Martian Weather Station Teacher Guide

Summary

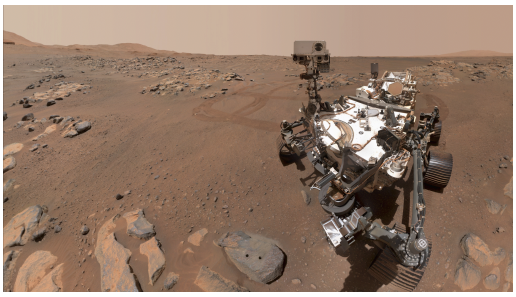
- Coding skill level: **Advanced**
- Recommended grade level: **Grades 6-12 (U.S.), Years 7-13 (U.K.)**
- Time required: **50 minutes**
- Number of modules: **1 module**
- Coding Language: **Python**

Teacher Guide Outline

Hour of Code
Martian Weather Station

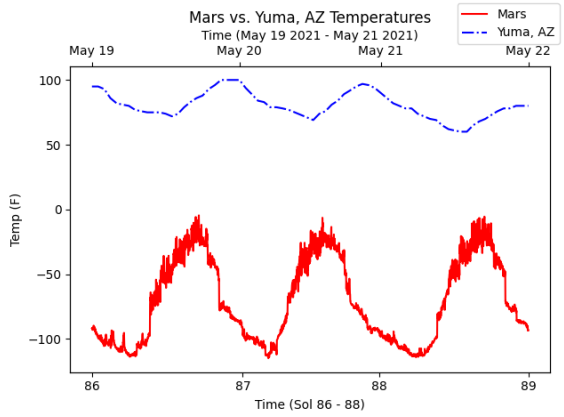
Welcome!

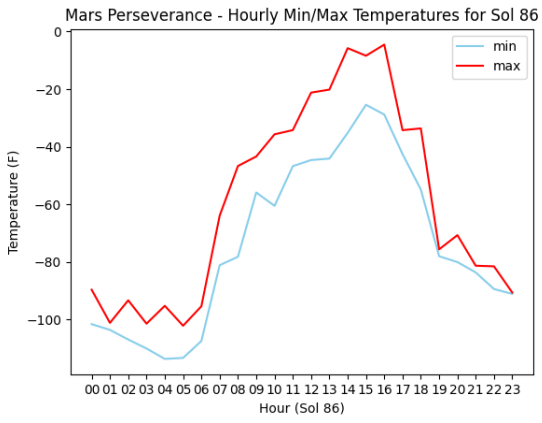
In today's lesson, students will have the exciting opportunity to analyze Mars temperature data, perform statistical calculations, and create charts using Python! Students will begin by learning about *Perseverance*, a NASA rover that takes weather measurements on Mars:



Students will also discuss topics related to data science. Next, students will move onto the DIY tutorial, where they'll follow step-by-step directions to complete a project that compares the temperature variation on Mars. Additionally, students will compare Martian weather against various places on Earth that are known for its extreme weather. This will allow students to visualize the data and explore how the weather on Mars can be quite extreme.

Below is an example of the various charts students can create by the end of today's coding adventure. The chart on the left compares the temperature on Mars to the temperature of Yuma, Arizona. On the right, is a chart that provides the hourly minimum and maximum temperatures on Mars for Sol 86. Let's see what amazing, informative charts your students can create!





How to Prepare

This activity is designed for self-directed learning. Your role will be to help students individually and facilitate as they complete the activities. The best way to prepare is to:

