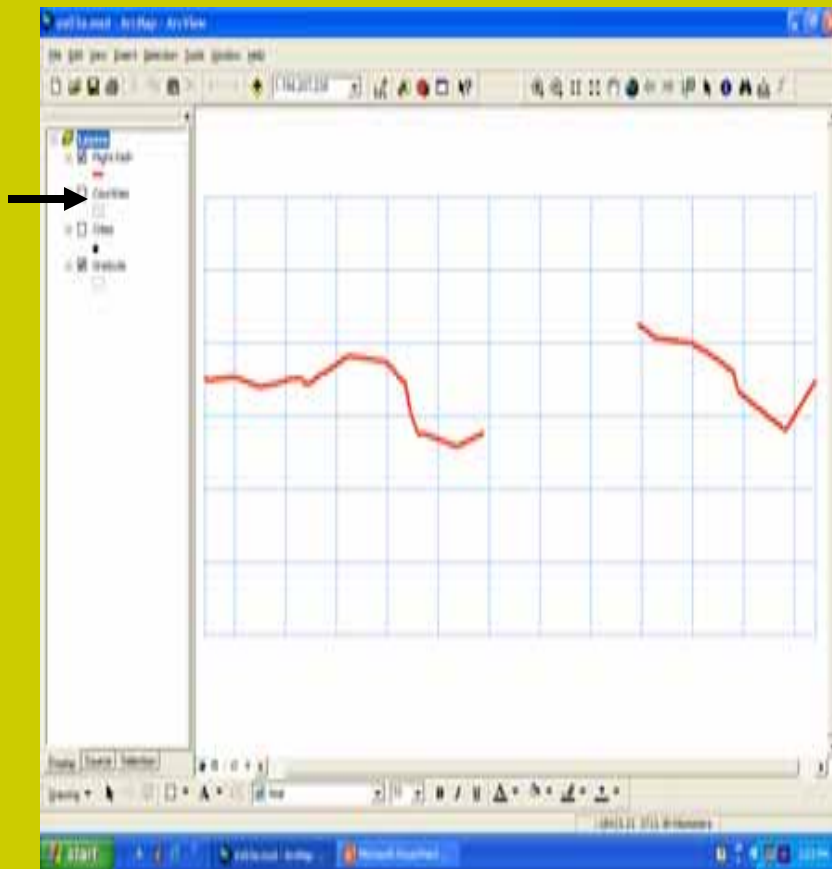
Choose

C:\GTKArcGIS\Chapter03

Click **ex03a.mxd**



Map ex03a.mxd



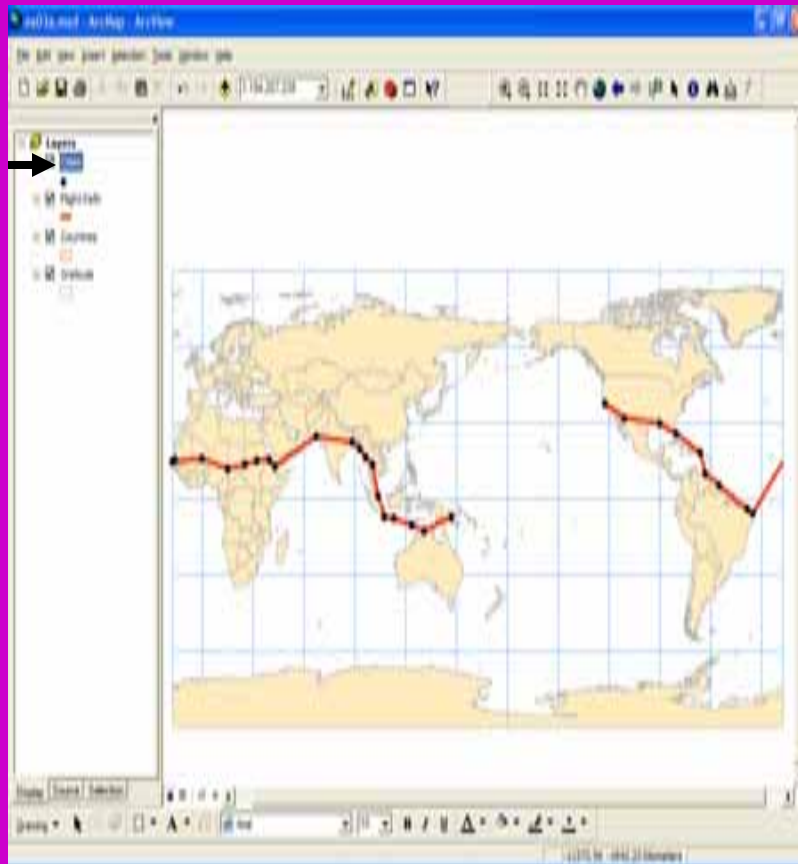
- Click on the check box next to the countries layer to make it disappear

