Flowcharts

Flowcharts were first used in the 1920's by engineers. A flowchart illustrates a process, system, or computer algorithm. It is used mainly to document, study, plan, improve, and/or communicate complex processes in clear, easy-to-understand diagrams. A flowchart uses shapes to define the type of step and connecting arrows to define flow and sequence. Flowcharts range from simple, hand-drawn charts to wide-ranging computer-drawn process maps depicting more complex steps and routes.

Uses of flowcharts:
- Engage and excite students about complex content
- Engage students in complex problem solving
- Create a visual format for a procedure, process, or task
- Create a visual format for the flow of information, distribution of products, and/or processes
- Break down complex systems into manageable pieces

Computational Thinking:
- Abstraction – Determining information or steps that might be <u>unnecessary</u> to complete a task, learn a skill, or master a concept. (Flowcharts require students to remove information that is not absolutely necessary to the flow of information or completion of the task.)
- Algorithmic Design – Creating an algorithm is the process of creating parts/steps and placing them in a logical order. (Flowcharts require students to determine the correct order of steps as well as the order of information flow (i.e. Yes/No, If/Then, etc.)).
- Decomposition – Breaking a given task, procedure or process into steps. (Flowcharts require students to break down the process, procedure, idea, concept, and/or task into its parts.)
- Pattern Recognition – Identifying patterns in the task, concept, idea, process, and/or procedure to combine, simplify, and create the steps for the flowchart's algorithm.

Tips for flowcharts:
- Because clear communication is the goal, your audience becomes the focus of your flowchart design.
- When creating complex multilevel flowchart(s), subdivide the task into categories, and assign teams to create a specific part of the flowchart based on the categories.
- When the chart requires multiple pages, use connectors that allow the flowchart to flow east.

How to implement flowcharts:

1. Ensure students understand the purpose and scope. NOTE: *The level to which students define the purpose and scope is dependent upon their level of success and familiarity with the flowcharting process, and the level of complexity of what is being charted.* To assign students to define the purpose and scope themselves, ask
   a. What goal(s) are to be accomplished?
   b. What is/are the goal(s)' start and end points?
   c. What level of detail must the flowchart to understand the content? Note: Flowcharts must be simple BUT detailed and easy to read and follow.
2. Ensure students identify steps and put them in order. NOTE: *This requirement might involve conferencing with participants, observing a process, and/or reviewing any existing documentation.*
3. Require students to organize the steps by type and corresponding shape, such as process, decision, data, inputs or outputs.
4. Require students to draw a draft chart, either by sketching or using a computer program or app.
5. Require students to confirm the flowchart by observing others using it. NOTE: *This requirement ensures that the process does not miss anything important to the purpose and/or scope.*

References:

- Elango, Rajasekar (2018, April 1). How can you teach computer science algorithms to middle school students? [Medium]. Retrieved from https://medium.com/@e.rajasekar/how-you-can-teach-computer-science-algorithms-to-middle-school-students-873310874c92
- Farkas, D. (2010). *Introducing the Understanding Science Flowchart to middle school students.* Retrieved from https://undsci.berkeley.edu/lessons/introducing_flow_ms.html

Resources:

- Student Examples: https://www.edrawsoft.com/flowchart-examples-for-students.php
- Free online Flowchart Makers:
  - Lucidchart https://www.lucidchart.com
  - Draw.io https://www.draw.io
  - Cacoo https://www.cacoo.com
  - Gliffy https://www.gliffy.com
  - Wireflow https://www.wireflow.co
  - Textographo https://www.textographo.com
  - Google Drawings https://docs.google.com/drawings