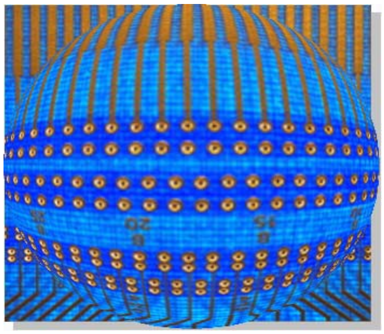


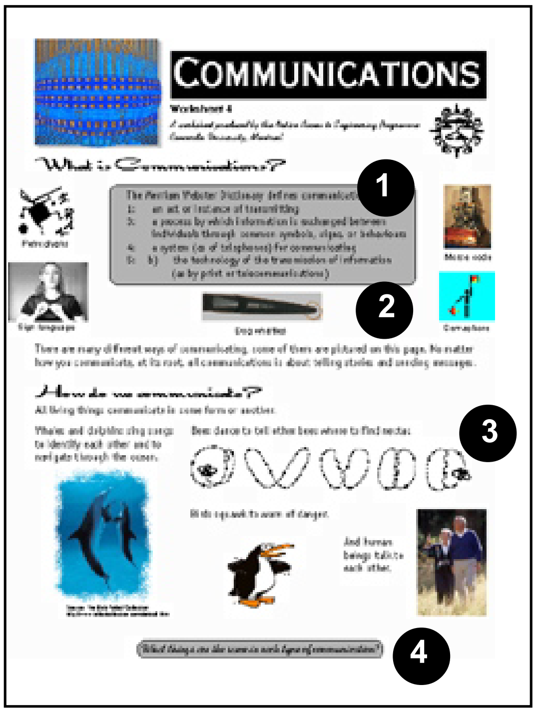
COMMUNICATIONS

Worksheet 4

A worksheet produced by the Native Access to Engineering Programme

Teacher`s Guide

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



1. The definition of communications is very long. It refers to 2 distinct things, the process of communication and the technology of communication. It might be interesting to have your students look up the definition in a few different dictionaries to see what common elements are contained in each. You could also have a discussion about how “communication” can refer to both a process and technologies.

2. The types of communication pictured are only a few of many different types. Do your students know what all of the given examples are and where or when they are (were) used?

Petroglyphs are rock paintings left by ancient peoples on the walls of caves and mountains all over the world. They were probably originally painted as a parts of sacred ceremonies and to commemorate events like hunts. They have also served the function of being a tool or technology which has enabled ancient peoples to communicate over time; because of their permanence we are able to get a glimpse at life from thousands of years ago. Do your students know of any symbols still in use that may have had their origin in ancient times?

Sign language is used by hearing impaired and deaf people all over the world. Just like oral languages there are many different sign languages. The woman pictured is in the process of signing “broadcast” in American Sign Language (ASL).

Dog whistles are used to train and call dogs. Dogs have better hearing than humans, which means they can hear sounds which we cannot. Dog whistles are designed to emit a sound in frequencies only dogs can hear.

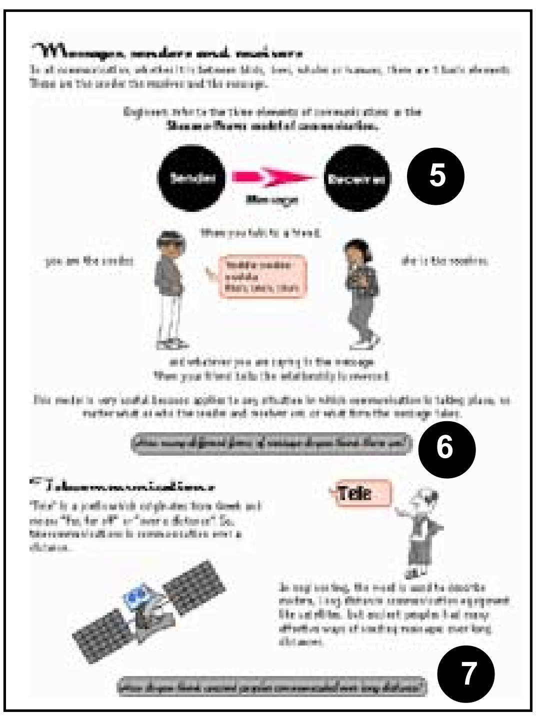
Semaphore is a system of communication with flags. In the illustrated case the signal is making the letter K. Semaphore flags are used in places where it is hard to communicate orally, but easy to communicate visually. A variation on semaphore is used at airports to direct planes in and out of their gates.