1. **Familiarize yourself with the material.** After selecting your Tynker lesson, read through this teacher guide and complete the activity before assigning it to students. This will allow you to troubleshoot anything in advance and plan for potential questions from your students.
2. **Get students excited about coding.** Inspire students and get them excited for the Hour of Code event. Here is a link to resources such as inspirational videos and posters from the Hour of Code website: https://hourofcode.com/us/promote/resources#videos
3. **OPTIONAL: Sign up for a teacher account.** Although an account is NOT required, creating a free teacher account will allow you to access teacher guides, answer keys, and tons of additional resources. You'll also be able to create free accounts for your students, monitor their progress, and see their projects.
4. **OPTIONAL: Create student accounts.** From your teacher account, you can easily create free student accounts for all your students. This will allow them to save their projects and progress, so they can continue coding when they get home! Again, this is not necessary to complete the Earth As Art and Terrain Generator lesson.
5. **OPTIONAL: Print certificates to hand out.** While signed in to your Tynker teacher account, you can print certificates by clicking on a classroom from your teacher dashboard, clicking the "Gradebook" tab, going to "Hour of Code," and clicking the "Print All Certificates" button. This will only print certificates for student accounts assigned to the selected classroom.

Activity

Overview

Objectives

Students will...

- Discuss how *Perseverance*, a NASA rover, is collecting weather data on Mars
- Discuss open-ended questions about data
- Use *Python* to create charts and graphs
- Graph minimum and maximum temperatures

Materials

- **For web:** Computers, laptops, or Chromebooks (1 per student)
- **For mobile:** iPads or Android tablets (1 per student)

Vocabulary

- **Code:** The language that tells a computer what to do
- **Sequence:** The order in which steps or events happen
- **Command:** A specific action or instruction that tells the computer to do something
- **Function:** A set of known actions that the computer can perform
- **Data analysis:** The process of recording data, selecting data, understanding patterns in your data, and displaying the data using an informative method (such as a chart or graph).

U.S. Standards

- **CCSS-ELA:** RI.6.4, RI.6.7, SL.6.1, RI.7.4, SL.7.1, SL.8.1, RI.8.4, RI.9-10.5, RI.11-12.6
- **CCSS-Math:** MP.1
- **CSTA:** 2-AP-13, 3A-AP-17, 2-DA-08, 2-DA-09, 3A-DA-11, 3A-DA-12
- **CS CA:** 6-8.AP.13, 6-8.AP.16, 6-8.DA.7, 6-8.DA.8, 9-12.AP.12, 9-12.AP.16, 9-12.DA.10, 9-12.DA.11
- **Illinois CS:** 6-8.AP.14, 6-8.AP.18, 6-8.DA.08, 6-8.DA.09, 9-10.AP.17, 11-12.AP.13, 9-10.DA.11, 9-10.DA.12
- **ISTE**: 1.c, 1.d, 4.d, 5.c

U.K. Standards

National Curriculum in England (computing):

- **Key Stage 3 (Years 7-9)**
  - Create, reuse, revise and repurpose digital artefacts for a given audience, with attention to trustworthiness, design and usability
  - Understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct, and know how to report concerns
- **Key Stage 4 (Years 10+)**
  - Develop their capability, creativity and knowledge in computer science, digital media and information technology
  - Develop and apply their analytic, problem-solving, design, and computational thinking skills

Getting Started (20 minutes)

- As a class, go to this website and look at the latest temperature data that was collected by *Perseverance*:

https://mars.nasa.gov/mars2020/weather/

- Next, model how to read the provided chart. The chart should look similar to this:

Date	Sol	Air Temperature (°F | °C)	
		Max.	Min.
Oct. 20, 2021	238	-6°F	-111°F
Oct. 19, 2021	237	-9°F	-110°F
Oct. 18, 2021	236	-7°F	-107°F
Oct. 17, 2021	235	-4°F	-109°F
Oct. 16, 2021	234	-8°F	-109°F
Oct. 15, 2021	233	-1°F	-110°F
Oct. 14, 2021	232	-7°F	-109°F

Explain that a sol is a solar-day on Mars. Meaning, 1 sol = 1 Mars-day. Also explain that 1 sol is slightly longer than 1 Earth day.

- Get students excited for today's coding adventure by going to this website: https://mars.nasa.gov/mars2020/spacecraft/rover/
  When you click it, you are shown a map of exactly where the rover was within Jezero Crater at the time the temperature readings in today's coding activity were obtained:

- Time permitting, lead a discussion about data science with your students:
  - What are some examples of data? (Examples: names of NASA rovers, number of items, prices, etc.)
  - What does "data analysis" mean to you? (Answers will vary.)
  - As a class, what data can we collect from each other? What meaning does the data provide? Hint: By collecting data from each person in your school, what conclusions, significance, or implications can you make about the data? (Answers will vary.)