Map ex03a.mxd



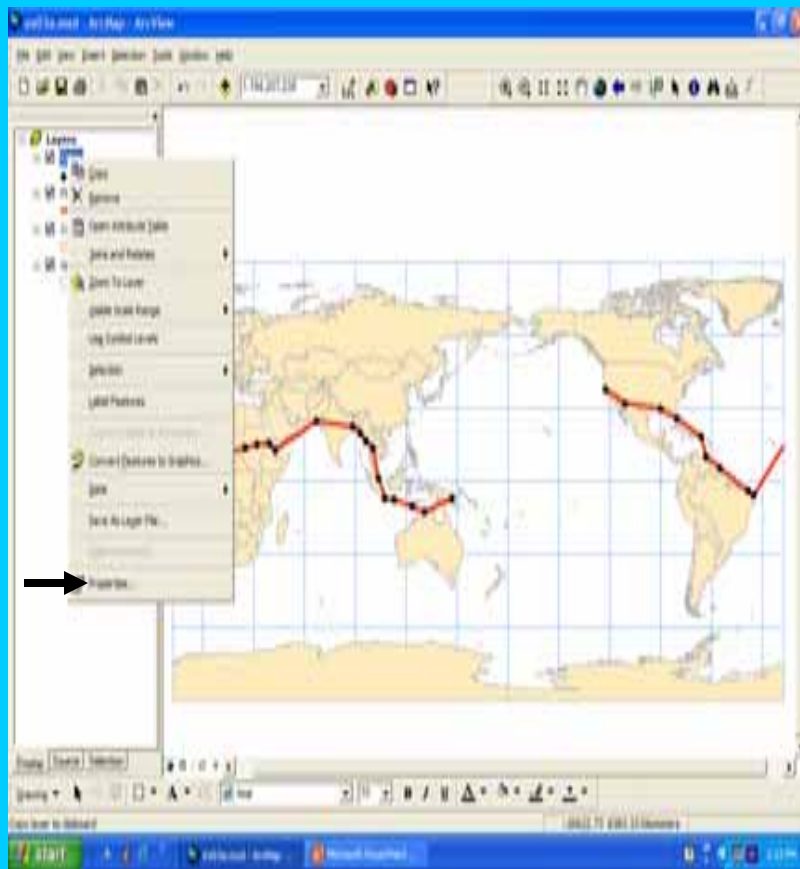
- Click the Countries checkbox to make it reappear