Morse code was invented by Samuel F. B. Morse, an American painter born in 1791. He improved the existing telegraph system to make it easy to use for everyday life. He also designed the transmission code named after him. It all began during a sea voyage when Samuel Morse heard about many attempts to create usable telegraphs. He was fascinated by this problem and began to study books on physics for two years to acquire scientific knowledge. His first tests failed; however, together with some technically gifted friends, Morse developed his fully functional telegraph in 1837. The signaling device was quite simple. It consisted of a transmitter (containing a battery and a key), a small buzzer (used as a receiver) and a pair of wires connecting the two. Due to its simplicity, Morse's system was very reliable and easy to use. It rapidly gained acceptance all over the world. As early as in 1850, a sea cable linked England to the European continent, and since 1858 there has been electrical telecommunication between North America and Europe.
Source: http://www-stall.rz.fht-esslingen.de/telehistory/morse.html

3. Can your students identify other means of communication? For example:

- hunting calls
- facial expressions
- smoke signals
- other animal behaviours etc.

4. The answer to this question appears on the next page. But have the students think about what it means to communicate. If someone talks and no one listens, does communication take place? How about if they don't turn on the radio to hear a broadcast?



5. If you put the Shannon-Weaver model up on the board your students can identify senders receivers and their messages.

Sender	**Message**	**Receiver**
One person	Whatever is said	Other person
TV station	TV show	TV/people watching
Radio station	Music	Radio/people listening
Satellite	Electronic signal	Satellite dish
CB radio	Whatever is said	CB radio/person listening
Computer 1	email	Computer 2

The interesting thing is that some of these relationships are reversible, and others are not.

In a conversation between two people, face-to-face, by telephone or CB, the relationship between sender and receiver switches back and forth. Satellites and satellite dishes can also reverse their relationship; a signal can come down from the satellite to the dish or go up from the dish to the satellite. When the relationship is reversible, it is referred to as two-way communication.

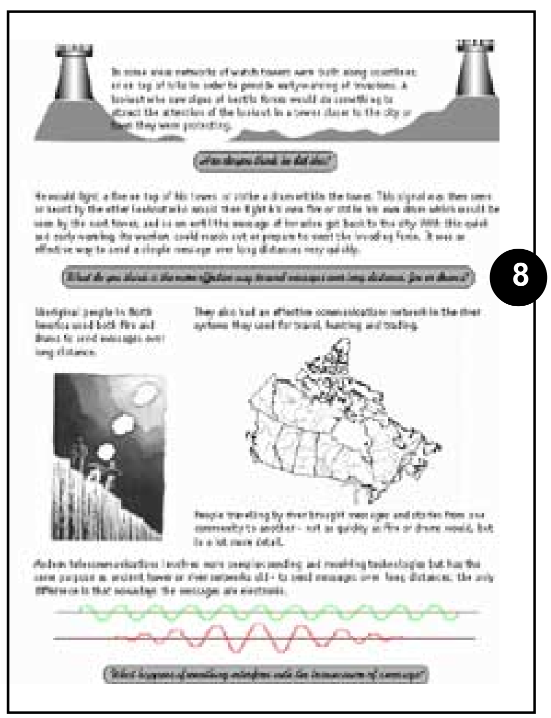
However, in the case of television or radio broadcasts the communication is only one-way. The signal can only travel in one direction from sender (the broadcaster) to receiver (TV, radio).

This one-way broadcast capability was one of the reasons that encouraged Native peoples in various areas of the country to establish their own broadcast societies. If you can only receive, you can only listen to the stories of other people, but if you have the ability to broadcast, you can tell your own stories.

