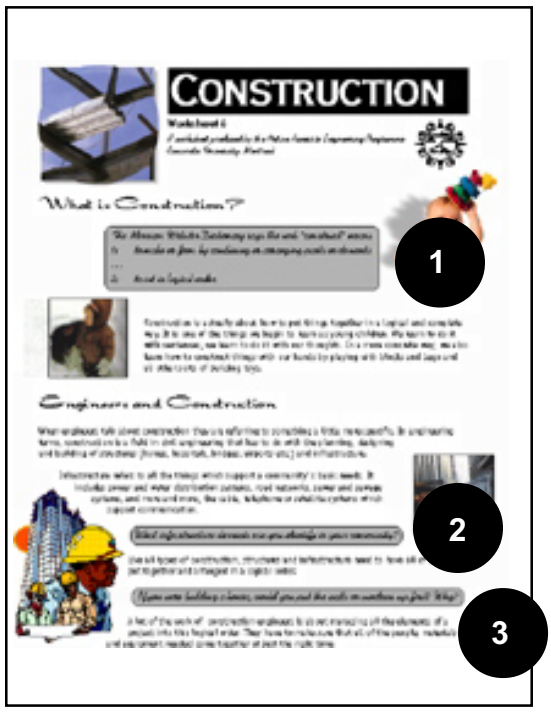
CONSTRUCTION

Worksheet 6

A worksheet produced by the Native Access to Engineering Programme
Concordia University, Montreal

Teacher's Guide

Here are some suggestions for how you can work with this worksheet.



1. Do the students understand the definition? Can they make the connection between the verb "to construct" and the noun "construction"?

2. Infrastructure can be any of the items listed above the question or their elements. Streetlights, sewage tanks, piping, electrical conduits, power lines, roads (paved and unpaved), telephone lines and satellites or satellite dishes can all be elements of the infrastructure.

3. When building a house you always have to build from the ground up. Walls always have to be built before windows are installed otherwise there would not be anything to hold the windows in place.

4. Having your students think about how they go about doing a school project should give them a good appreciation for the process which occurs in large-scale (and even small-scale) construction because the planning of most projects follows a similar model. First there's conception, getting the idea, although in the students' case sometimes this may come from you. Then they have to design and plan how they are going to execute the project - what questions will they need to answer, where will they find the answers, how much time do they have to work on it? Eventually they construct the project by actually doing the research and writing or building what is required. (Hopefully they skip the whole bidding process!)

   What they should understand from this exercise is that that there are many things which have to be considered in any project and that the key to successful completion is the organization and management of all the resources at their disposal.

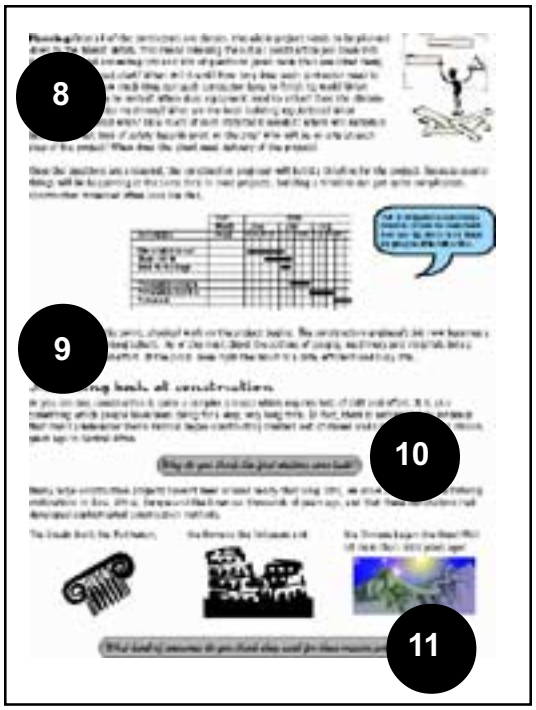
5. Depending on the size of a construction project there can be a few or hundreds of people involved. Each of these people (or at least each group) brings a specialized skill to the project. Can your students identify any of the professions or trades which might be on a construction site?