Map ex03a.mxd

















- Click On the cities layer to highlight it and drag it to the top

Map ex03a.mxd

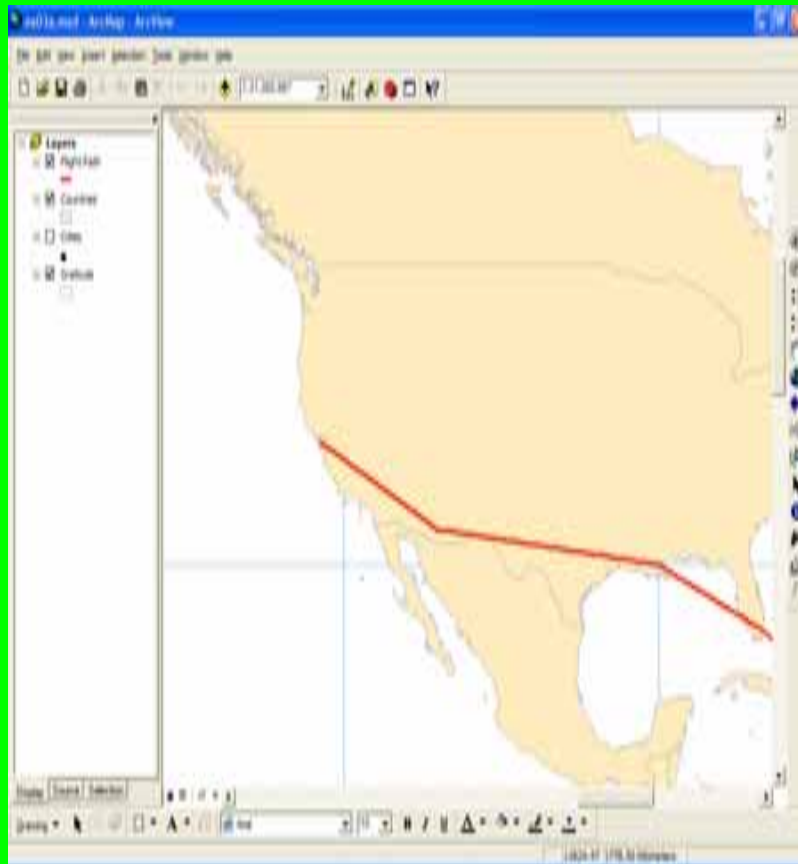


- Right click on the city layer name, A Context menu opens
- Click Properties

Tools

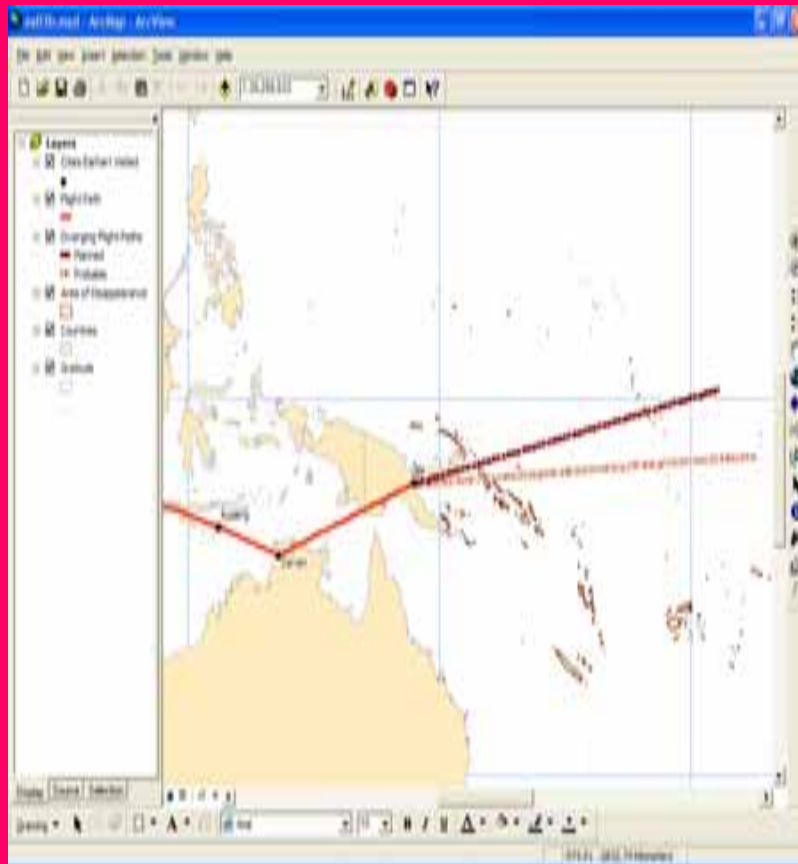
-  Zoom In
-  Zoom Out
-  Fixed Zoom In
-  Fixed Zoom Out
-  Pan
-  Full Extent
-  Previous Extent
-  Next Extent
-  Select Features
-  Select Elements
-  information
-  Find
-  Measure
-  Hyperlink

Map ex03a.mxd



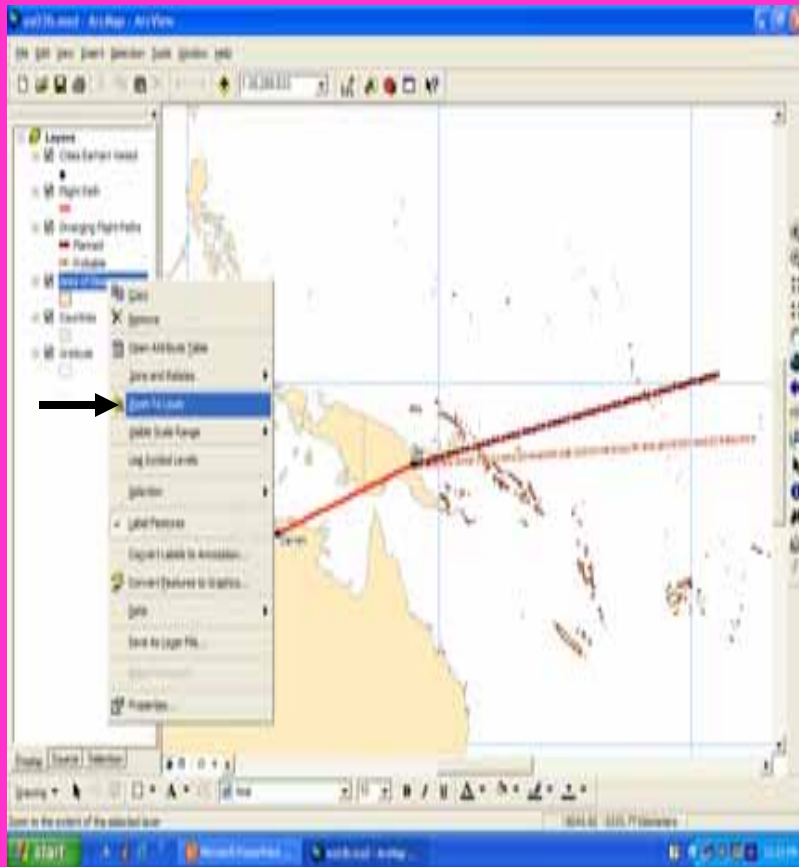
- Click the zoom in tool
- Move the mouse pointer over the map
- Drag a box around the United States