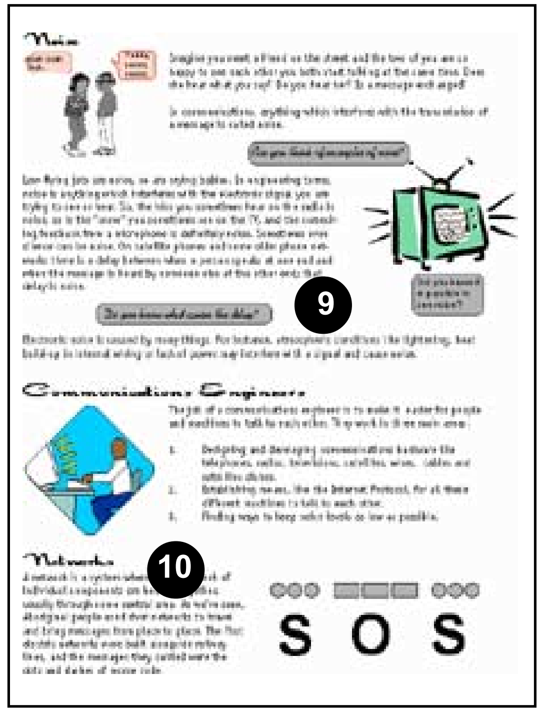
6. There are as many different forms of message as there are ways of communicating. With respect to technologies of communication we usually deal with audio (sound), visual (text, graphics, images) messages in either an analog or digital format. There are of course other forms of message; messages come to us through all of our senses, so we also receive messages through touch, taste and smell. Humans rely largely on audio-visual communication, other animals use touch, taste and smell much more.

7. Again, the answer to this question is contained on the next page. It might make an interesting question for more in-depth research or study by your students.

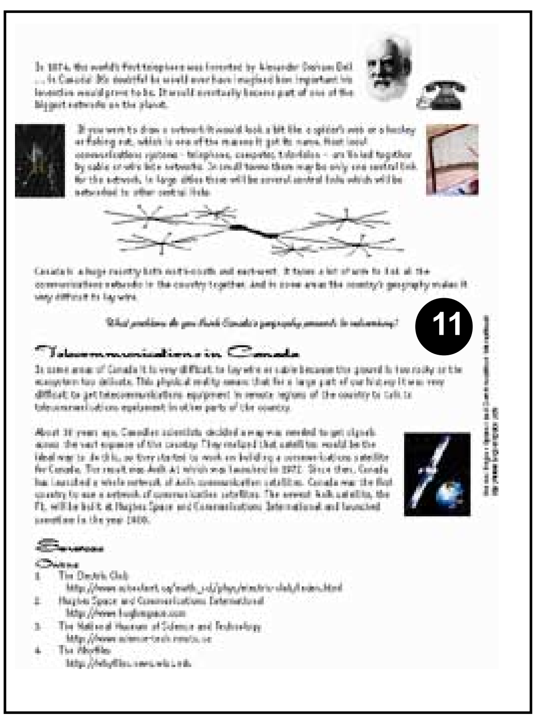
8. As a general rule, light travels faster than sound, so the quick answer is fire - but the answer really depends on where you find yourself. They will both work fairly well on an open plain or from a high point. Inside a canyon, however, or in very hilly areas, sound might just echo off the rock or hills and never get where it is supposed to go. Fires, on the other hand, will produce smoke which will rise above the hills and been seen for miles. But, weather conditions will also make a difference - it's hard to start a fire in the rain, or it may not be wise to start a fire if it has been too dry.



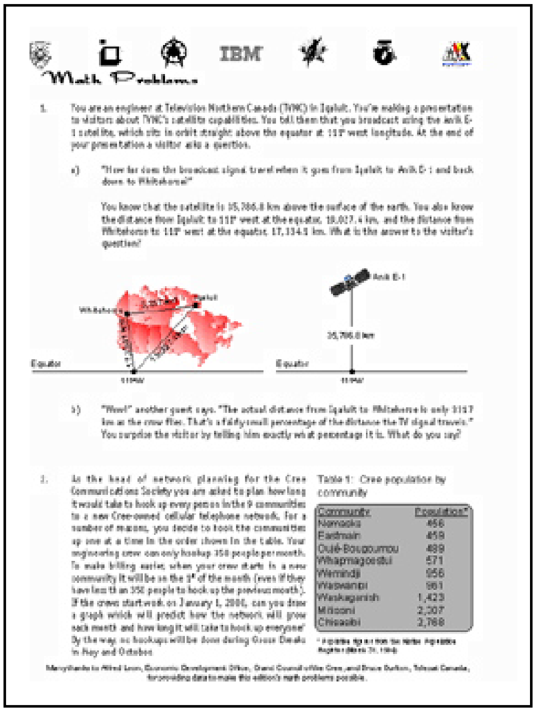
9. On satellite phones and some older phone systems it takes a while for the signal to travel from the sender to receiver. On land, this may be because it has to travel through a number of switching stations. In the case of satellites, a signal travels much further than it ever would on land because it has to travel up to the satellite and back down again. Most communications satellites are in geostationary orbit over the equator (they stay over the same point on the equator at al times) at a height of more than 42,000 km from the centre of the earth. If you were to send the signal straight up to the satellite and right back down again it would travel almost 80,000km! Most signals travel farther than that because they don't originate directly underneath the satellite. Even though the signal may be moving fairly quickly up to and down from the satellite, the distance it has to cover means there is often a delay between when the sender speaks and the receiver hears what has been said.