   They include: plumbers, electricians, machine operators (crane, bulldozer, steam roller, backhoe etc…), masons, carpenters, architects, engineers (mechanical, civil, construction, building, electrical), painters, steel workers, roofers, welders, general construction workers and many more.

6. At the conception and design stage there are many things which might stop the project. Some of the possibilities are: it may be impossible to build what the client wants, or way too expensive to build what the client wants; the proposed site may not be suitable for any number of reasons - safety, zoning, soil problems, pollution, drainage etc…; construction permits may not be issued.

   What other things do your students think might stop a project at this point?

7. Again there are a number of problems which can arise at this point in the project. At the bidding stage the supervising engineer generally has an idea of what each aspect of the project should cost. Problems can arise if all of the bids are significantly above the estimated cost; this may mean the engineer has forgotten something really important when talking to the client!



8. Can your students come up with other questions they think might be asked at this stage?

9. We have compared the construction engineer's job to that of a dance choreographer, but it's also very similar to that of an orchestra conductor, a movie director or even a hockey or lacrosse coach.

10. The first shelters were built for shelter from the elements and as protection against predators.

11. The Greeks, Romans and Chinese used resources that were available to them. They were all civilizations with an advanced understanding of mathematics and so they used that knowledge in their construction. They also made use of natural resources (particularly stone) from their own (and surrounding) regions. But the resource they used the most was people. None of the great ancient monuments could have been built without the sheer physical effort of thousands of people.

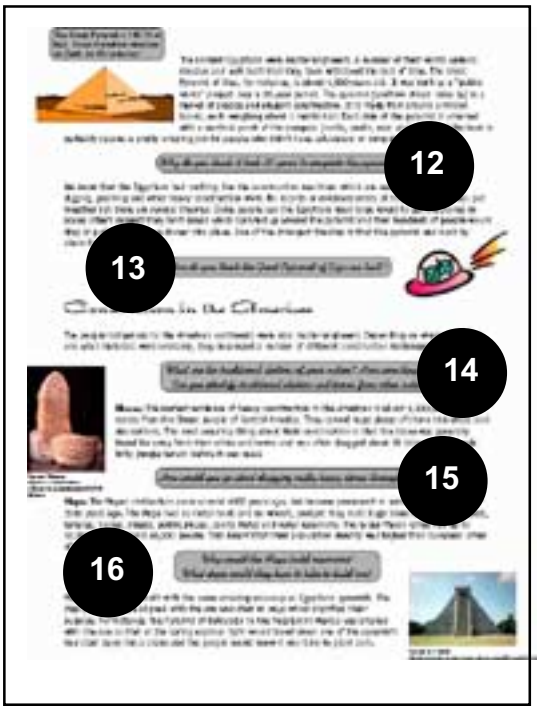
12. Mainly because the Great Pyramid was so big and could only be built so fast; it takes a lot of time to put 2 million blocks in place.

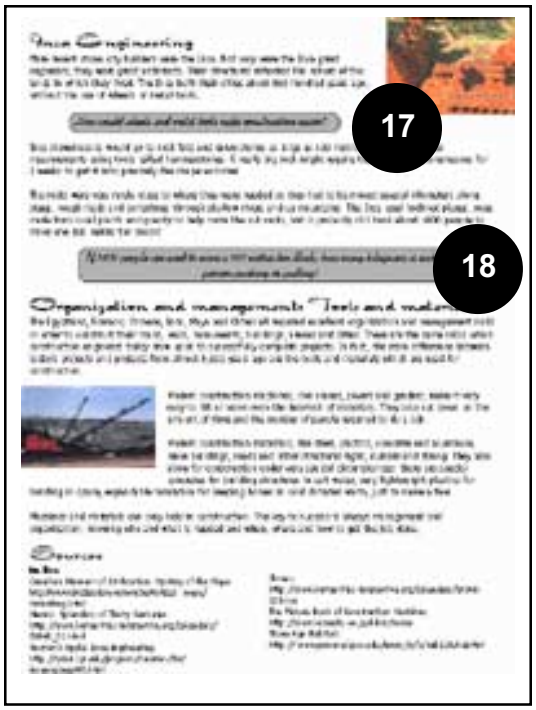
13. See what kind of ideas your students can come up with. Maybe they would be interested in researching this question further in the library or by using the Internet.