DIY Module (30 minutes)

This lesson has 1 DIY (do-it-yourself) module. Facilitate as students complete the module on their own:

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- Now it's time to take provided data of Mars temperature and use Python to create graphs and charts that tell a story. They're provided a sample project, ideas on how to expand on their project, and code snippets to help them get started. However, students are encouraged to experiment with their code and add their own unique features to the project.
- Point out to students that clicking a blue hyperlink in the tutorial will take them to a specific file. Here's an example of what a blue hyperlink looks like:

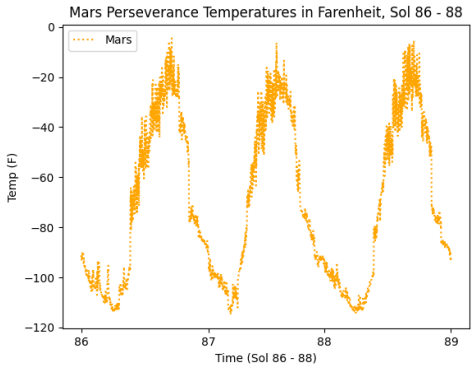
  main.py

- Do students want to change the linestyle in their chart? Direct their attention to the linestyle variable:

  ```
  linestyle='-'
  ```

  Next, ask them to try out these different line styles: 'solid', 'dotted', 'dashed', 'dashdot'. Here's an example:

  ```
  linestyle='dotted', color='orange'
  ```



- In the example above, the color of the line was also changed. To do this, direct your students' attention to the color variable. Their line could be green, red, blue, or whatever color they choose. Here's an example:

  ```
  color='pink'
  ```

  Optional: Ask students to consider what "poor color choices" would be. (Suggested answer: You wouldn't want to have lines where the colors are too similar, such as one line that is the color red and another line that is the color pink. You also don't want to use a color that won't stand out, such as 'yellow'.)
- For the adventurous coder, encourage them to compare the Martian Weather data to the weather of their hometown or a city of their choice. Note that the provided Mars temperature data is from Sol 86-88, which is roughly equivalent to May 19-21, 2021. If students are struggling to find data, direct their attention to these websites:

    - Weather in May 2021 in South Pole, Antarctica: https://www.timeanddate.com/weather/antarctica/south-pole/historic?month=5&year=2021
    - Weather in May 2021 in Antofagasta, Chile: https://www.timeanddate.com/weather/chile/antofagasta/historic?month=5&year=2021
- Did students finish early? Ask them to try the bonus activities by themselves or with a partner. Here are additional questions they can think about:
    - What story can they tell using the provided data?
    - What steps would they need to take in order to calculate the mean, median, mode, or standard deviation?
    - Is their chart an example of numerical data or categorical data? What's the difference?
- *Optional:* If students finish early, ask them to go to the link below and see if they can locate the images that were taken when the Mars temperature data was acquired. Hint: Ask students to set sols to 86-89. https://mars.nasa.gov/mars2020/multimedia/raw-images/

Extended Activities (10 minutes each)

Ask students:

- How did you experiment with your charts, graphs, or data? (Answers will vary.)
- Would anyone like to share their work and explain how they overcame any bugs or difficulties? (Answers will vary.)
- What was the most confusing part of creating a graph in code? (Answers will vary.)
- What can data on Mars tell us about its weather? (Example: The surface of Mars is too inhospitable for astronauts.)

Research activity:

- Encourage students to learn more about the *Perseverance* rover by exploring these websites:
    - https://mars.nasa.gov/mars2020/spacecraft/rover/
    - https://mars.nasa.gov/mars2020/
    - https://mars.nasa.gov/files/mars2020/Mars2020_Fact_Sheet.pdf
    - https://mars.nasa.gov/mars2020/spacecraft/instruments/meda/
- Next, ask students to write down 3-5 fun facts they learned. Challenge students to dig deep in their research. Once they have 3-5 facts written down, encourage them to share their facts with the class or a partner.