10. In order to demonstrate what networks look like you could use a map of local rivers and lakes. In this case the rivers would be the "wires" leading to the lakes where the water is redistributed in to other lakes. Lakes and rivers represent a one-way communications network because the water always flows in one direction.



11. The first problem arising from Canada' geography is its size - it would require a lot of wire to connect all the communications networks together. Even if there were enough wire, the physical geography of the country precludes its use in certain areas, particularly in the North and remote regions. Problems include delicate ecosystems which can neither support towers which carry cabling above ground, nor recover from the digging and construction required to lay cabling underground. In areas of permafrost, laying cable underground is impossible and extreme weather makes it inefficient to install above ground cable except in very localized areas. As a general rule any area where it difficult to build and maintain roads will also present difficulties for laying wire.



Math Problems

1. You are an engineer at Television Northern Canada (TVNC) in Iqaluit. You're making a presentation to visitors about TVNC's satellite capabilities. You tell them that you broadcast using the Anik E-1 satellite, which sits in orbit straight above the equator at 111° west longitude. At the end of your presentation a visitor asks a question.

a) "How far does the broadcast signal travel when it goes from Iqaluit to Anik E-1 and back down to Whitehorse?"

You know that the satellite is 35,786.8 km above the surface of the earth. You also know the distance from Iqaluit to 111° west at the equator, 19,027.4 km, and the distance from Whitehorse to 111° west at the equator, 17,334.1 km. What is the answer to the visitor's question?

b) "Wow!" another guest says. "The actual distance from Iqaluit to Whitehorse is only 3117 km as the crow flies. That's a fairly small percentage of the distance the TV signal travels." You surprise the visitor by telling him exactly what percentage it is. What do you say?

2. As the head of network planning for the Cree Communications Society you are asked to plan how long it would take to hook up every person in the 9 communities to a new Cree-owned cellular telephone network. For a number of reasons, you decide to hook the communities up one at a time in the order shown in the table. Your engineering crew can only hookup 350 people per month. To make billing easier, when your crew starts in a new community it will be on the 1st of the month (even if they have less than 350 people to hook up the previous month). If the crews start work on January 1, 2000, can you draw a graph which will predict how the network will grow each month and how long it will take to hook up everyone? By the way, no hookups will be done during Goose Breaks in May and October.

Table 1: Cree population by community

Community	Population*
Nemaska	456
Eastmain	459
Oujé-Bougoumou	489
Whapmagoostui	571
Wemindji	956
Waswanipi	961
Waskaganish	1,423
Mistissini	2,207
Chisasibi	2,768

Many thanks to Alfred Loon, Economic Development Office, Grand Council of the Crees, and Bruce Burton, Telesat Canada, for providing data to make this edition's math problems possible.

Solutions

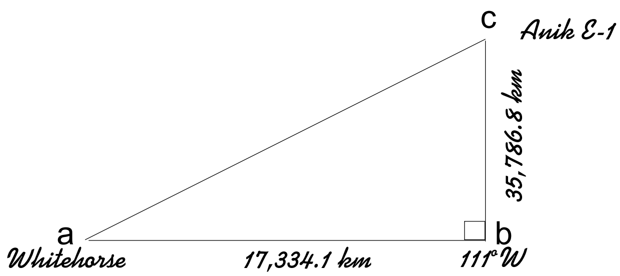
Problem 1a.

I. What do you know?

- Distance from Whitehorse to 111°W = 17,334.1 km
- Distance from Iqaluit to 111°W = 19,027.4 km
- Distance from 111°W to Anik E-1 = 35,786.8 km
- Anik E-1 sits directly above the equator.