Map ex03b.mxd



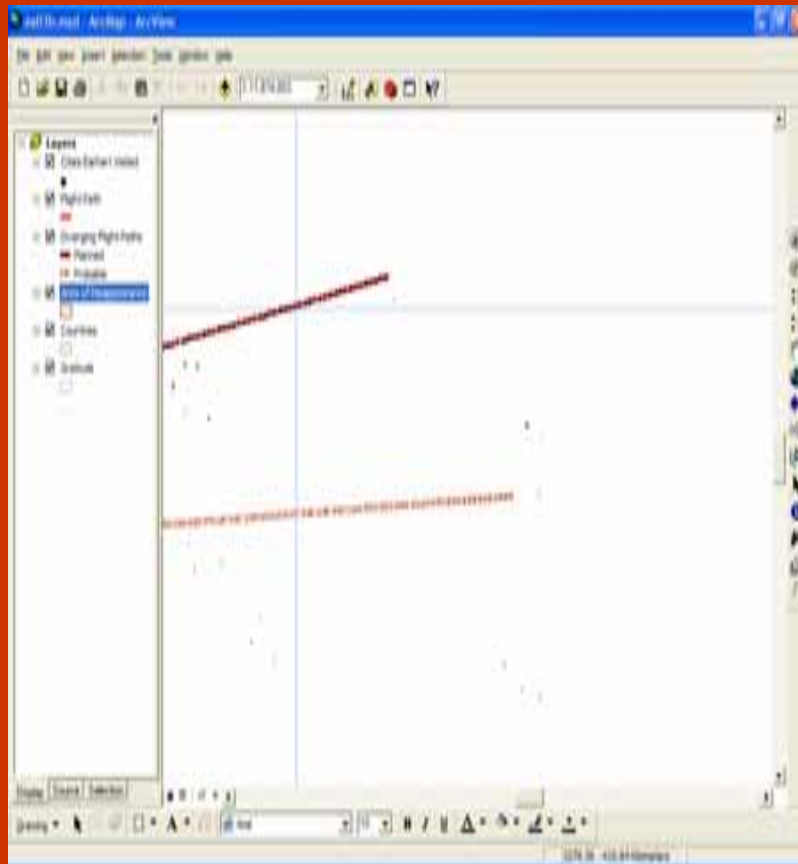
- After Map ex03b opens click the zoom in tool
- Place the box over Southeast Asia
- Click on the PAM tool
- Drag the display left to follow the flight path

Map ex03b.mxd



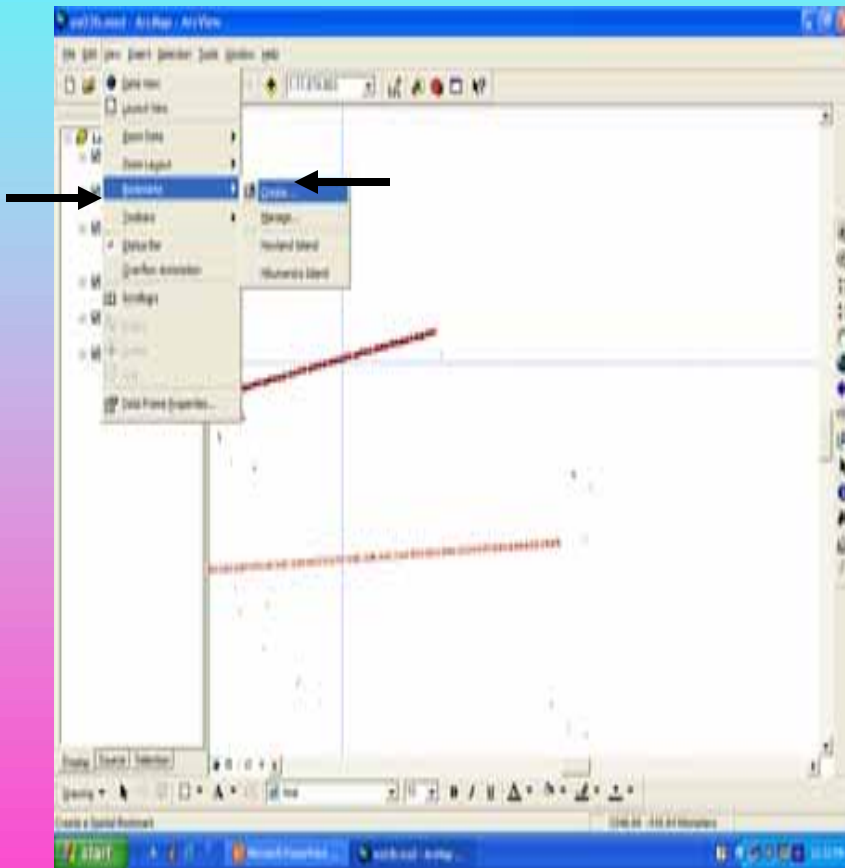
- In the table of contents Right Click on area of disappearance and click on zoom to layer