Going Beyond an Hour

If your students enjoyed an Hour of Code, they're sure to enjoy the rest of what Tynker has to offer! Tynker offers a complete premium solution for schools to teach computer science. Over 400 hours of lessons are available to take K-8 students from block coding to advanced text coding. We offer tons of resources for teachers, including comprehensive guides, free webinars, and a forum to connect with other educators.

More Hour of Code Activities

Tynker offers many other tutorials for the Hour of Code, including STEM Hour of Code lessons that you can integrate into the subjects you already teach. Check out the main Tynker Hour of Code page to see all the tutorials!

Do More with Tynker

With Tynker, kids don't just acquire programming skills--they explore the world of possibilities that coding opens up. Tynker has several interest-driven learning paths that make coding fun, both inside and outside the classroom:

- **Coding and Game Design:** Your students can use Tynker Workshop, a powerful tool for crafting original programs to make games, stories, animations, and other projects. They can even share their work with other kids in the Tynker Community.
- **Drones and Robotics:** Tynker integrates with connected toys, including Parrot drones and Lego WeDo robotics kits, so kids can see their code come to life.
- **Minecraft:** Tynker integrates with Minecraft so your students can learn coding through a game they love. Tynker offers skin and texture editing, as well as a custom Mod Workshop that lets kids try their original code in Minecraft.

Tynker for Schools

Used in over 90,000 schools, our award-winning platform has flexible plans to meet your classroom, school, or district needs. All solutions include:

- Grade-specific courses that teach visual coding, JavaScript, Python, robotics and drones
- A library of NGSS and Common Core compliant STEM courses that are great for project-based learning
- Automatic assessment and mastery charts for whole schools and individual classes and students
- Easy classroom management with Google Classroom and Clever integration

- Professional training, free webinars and other teacher training resources

Need help getting Tynker started at your school? Contact us to learn more about teaching programming at your school with Tynker!

Help

Need help? Below you'll find answers to frequently asked questions about the Earth As Art and Terrain Generator lesson.

What is Hour of Code?

The Hour of Code is a global learning event in which schools and other organizations set aside an hour to teach coding. No prior coding experience from you or your students is needed! The event is held every December during Computer Science Education Week. You can also organize an Hour of Code year-round. The goal of the Hour of Code is to expand access to computer science education for people of all backgrounds. Learning computer science helps students develop logic and creativity, and prepares them for the changing demands of the 21st century. Tynker has been a leading provider of lessons for the Hour of Code since the event began in 2013. Since then, over 100 million students from 180 countries have finished an Hour of Code.

How can Tynker help me manage my Hour of Code?

Tynker has several free features for registered teachers that will help you manage your Hour of Code. If you set your students up with a Tynker classroom, you will be able to track their progress and print Hour of Code completion certificates for them to keep.

How do I open the DIY modules?

Have your students go to this URL: tynker.com/hour-of-code. Next, direct them to the activity you want them to complete.

Who is this activity for?

Martian Weather Station is intended for students in grades 6-12 (U.S.) and Years 7-13 (U.K.) with some coding experience.

Do I need to create Tynker accounts for my students?

No, you do not need to create Tynker accounts for your students.

What devices do I need?

- **For web:** Computers, laptops, or Chromebooks (1 per student) with an internet connection
- **For mobile:** iPads or Android tablets (1 per student) with an internet connection
- If not enough devices are available, students can work in pairs on the same device

What will my students learn?

Students will reinforce coding concepts and experiment with their code as they complete the Martian Weather Station project. In this process, students will develop debugging and logical reasoning skills.

Do you have a sample solution?