II. Distance from Whitehorse to Anik E-1

We have a right angled triangle with the vertices at Whitehorse, Anik E-1 and 111°W. Because we know two of the distances involved, we can find the distance from Whitehorse to the satellite by using Pythagorean theorum. (In reality the Earth curves and the calculation is a bit more complex, but engineers are allowed to make reasonable assumptions.)



$$\overline{ab}^2 + \overline{bc}^2 = \overline{ac}^2$$
$$(17{,}334.1\text{ km})^2 + (35{,}786.8\text{ km})^2 = \overline{ac}^2$$
$$300{,}421{,}022.8\text{ km}^2 + 1{,}581{,}167{,}743\text{ km}^2 = \overline{ac}^2$$
$$1{,}881{,}588{,}756.8\text{ km}^2 = \overline{ac}^2$$
$$\sqrt{1{,}881{,}588{,}756.8\text{ km}^2} = \overline{ac}$$
$$\overline{ac} = 39{,}763.9\text{ km}$$

Distance from Whitehorse to Anik E-1 is 39,763.9 km.

III. Distance from Iqaluit to Anik E-1

Here too we have a right angled triangle with two of the sides known.

$\overline{bd}^2$	+	$\overline{bc}^2$	=	$\overline{cd}^2$
$(19{,}027.4\ km)^2$	+	$(35{,}786\ km)^2$	=	$\overline{cd}^2$
$362{,}041{,}950.7\ km^2$	+	$1{,}581.167{,}743\ km^2$	=	$\overline{cd}^2$
		$1{,}943{,}209{,}693.7\ km^2$	=	$\overline{cd}^2$
		$\sqrt{1{,}943{,}209{,}693.7\ km^2}$	=	$\overline{cd}$

$\overline{cd}$ = 40,530.7 km

Distance from Iqaluit to Anik E-1 is 40,530.7 km.

I. Distance signal travels.

Distance signal travels = Distance from Whitehorse to Anik E-1 + Distance from Iqaluit to Anik E-1

= 39,763.9 km + 40,530.7 km

= 80,294.6 km

Answer
The signal travels 80,294.6 km from Whitehorse to Iqaluit.

Problem 1b.

I. What do you know?

- Distance from Iqaluit to Whitehorse as the crow flies is 3,317 km.
- Distance signal travels (from problem 1a) is 80,294.6 km.

II. Percentage

This is a straight forward percentage calculation.

$$\% = \frac{\text{Distance from Iqaluit to Whitehorse}}{\text{Distance signal travels}} \times 100$$

$$= \frac{3{,}317\ km}{80{,}294.6\ km} \times 100$$

$$= 0.00413 \times 100$$

$$= 4.13\%$$

Answer
The distance from Whitehorse to Iqaluit as the crow flies is only 4.13% of the distance the signal travels.

Problem 2.

I. What do you know?

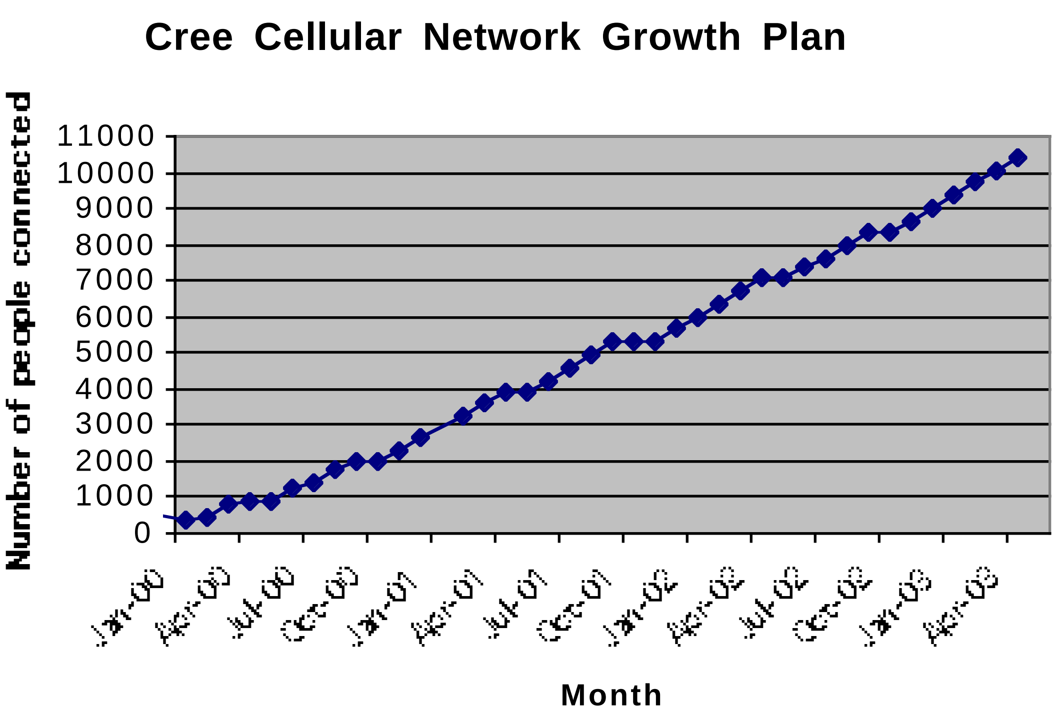
- Start date is January 1, 2000.
- Able to hookup a maximum of 350 people per month.
- Work in each community begins on the 1st of every month.
- The number of people in each community.
- The order in which communities are hooked up.
- No work takes place during Goose Break in May and October.