Map ex03b.mxd



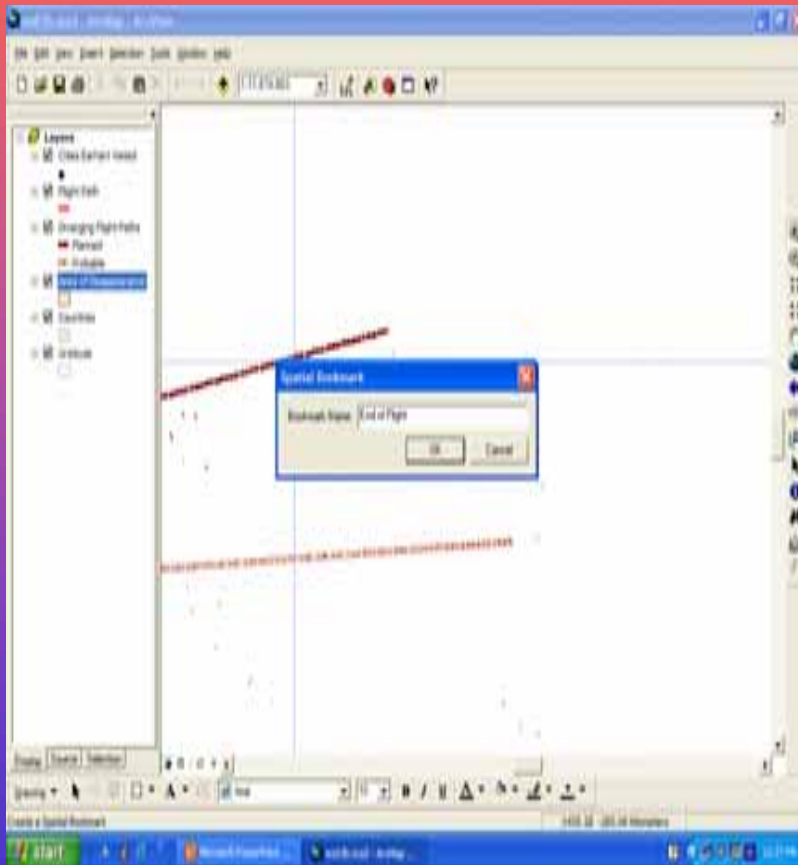
- On the tools toolbar,click the zoom in toolbar.
- On the map Draw a rectangle that includes the ends of both flight paths.

Map ex03b.mxd



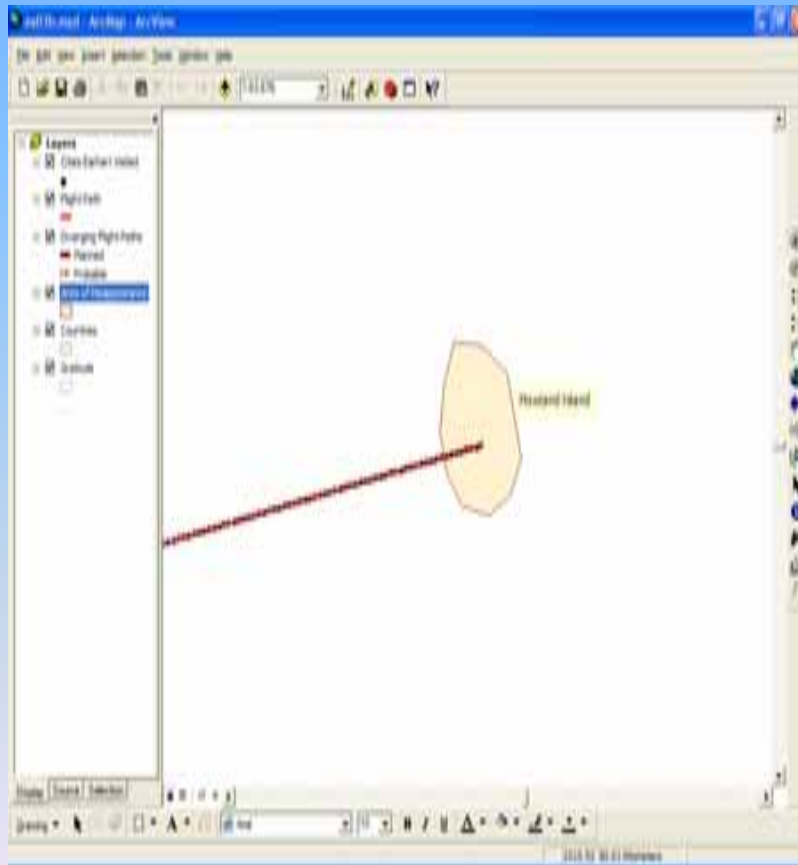
- Click the view menu
- Point to bookmarks
- Click Create