Yes, below is a sample solution for the *Mars Weather Station* project:

(Please see the next page)

Hour of Code
Martian Weather Station

```
import matplotlib.pyplot as plt
import pandas as pd

# loading the data
mars_df = pd.read_csv('mars-temperature.csv')

# print(mars_df)

# print(mars_df['Temperature'])

# initial investigations
print('Mars - Perseverance Temperature Statistics (Sol 86 - 88)')
print('Minumum Temperature: ' + str(min(mars_df['Temperature'])) + ' degrees farenheit')
print('Maximum Temperature: ' + str(max(mars_df['Temperature'])) + ' degrees farenheit')
print('Average Temperature: ' + str(sum(mars_df['Temperature']) / len(mars_df['Temperature'])) + ' degrees farenheit')

earth_df = pd.read_csv('earth-temperature.csv')

print('Earth - Yuma Arizona Temperature Statistics (May 19 - May 21)')
print('Minumum Temperature: ' + str(min(earth_df['Temperature'])) + ' degrees farenheit')
print('Maximum Temperature: ' + str(max(earth_df['Temperature'])) + ' degrees farenheit')
print('Average Temperature: ' + str(sum(earth_df['Temperature']) / len(earth_df['Temperature'])) + ' degrees farenheit')

# plotting the mars temperature data
plt.figure(1)
plt.plot(mars_df['LTST'], mars_df['Temperature'], label = 'Mars', linestyle='-', color='red')

plt.ylabel('Temp (F)')
plt.xlabel('Time (Sol 86 - 88)')
plt.xticks(['0086 00:00:41', '0087 00:53:44', '0088 00:00:14', '0088 23:58:33'], labels=['86', '87', '88', '89'])

plt.title('Mars Perseverance Temperatures in Farenheit, Sol 86 - 88')
plt.legend()
plt.show()

# hourly minimum and maximum temperatures
mars_df['sol'] = mars_df['LTST'].str[2:4]
mars_df['hour'] = mars_df['LTST'].str[5:7]

sol_86_df = mars_df.drop(mars_df[mars_df.sol != '86'].index)

sol_86_mins_df = sol_86_df.groupby(['hour'], as_index=False).min()
# print(sol_86_mins_df)

sol_86_maxs_df = sol_86_df.groupby(['hour'], as_index=False).max()
# print(sol_86_maxs_df)

plt.figure(2)
plt.plot(sol_86_mins_df['hour'], sol_86_mins_df['Temperature'], label='min', color='skyblue')
plt.plot(sol_86_maxs_df['hour'], sol_86_maxs_df['Temperature'], label='max', color='red')

plt.xlabel('Hour (Sol 86)')
plt.ylabel('Temperature (F)')
plt.title('Mars Perseverance - Hourly Min/Max Temperatures for Sol 86')
plt.legend()
plt.show()

# adding earth data for comparison
fig, ax_mars = plt.subplots()
ax_earth = ax_mars.twiny()

plt.figure(3)
ax_mars.plot(mars_df['LTST'], mars_df['Temperature'], label = 'Mars', linestyle='-', color='red')
ax_earth.plot(earth_df['Time'], earth_df['Temperature'], label = 'Yuma, AZ', linestyle='-.', color='blue')

ax_mars.set_ylabel('Temp (F)')
ax_mars.set_xlabel('Time (Sol 86 - 88)')
ax_earth.set_xlabel('Time (May 19 2021 - May 21 2021)')

ax_mars.set_xticks(['0086 00:00:41', '0087 00:53:44', '0088 00:00:14', '0088 23:58:33'])
ax_mars.set_xticklabels(['86', '87', '88', '89'])
ax_earth.set_xticks(['05/18/2021 23:57 UTC', '05/19/2021 23:57 UTC', '05/20/2021 23:57 UTC', '05/21/2021 23:57 UTC'])
ax_earth.set_xticklabels(['May 19', 'May 20', 'May 21', 'May 22'])

plt.title('Mars vs. Yuma, AZ Temperatures')
fig.legend(loc='upper right')
plt.tight_layout()
plt.show()
```

Note: This is an open-ended project where students are encouraged to experiment with their code.

How can I contact the Tynker support team?

If you have any issues or questions, send us an email at support@tynker.com.