II. Graphing network growth.

The easiest way to graph network growth is to build a table which tells you what month it is, where you are, how many people were hooked up that month, how many people are left to hook up in the community and the total number of people already hooked up.

This is a time consuming process, that involves only addition and subtraction. (A sample table is provided on the next page.)

Once the table is made, a graph can be plotted.



Answer
The project will be finished in April 2003.

Date	Community	# in community	# hooked up this month	# left to hook up	Total hooked up
Jan-00	Nemaska	456	350	456-350=106	350
Feb-00	Nemaska	456	106	0	456
Mar-00	Eastmain	459	350	459-350=109	806
Apr-00	Eastmain	459	109	0	915
May-00	______	0	0	0	915
Jun-00	Oujé-Bougoumou	489	350	489-350=139	1265
Jul-00	Oujé-Bougoumou	489	139	0	1404
Aug-00	Whapmagoostui	571	350	571-350=221	1754
Sep-00	Whapmagoostui	571	221	0	1975
Oct-00	______	0	0	0	1975
Nov-00	Wemindji	956	350	956-350=606	2325
Dec-00	Wemindji	956	350	956-700=256	2675
Jan-01	Wemindji	956	256	0	2931
Feb-01	Waswanipi	961	350	961-350=611	3281
Mar-01	Waswanipi	961	350	961-700=261	3631
Apr-01	Waswanipi	961	261	0	3892
May-01	______	0	0	0	3892
Jun-01	Waskaganish	1423	350	1423-350=1073	4242
Jul-01	Waskaganish	1423	350	1423-700=723	4592
Aug-01	Waskaganish	1423	350	1423-1050=373	4942
Sep-01	Waskaganish	1423	350	1423-1400=23	5292
Oct-01	______	0	0	23	5292
Nov-01	Waskaganish	1423	23	0	5315
Dec-01	Mistissini	2307	350	2307-350=1957	5665
Jan-02	Mistissini	2307	350	2307-700=1607	6015
Feb-02	Mistissini	2307	350	2307-1050=1257	6365
Mar-02	Mistissini	2307	350	2307-1400=907	6715
Apr-02	Mistissini	2307	350	2307-1750=557	7065
May-02	______	0	0	557	7065
Jun-02	Mistissini	2307	350	557-350=207	7415
Jul-02	Mistissini	2307	207	0	7622
Aug-02	Chisasibi	2768	350	2768-350=2418	7972
Sep-02	Chisasibi	2768	350	2768-700=2068	8322
Oct-02	______	0	0	2068	8322
Nov-02	Chisasibi	2768	350	2768-1050=1718	8672
Dec-02	Chisasibi	2768	350	2768-1400=1368	9022
Jan-03	Chisasibi	2768	350	2768-1750=1018	9372
Feb-03	Chisasibi	2768	350	2768-2100=668	9722
Mar-03	Chisasibi	2768	350	2768-2450=318	10072
Apr-03	Chisasibi	2768	318	0	10390