Bookmark



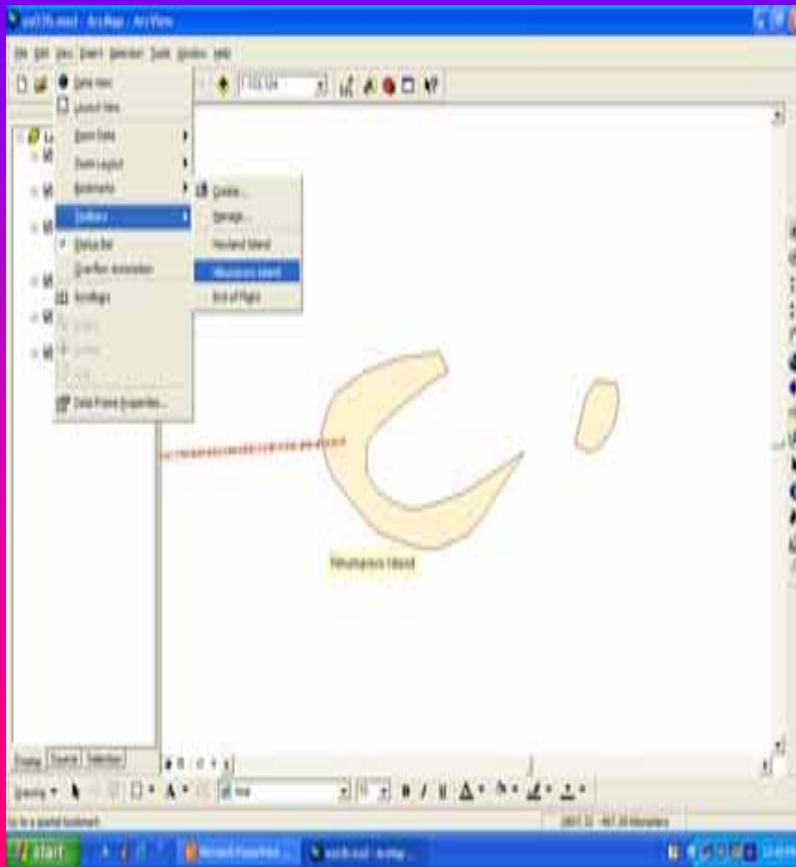
- Replace existing text with End of Flight
- Click Ok