14. The answer to this question will depend on the nation and its location. Perhaps an elder could be invited to class to discuss traditional constructions with the students.

15. The Olmec probably used large vines from the local jungle and lots of people to push and pull the stones. There is also the possibility that they helped to decrease the resistance of each stone against the ground by lubricating the stone's path with mud, therefore making it easier to move.

16. The Maya built reservoirs to store water in areas where ground water was scarce during the dry season.





17. Ask your students if they would rather drag bags back from the grocery store or pull them back in a wagon. Wheels (and axles) are simple machines (see worksheet #2). Simple machines allow you to accomplish a task while doing less work. It is much easier to push or pull a heavy load which is on wheels than it is to just drag the load along the same path.

    The Inca were carving one type of stone with a slightly harder type of stone. Metal tools would have made their job easier because - in general - metal is harder and more durable than stone. Their carving would have been quicker and they would have required less effort if they had had metal tools.

18. A math problem.

    First convert the metric tons to kilograms. There are 1000 kilograms in each metric ton, so each block weighed 100,000 kilograms. Then divide that weight by the number of people pulling (1800). The answer is about 55.5 kilograms.

Solution

This problem may look daunting to the students. It is not that hard if they follow these steps.

Question a.

I. What do you know?
- Start date: Monday June 1
- Crew works 7 days a week
- The very first job to be done is site preparation, so it starts June 1.

II. You also know each job that needs to be done, how long it will take, when it can begin and the order the jobs need to be done in. Perhaps the easiest way to get the students to realize this is to have them highlight or underline each job in the paragraph and somehow connect it to the time it will take to complete. For example:

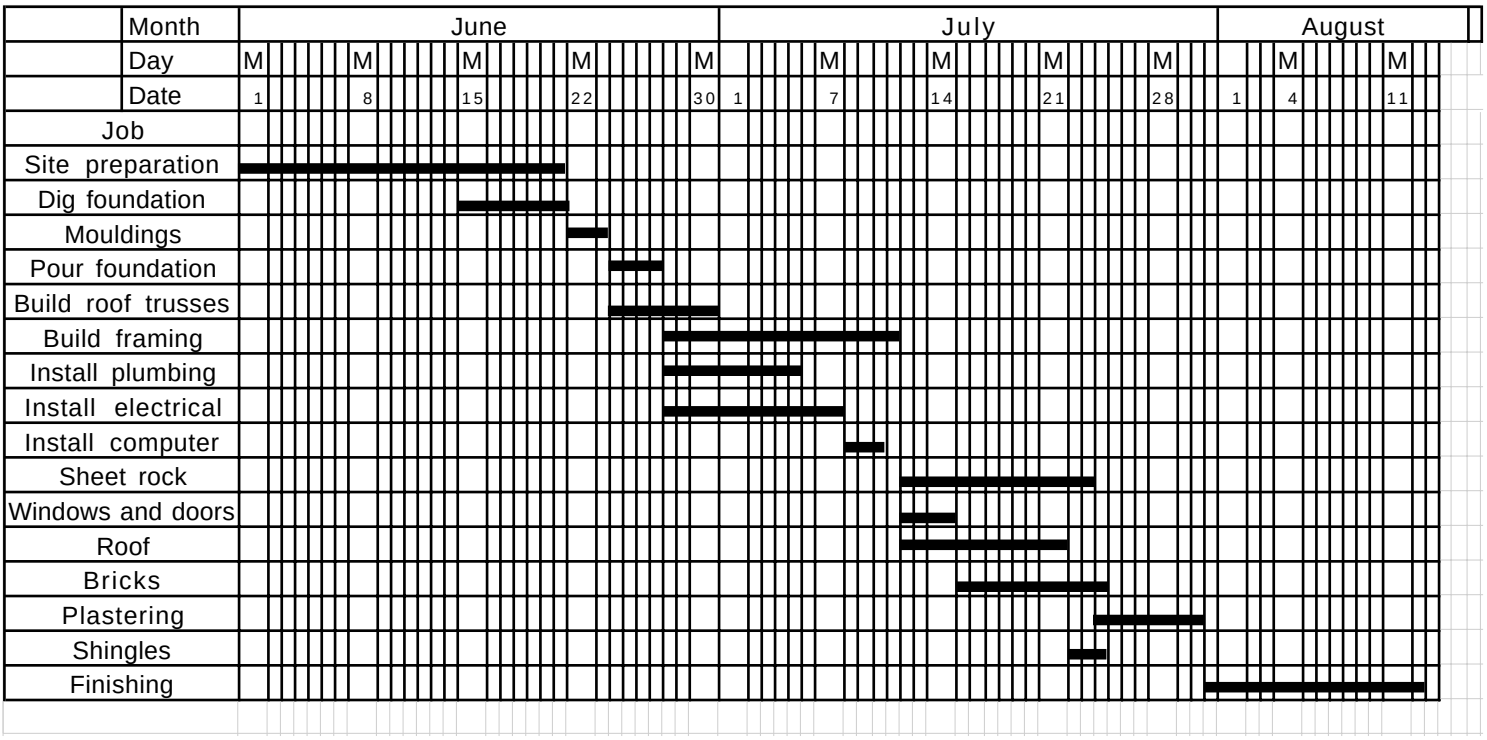
First the site will need to be prepared (leveled, some trees cleared, services run-in etc…), which will take 3 weeks. You will be able to begin digging the foundations after 2 weeks and they will take a week to complete. Before you pour the concrete for the foundations (1 day to pour and 3 days to set), you have to build and place the moldings for them, a job that will take 2 days. While you are waiting for the concrete to set you can begin construction of the roof trusses (1 week). Once the concrete is dry you will need 2 weeks to raise the frame of the house. As the framing goes up, the plumbing and electrical services can be installed, they will take 8 and 10 days respectively. The wiring for Internet access can only be done once all other electrical services have been installed, it will take 3 days to do. Once the framing and wiring are complete, a number of jobs can begin at the same time:

- insulation and indoor sheet rock can be installed in the walls (12 days);
- windows and doors can be placed (3 days);
- the roof can be built (10 days).

As soon as the windows and doors are installed, the outside bricks can be laid to complete the walls, this should take 10 days. Plastering (1 week) the inside walls can begin when the indoor sheet rock is installed. Shingling the roof will take 3 days after the roof construction is finished. Final inside finishing will take 12 days once the inside of the house has been plastered.

III. The plan

The students can then build a framework for the plan. Essentially they are building a chart. They can start by listing the jobs in something close to the order they think they will occur. Things which are happening at the same time, like plumbing and electrical services, should be listed close together. They should also write the dates across the top of the chart. They might want to do this on graph paper and will probably need to tape two pieces together to complete the chart.



Once they have constructed the chart outline, the students can fill in how long each job will take, as shown above.

Questions b & c

Once the plan is constructed answering these questions is a matter of reading dates of the chart. The start and end dates for each individual job are shown in the table on the next page. The end date for the entire project is August 12.

Job	Start Date	End Date
Site preparation	1-Jun	21-Jun
Dig foundation	15-Jun	21-Jun
Mouldings	22-Jun	23-Jun
Pour foundation	24-Jun	28-Jun
Build roof trusses	24-Jun	30-Jun
Build framing	28-Jun	11-Jul
Install plumbing	28-Jun	5-Jul
Install electrical	28-Jun	7-Jul
Install computer	7-Jul	10-Jul
Sheet rock	12-Jul	23-Jul
Windows and doors	12-Jul	13-Jul
Roof	12-Jul	21-Jul
Bricks	15-Jul	24-Jul
Plastering	24-Jul	30-Jul
Shingles	22-Jul	24-Jul
Finishing	31-Jul	12-Aug

Bonus Question

In order to answer the bonus question the students will have to redraw their project plans taking into account the 5-day delay in concrete delivery. If such a delay occurs, the project will finish on August 16.

Notes