Bookmark



- Go to View
- Click Bookmarks
- Click Howland Island

Bookmark

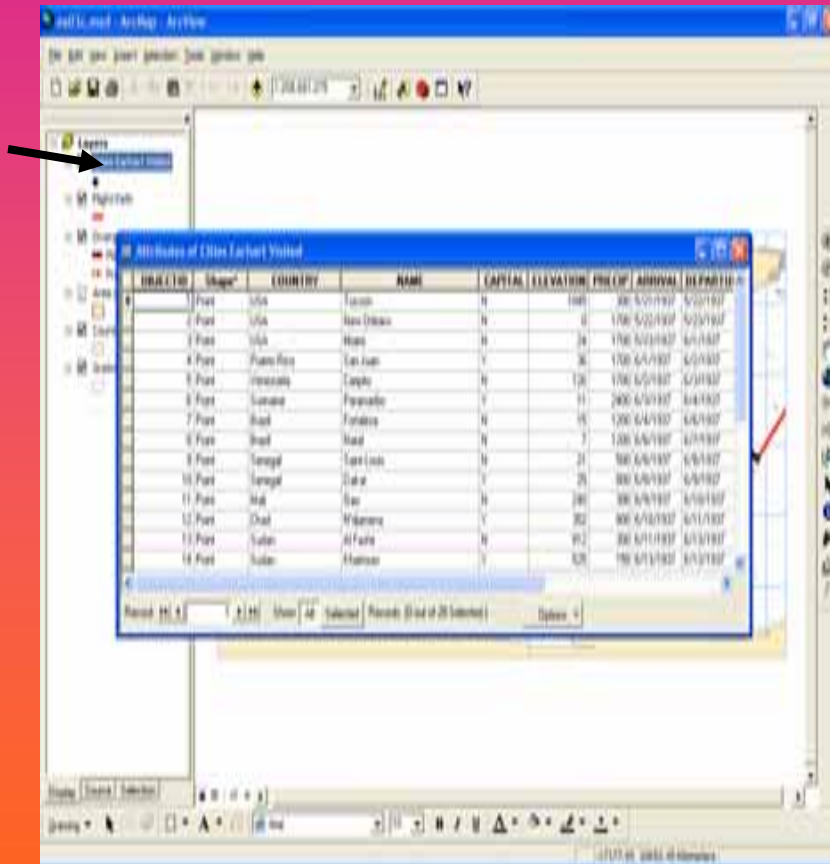


- Again Go to View
- Click Bookmarks
- Click Nikumaroro Island

Bookmark

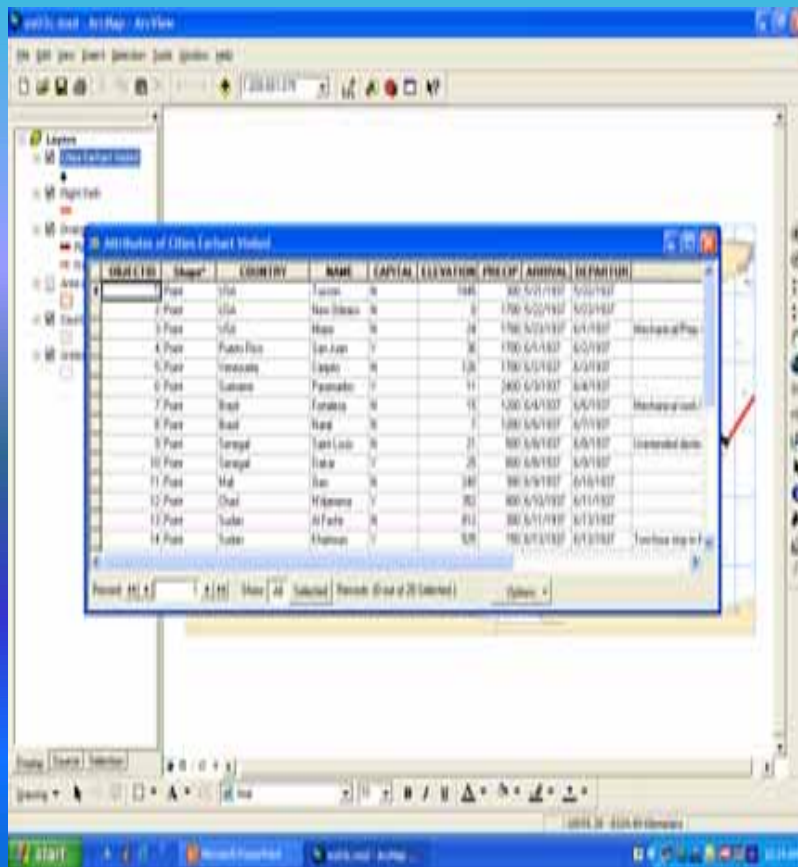
- Click View
- Click End of Flight

Map ex03c.mxd



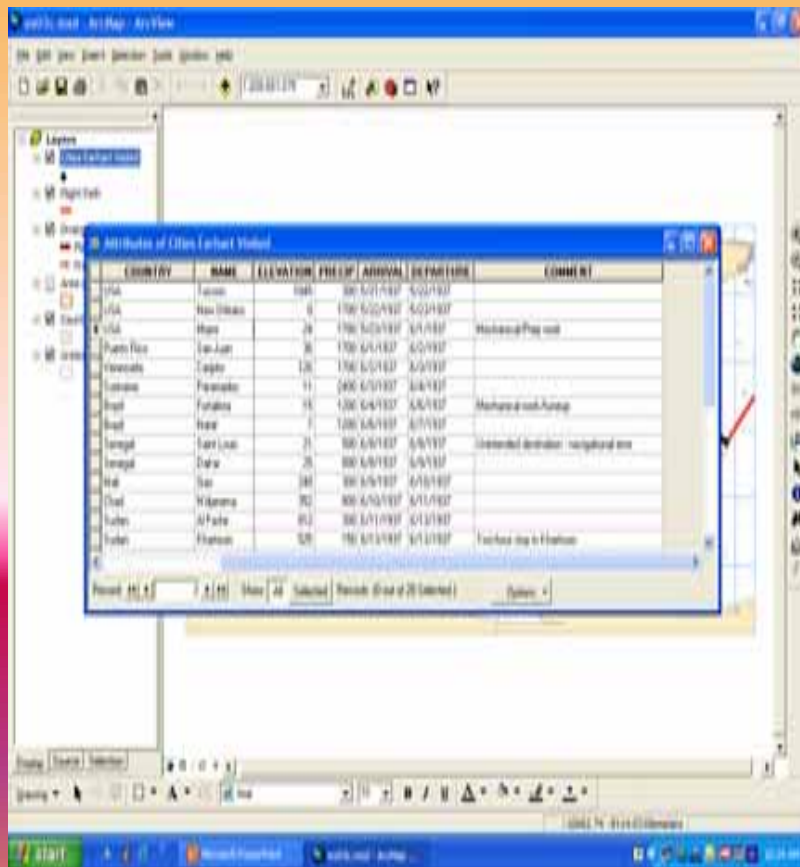
- In the Table of Contents Right click on cities Earheart visited
- Click on Attributes table

Map ex03c.mxd



- Place the mouse pointer on the vertical black bar between the name and capital
- Drag the cursor to the left

Map ex03c.mxd



COUNTRY	NAME	ELEVATION	TIME OF ARRIVAL	DEPARTURE	COMMENT
USA	London	545	01/01/1937	02/01/37	
USA	New Orleans	0	1/01/02/1937	02/01/37	
USA	Paris	24	1/01/02/1937	01/1/37	Marked as Prop. out
France	San Juan	36	1/01/02/1937	02/1/37	
France	Legge	126	1/01/02/1937	02/1/37	
France	Popocatepetl	11	04/02/1937	04/1/37	
Spain	Torres	14	12/02/1937	04/1/37	Marked as not a Pump
Spain	Madrid	1	12/02/1937	01/1/37	
Germany	Saint Louis	21	01/02/1937	04/1/37	Unintended departure - neighborhood area
Germany	Dahle	25	01/02/1937	04/1/37	
Italy	Sao	30	01/02/1937	01/01/37	
Italy	Wigamsa	70	01/02/1937	01/01/37	
Italy	Al Fata	62	01/01/1937	01/01/37	
Italy	Thames	52	1/01/1937	01/01/37	Tracked up to Thames

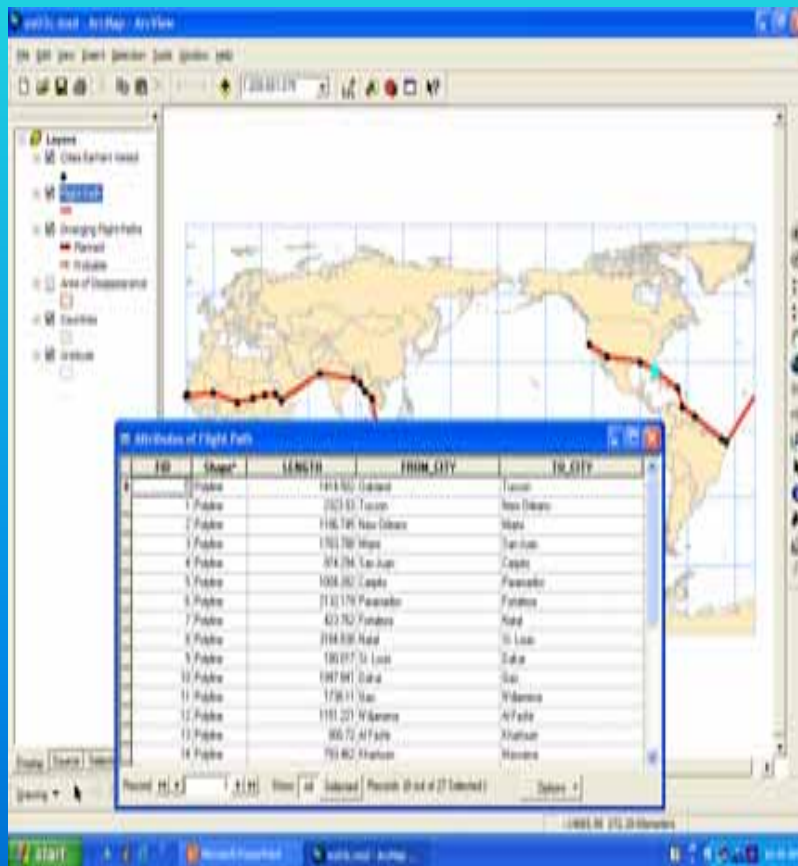
- Hide the Capital Field
- Extend the Departure field

Map ex03c.mxd



- Click the gray at the left edge of the first record in the table.

Map ex03c.mxd



- Close Table
- Right click flight layer path
- Click Open Attribute Table

Map ex03c.mxd



- Right click on the length field name
- Click Sort descending

End Notes

- Screen shots in the student's Slide Show: "Teaching GIS" included views of tutorial graphics from *Getting to Know ArcGIS Desktop, 2nd Edition* (Ormsby et al, 2004).
- MS Clip Art was used for any clip art.
- Other graphics were drawn by the author.

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APPENDIX C: Author Information

Sara Masters has masters' degrees in Math Education as well as Information Science. She is interested in using 3d computer graphics and maps to teach math and science. Currently, she is an **online facilitator** for the *Art Institute Online* and a local community college. Also, she does some copyediting and graphics.

For about five out of the last six years, she has assisted with the *Computing Workshop for Special Needs Students*, a month-long, annual event that opens up career and educational opportunities for secondary level special needs students (mostly autistic) who are otherwise blocked from entering the computer lab. Students are tutored one-on-one and in small groups. Social interaction and innovation are encouraged.

She also has grown children and enjoys playing music.

Reach her at saramasters@juno.com .